



Project Manual

for

Humble High School Additions and Renovations Phase Two

PBK Project No.: 220537

Owner Project No.: CSP# 2025-09

for the

HUMBLE INDEPENDENT SCHOOL DISTRICT

18 December 2024

Issue for Proposal

Volume 1 of 2



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Team

Architect

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11 Greenway Plaza, 22nd Floor
Houston, Texas 77046
Phone: (713) 965-0608

Civil

DIG Engineers
11 Greenway Plaza, Ste # 1520
Houston, Texas 77046
Phone: (713) 965-0608

Landscape

GreenScape Associates
5030 Bryan Road
Richmond, Texas 77469
Phone: (281) 341-9975

Structural

Kubala Engineers
11 Greenway Plaza, Ste # 1510
Houston, Texas 77046
Phone: (713) 940-3343

MEPT



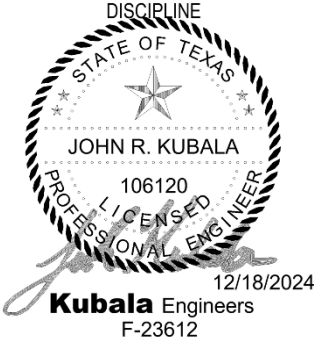
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11 Greenway Plaza, 15th Floor
Houston, Texas 77046
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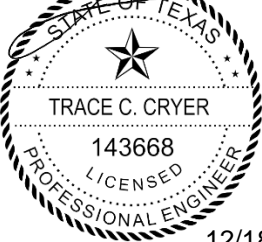


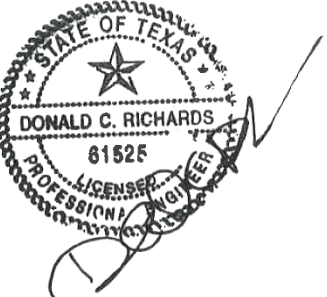

Building Envelope

BEAM Professionals
11 Greenway Plaza, 15th Floor
Houston, Texas 77046
Phone: (713) 965-0608

Issue for Proposal

Each specification section included herein is listed in the Project Manual Table of Contents with a letter code, indicated below, designating the Designer of Record responsible for its preparation, under whose seal and/or authority it is issued for the purpose(s) stated above. Seals and signatures do not apply to documents not included herein, nor (except as otherwise indicated) to documents prepared by the Owner or others ("O"), including but not necessarily limited to documents in Division 00, geotechnical and other reports, etc.

<p>Architect of Record: Gregory A. Prince R. A.# 27199</p>	 <p>12-18-2024</p>	<p>PBK Architects 11 Greenway Plaza, 22nd Floor Houston, Texas 77046</p>
<p>Architect of Record, Landscape: Name: Brett Legendre L.A.# LA3280</p>	 <p>12-18-2024</p>	<p>Greenscape Associates 5030 Bryan Road Rosenberg, Texas 77469 Phone: (281) 341-9975</p>
<p>Engineer of Record, Structural: John R. Kubala P.E# 106120</p>	 <p>12/18/2024 Kubala Engineers F-23612</p>	<p>Kubala Engineers 11 Greenway Plaza, Suite 1510 Houston, Texas 77046</p>

<p>Engineer of Record, Civil: Trace Cryer P.E# 143668 TX Firm #18326</p>	 <p>12/18/2024</p>	<p>DIG Engineers 11 Greenway Plaza, Suite 1520 Houston, Texas 77046 TX Firm No. F-18326</p>
<p>Engineer of Record, Mechanical: Mital Patel, P.E. P.E# 111622</p>	 <p>December 18, 2024</p>  <p>F-18672</p>	<p>LEAF Engineers 11 Greenway Plaza, 15th Floor Houston, Texas 77046</p>
<p>Engineer of Record, Electrical, Plumbing & Technology: Donald Richards, P.E. P.E# 61525</p>	 <p>December 18, 2024</p>  <p>F-18672</p>	<p>LEAF Engineers 11 Greenway Plaza, 15th Floor Houston, Texas 77046</p>

DOCUMENT 00 00 10 TABLE OF CONTENTS

<i>Section No.</i>	<i>Title</i>
00 00 00	Project Manual Cover Sheet
00 00 01	Seals Page
00 00 10	Table of Contents
00 11 00	Request for Competitive Sealed Proposals
00 20 01	Humble ISD Selection Criteria
00 21 16	Instructions to Offerors
00 31 00	Affidavit of Non-Asbestos, Lead and PCB Use Affidavit
00 31 32	Geotechnical Data
00 31 32.1	Geotechnical Report
00 40 00	Competitive Sealed Proposal Form
00 40 01	Proposal Bond
00 40 12	List of Subcontractors
00 50 00	Texas Statutory Performance Bond
00 50 01	Texas Statutory Payment Bond
00 71 00	AIA Document A101 – Standard Form of Agreement Between Owner and Contract
00 71 00A	AIA Document A201 – General Conditions of the Contract for Construction
00 72 00	Supplementary Conditions to the AIA Document A201
00 73 00	Exhibit A to A101 – Owner’s Construction Bond and Insurance Requirements
00 73 50	Prevailing Wage Rate Determination Information

DIVISION 1 GENERAL REQUIREMENTS

01 10 00	Summary
01 21 00	Allowances
01 22 00	Unit Prices
01 23 00	Alternates
01 25 13	Product Substitution Procedures
01 25 13.01	Request for Substitution Form
01 26 00	Contract Modification Procedures
01 29 00	Payment Procedures
01 29 73	Schedule of Values
01 29 73.1	Schedule of Values – Sample
01 31 00	Project Management and Coordination
01 32 00	Construction Progress Documentation
01 32 33	Photographic Documentation
01 33 00	Submittal Procedures
01 40 00	Quality Requirements
01 42 00	References
01 45 23	Structural Testing and Inspection Services
01 45 23	Testing and Inspecting Services
01 50 00	Temporary Facilities and Controls
01 50 00	Temporary Facilities (Civil)
01 55 26	Traffic Control
01 56 00	Temporary Jobsite Protection
01 56 23	Traffic Barricades
01 57 13	General Source Controls
01 57 13.13	Filter Fabric Fence
01 57 13.14	Reinforced Filter Fabric Barrier
01 57 13.15	Stabilized Construction Exit
01 57 26	Texas Pollution Discharge Elimination System
01 60 00	Product Requirements
01 73 00	Execution
01 73 29	Cutting and Patching
01 77 00	Closeout Procedures

01 77 01	Closeout Forms A-D
01 77 13	PBK Exterior Punch List Form
01 77 16	PBK Interior Punch List Form
01 78 39	Project Record Documents
01 79 00	Demonstration and Training

DIVISION 2 EXISTING CONDITIONS

02 41 00	Demolition
02 41 13	Selective Demolition
02 41 13.23	Abandonment of Existing Utilities
02 41 19	Selective Structural Demolition

DIVISION 3 CONCRETE

03 05 80	Under Slab Vapor Retarder
03 10 00	Concrete Forming and Accessories
03 10 01	Spread Footings
03 11 00	Concrete Formwork
03 11 31	Void Forms
03 15 00	Concrete Accessories (Civil)
03 15 00	Concrete Accessories (Arch)
03 15 13	Waterstops
03 20 00	Concrete Reinforcement (Civil)
03 20 00	Concrete Reinforcing (Structural)
03 30 00	Cast-in-Place Concrete
03 31 00	Structural Concrete
03 35 19	Concrete Floor Staining
03 52 16	Lightweight Insulating Concrete Deck System

DIVISION 4 MASONRY

04 20 00	Unit Masonry
04 22 00	Concrete Unit Masonry

DIVISION 5 METALS

05 12 00	Structural Steel Framing
05 12 13	Architecturally Exposed Structural Steel Framing
05 21 00	Steel Joist Framing
05 31 13	Steel Floor Decking
05 31 23	Steel Roof Decking
05 40 00	Cold Formed Metal Framing
05 50 00	Metal Fabrications
05 51 00	Steel Stairs, Handrails and Railings
05 58 13	Column Covers
05 70 00	Decorative Metal
05 73 00	Decorative Railing System

DIVISION 6 WOOD, PLASTICS, AND COMPOSITES

06 10 00	Rough Carpentry
06 20 00	Finish Carpentry and Millwork
06 40 23	Interior Architectural Woodwork
06 82 00	Fiberglass Reinforced Plastic Panels

DIVISION 7 THERMAL AND MOISTURE PROTECTION

07 05 43	Thermal Clips
07 13 00	Shower Stall Waterproofing
07 14 00	Cold-Fluid Applied Waterproofing
07 16 00	Below Grade Waterproofing

07 21 00	Thermal Insulation
07 27 26	Fluid Applied Air Barrier System
07 42 11	Formed Metal Wall Panels
07 42 13	Metal Composite Material Wall Panels
07 42 23	External Cladding
07 52 19	Modified Bitumen "Cool Roof" Membrane Roofing System
07 62 00	Roof Related Sheet Metal
07 65 00	Flexible Flashing
07 72 00	Roof Accessories
07 72 33	Roof Scuttle (Hatches) and Heat/Smoke Vents
07 81 00	Applied Fireproofing
07 84 00	Firestopping
07 92 00	Joint Sealants
07 95 00	Expansion Control

DIVISION 8 OPENINGS

08 11 13	Hollow Metal Doors and Frames
08 14 23	Plastic Laminate Faces Wood Doors
08 31 13	Access Doors and Frames
08 35 16	Folding Grilles
08 41 13	Aluminum Framed Entrances and Storefronts
08 44 13	Glazed Aluminum Curtain Walls
08 71 00	Door Hardware
08 71 00	Door Hardware - Alternate
08 80 00	Glazing
08 83 00	Mirrors
08 87 23	Safety and Security Film
08 91 00	Fixed Louvers

DIVISION 9 FINISHES

09 21 16	Gypsum Board Assemblies
09 24 00	Cement Plastering
09 30 13	Ceramic Tiling
09 30 19	Porcelain Tile
09 51 00	Acoustical Ceiling Panels
09 62 33	Rubber Sports Flooring
09 64 66	Wood Gymnasium Flooring
09 65 13	Resilient Base
09 65 16	Vinyl Sheet Flooring
09 65 19	Resilient Tile Flooring
09 68 00	Carpeting
09 84 13	Fixed Sound Absorptive Panels
09 90 00	Paintings and Coatings
09 93 00	Hardwood Floor Adhesives, Finishing, and Maintenance
09 96 46	Intumescent Painting
09 97 23	Concrete Floor Sealer

DIVISION 10 SPECIALTIES

10 01 00	Miscellaneous Specialties
10 11 00	Markerboards and Tackboards
10 14 00	Graphics
10 14 33	Electronic Signage
10 14 53	Traffic Signage
10 21 13	Solid Plastic (HDPE) Toilet Partitions
10 26 13	Corner Guards
10 28 13	Toilet Accessories

10 44 00	Fire Extinguisher and Cabinets
10 51 13	Metal Lockers and Benches
10 56 16	Metal Storage Shelving
10 71 13	Exterior Sun Control Devices
10 73 13	Aluminum Canopy

DIVISION 11 EQUIPMENT

11 66 00	Gymnasium Equipment
11 66 43	Indoor Scoreboard

DIVISION 12 FURNISHINGS

12 11 00	Digitally Printed Vinyl Murals
12 21 13	Horizontal Louver Blinds
12 24 00	Window Shades
12 35 50	Educational Casework
12 35 53	Laboratory Casework
12 36 62	Simulated Stone Countertops
12 66 13	Telescoping Bleachers
12 93 00	Site Furnishing

DIVISION 13 SPECIAL CONSTRUCTION – not used

DIVISION 14 CONVEYING EQUIPMENT

14 24 00	Hydraulic Elevator
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VOLUME 2

DIVISION 21 – FIRE SUPPRESSION

21 05 00	Common Work Results for Fire Protection
21 05 29	Hangers and Supports for Fire Suppression System
21 05 48.13	Vibration Controls for Fire Suppression System
21 11 13	Fire Suppression System

DIVISION 22 PLUMBING

22 05 00	Common Work Results for Plumbing
22 05 10	Sanitary Pipe Testing
22 05 12	Water Pipe Testing
22 05 29	Plumbing Hangers and Supports
22 05 48.13	Vibration Controls for Plumbing Piping Equipment
22 08 00	Commissioning of Plumbing Systems
22 11 16	Domestic Water Piping
22 13 16	Sanitary Waste and Vent Piping
22 13 21	Acid Waste and Vent Systems
22 14 13	Storm Drainage Piping
22 20 23	Gas Piping
22 30 00	Plumbing Equipment
22 40 00	Plumbing Fixtures

DIVISION 23 MECHANICAL

23 05 00	Common Work Results for HVAC
23 05 13	Common Motor Requirements for HVAC Equipment
23 05 14	Variable Frequency Drives
23 05 16	Expansion Fittings and Loops for HVAC Piping
23 05 19	Meters and Gages for HVAC Piping
23 05 23	General Duty Valves for HVAC Piping
23 05 29	Hangers and Supports for HVAC Piping and Equipment

23 05 48	Vibration and Seismic Controls for HVAC Piping and Equipment
23 05 53	Identification for HVAC Piping and Equipment
23 05 93	Testing, Adjusting, and Balancing for HVAC
23 07 13	Duct Insulation
23 07 16	HVAC Equipment Insulation
23 07 19	HVAC Piping Insulation
23 08 00	Commissioning of HVAC Systems
23 09 23	Direct Digital Controls
23 09 93	Sequences of Operation for HVAC Controls
23 21 13	Hydronic Piping
23 21 23	Hydronic Pumps
23 22 00	Condensate Piping
23 23 00	Refrigerant Piping
23 25 19	Flushing and Cleaning of Hydronic Piping Systems
23 31 13	Metal Ducts
23 31 18	Fabric Duct
23 33 00	Air Duct Accessories
23 33 19	Duct Silencers
23 34 00	HVAC Fans
23 34 23	High Plume Blower Systems
23 36 00	Air Terminal Units
23 37 13	Diffusers, Registers, and Grilles
23 37 23	HVAC Gravity Ventilators
23 43 00	Electronic Bi-Polar Ionization Air Cleaners
23 43 13	UVC Emitters
23 73 13	Modular Indoor Central Station Air Handling Units
23 74 13	Packaged Outdoor Central Station Air Handling Units
23 74 13.1	High Capacity Outside Air Packaged Outdoor Central-Station Air-Handling Units
23 81 26	Ductless Mini Split System Air Conditioners
23 82 39.19	Electric Unit Heaters

DIVISION 26 - ELECTRICAL

26 05 00	Common Work Results for Electrical
26 05 19	Low Voltage Electrical Power Conductors and Cables
26 05 26	Grounding and Bonding for Electrical Systems
26 05 29	Hangers and Supports for Electrical Systems
26 05 33	Raceway and Boxes for Electrical Systems
26 05 53	Identification for Electrical Systems
26 05 73.19	Arc-Flash Hazard Analysis
26 08 00	Commissioning of Electrical Systems
26 09 43	Digital Lighting Controls
26 20 00	Electrical Distribution Equipment
26 27 26	Wiring Devices
26 43 00	Surge Protection Devices (SPDs) for Low Voltage Electrical Power Circuits
26 50 00	Lighting

DIVISION 27 – TECHNOLOGY & AUDIO VISUAL

27 00 00	Basic Materials and Methods
27 32 43	Campus Radio Antenna System
27 51 23	Intercom and Clock Network
27 51 23.80	Local Sound Reinforcing Systems

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

28 05 00	General Electronic Safety Systems Requirements
28 05 44	Emergency Responder Radio Antenna System
28 13 00	Access Control System

28 16 00	Intrusion Detection System
28 23 00	IP Security Camera System
28 23 16	Aiphone Access Control System
28 31 00	Fire Alarm System

DIVISION 31 – EARTHWORK

31 13 13.13	Waste Material Disposal
31 20 00	Earthwork
31 23 00	Construction of Underground Utilities
31 23 23.13	Bank Sand Backfill
31 23 23.16	Cement Stabilized Sand Bedding and Backfill
31 31 16	Termite Control
31 32 13.17	Cement Stabilized Subgrade
31 32 13.19	Lime Stabilized Subgrade
31 32 13.20	Hydrated Lime and Lime Slurry
31 32 13.21	Lime Fly Ash Stabilized Subgrade
31 41 00	Trench Safety
31 50 00	Excavation Support and Protection

DIVISION 32 – EXTERIOR IMPROVEMENTS

32 01 90	Exterior Landscape Maintenance
32 13 13	Concrete Paving
32 16 13	Concrete Curb, Gutter, Sidewalks and Driveways
32 18 23.18	Knitted Nylon Synthetic Turf System with Foam Pad
32 31 19	Wrought Iron Fences and Gates
32 80 00	Irrigation
32 90 00	Planting
32 92 00	Turf and Grasses
32 92 13	Hydro-Mulch Seeding
32 92 23	Fertilizer
32 92 23.16	Solid Sod

DIVISION 33 – UTILITIES

33 01 30.13	Sanitary Sewer TCEQ Manhole Requirements
33 11 00	Water Distribution System PVC
33 33 13	Sanitary Sewer Lines
33 41 00	Storm Sewer and Appurtenances
33 44 19	Storm Water Management

DIVISION 34 - TRANSPORTATION

34 41 13	Traffic Signals
34 41 14	School Zone Flasher Assemblies

END OF DOCUMENT 00 00 10

SECTION 00 11 00 - REQUEST FOR COMPETITIVE SEALED PROPOSALS

Competitive Sealed Proposals for the work identified below in accordance with Proposal Documents and addenda as may be issued prior to date of proposal opening will be received by the Board of Trustees, Humble Independent School District, until proposal closing date and time, as identified below. Proposals from Offerors will then be opened in public and read aloud.

OWNER: Humble Independent School District
1703 Wilson Rd. Building B
Humble, Texas 77396
Owner Representative: Thomas Haggerty
Phone: (281) 641-8719

PROJECT: Humble High School Additions and Renovations Phase Two
1700 Wilson Road, Humble, Texas 77338

EST. BUDGET: **\$35,900,000.00**

PRE- PROPOSAL CONFERENCE: **Tuesday, January 7, 2025, @ 10:00AM;** site walk immediately following

PRE- PROPOSAL CONFERENCE LOCATION: **Humble ISD Maintenance Center**
1703 Wilson Rd., Building B
Humble, Texas 77396

LAST DAY TO SUBMIT QUESTIONS: **Friday, January 10, 2025, @ 4:00PM** (All questions must be submitted through IonWave only)

PROPOSAL CLOSES: **Thursday, January 23, 2025, @ 2:00PM – Base Proposal**
Thursday, January 23, 2025, @ 3:00PM – Alternate Proposal

PUBLIC OPENING: **Thursday, January 23, 2025, @ 3:00PM (Base and Alternate)**

All proposals are submitted electronically via Ion Wave @ <https://humbleisd.ionwave.net>

LOCATION OF PROPOSAL OPENING: **Humble ISD Maintenance Center**
1703 Wilson Rd., Building B
Humble, Texas 77396

ZOOM LINK: Join Zoom Meeting
<https://humbleisd.zoom.us/j/89601630903?pwd=fqAKVgo5ympNJ27biuudaSQ7DUpVgO.1>

Meeting ID: 896 0163 0903
Passcode: 378856

One tap mobile
+13462487799,,89601630903#,,,,*378856# US (Houston)
+16694449171,,89601630903#,,,,*378856# US

ARCHITECT: PBK Architects, Inc.
11 Greenway Plaza Boulevard, 22nd floor
Houston, Texas 77046
Phone: 713-965-0608 Fax: 713-961-4571

Digital sets will be readily available courtesy of the plan rooms as indicated below within this document. Subcontractors and Supplies purchasing a partial set of proposal documents are responsible for determining the documents it requires and is responsible for costs associated with printing and delivery.

Proposal Documents may be obtained from the following address:

PBK Architects, Inc.
11 Greenway Plaza, 22nd Floor
Houston, Texas 77046
(713) 965-0608

Office Hours are 8:00 AM to 5:00 PM

In addition, proposal documents can be reviewed at the following locations:

Associated General Contractors of Houston
(AGC).
910 Kirby Drive, Suite 131.
Houston, Texas 77098.
Phone: (713) 523-6222.

Virtual Builders Exchange
7035 W. Tidwell, Bldg J, Ste 112
Houston, Texas 77098
F: (832) 613-0344
www.virtualbx.com

ConstructConnect
(Formerly iSqFt & CMD)
Phone: (800) 364-2059
www.constructionconnect.com

Submit Proposals to the Owner no later than the date and time specified through Ion Wave @ <https://humbleisd.ionwave.net> and as directed in document 00 21 16 - Instructions to Offerors

The Owner reserves the right to reject any and all proposals and to waive any irregularities in the Competitive Sealed Proposal process.

No proposal shall be withdrawn within **90** days after the proposal opening without the specific consent of the Owner.

PROPOSAL BOND: A Proposal Bond from a bonding company acceptable to the Owner or a certified check in an amount equal to 5% of the greatest amount proposal shall accompany each Offeror's proposal.

PAYMENT BOND AND PERFORMANCE BOND: A Payment Bond and Performance Bond, each in an amount equal to 100% of the Contract Sum conditioned upon the faithful performance of the Contract will be required. Please note that all bonding companies presented must be acceptable to the Owner.

PBK Architects
Project No. 220537
CSP No. 2025-09

Humble High School Additions and Renovations Phase Two
Humble Independent School District

The prevailing rates of wages are the minimums that must be paid in compliance with applicable laws of the State of Texas.

Offerors submitting a proposal are encouraged to visit the site. All Offerors submitting a proposal are encouraged to attend the proposal opening.

END OF DOCUMENT 00 11 00

DOCUMENT 00 20 01 - SELECTION CRITERIA AND CONTRACTOR INFORMATION SHEET

Proposals are to include the information requested in this of this Request in the sequence and format prescribed. In addition to and separate from the requested information, offerors submitting proposals may provide supplementary materials further describing their capabilities and experience.

Following the deadline for receipt, the District's staff will receive, publicly open, and read aloud the names of the offerors and, if any are required to be stated, all prices stated in the proposals. The District's staff will recommend that the District select a construction contractor from the respondents to this Request for Proposals or reject all proposals.

The recommended ranking shall be based on the data furnished by the offerors in response to the request for CSPs. The following is a list of criteria and weight for each criterion. Unless modified by addendum prior to opening of the proposals, the following listing of criteria and weight of criteria shall be utilized by the District pursuant to Texas Government Code Chapter 2269, Subchapter D:

PROPOSAL QUALIFICATIONS SCORESHEET

1. Extent of the firm's experience in the construction/renovation of educational facilities of comparable size and complexity in the greater Houston area construction market. Possible Points: <u>15</u> Location / Page # _____
2. Whether the team personnel proposed have the appropriate experience and capabilities for the project. Also provide the proposed team's current commitments. Possible Points: <u>10</u> Location / Page # _____
3. Whether the firm has demonstrated the capability to meet project schedules and budgets. Provide the following project information for the last 5 years: original contractual completion date, original contract amount and final contract amount. Possible Points: <u>10</u> Location / Page # _____
4. How long the firm has been in business, and whether the firm's organizational structure, licensing and financial information indicate that the firm is capable of successfully completing this project. Possible Points: <u>10</u> Location / Page # _____
5. The firm's responsiveness and completeness regarding the Request for Qualifications submittal. Possible Points: <u>5</u> Location / Page # _____
6. The firm's safety and drug abuse programs, and history of safety performance. Possible Points: <u>3</u> Location / Page # _____
7. Whether the firm has previously worked for the District, and whether the work was satisfactory to the District. Possible Points: <u>2</u> Location / Page # _____
8. Responses from the firm's references. Do not enter score on this sheet. Score will be inserted on summary sheet. Possible Points: <u>5</u> Location / Page # _____
9. Price Possible Points: <u>40</u> Location / Page # _____

Contract award is based on qualifications (60 pts) and Price (40 pts)

DOCUMENT 00 21 16 - INSTRUCTIONS TO OFFERORS:

1.1 QUALIFIED OFFERORS

- A. **Competitive Sealed Proposals will be accepted from qualified Offerors (General Contractors) only for the entire scope of work described in the Contract Documents.** As a prerequisite to an Offeror's qualifying for the award of contract on this work, the Offeror must complete each item of the Contractor's Qualification Statement (AIA Document A305). The Statement forms may be obtained from the Houston Chapter of the American Institute of Architects, 315 Capitol, Suite 120, Houston, Texas 77002, (713) 520-0155. In addition to the information contained in the Statement form, offerors shall also address the selection criteria issues listed under the paragraph below for Determination of Successful Respondent and Award of Contract. The Qualification Statement and References shall be submitted in IonWave with proposal (only).
- B. The primary purposes of the evaluation process will be to:
1. Gather information for the Owner's evaluation procedure.
 2. Enable the Owner and/or Architect to evaluate the Offeror's qualifications.
- C. After review of Proposals and Contractor's qualifications evaluation the Owner will make his decision and each Offeror will be notified once board approval has been obtained.
- D. In arriving at his opinion concerning the Offeror's qualifications, the Architect will use the same criteria that the Owner will use in determination of the successful Offeror as detailed hereinafter.
- E. In the event a proposed Offeror fails to submit the specified Contractor's Qualification Statement (A305) by the specified date and time as noted in section 1.1 A of this document, such noncompliance shall be considered by both the Owner and Architect as a negative factor and could be grounds for disqualification at the Owner's discretion in the determination of the successful Offeror.

1.2 OFFEROR'S PRESENTATION

- A. Each Offeror by making his Proposal represents that:
1. He has read and understands the Proposal Documents and his Proposal is made in accordance therewith.
 2. He has thoroughly familiarized themselves with Division 01 General Requirements as they are applicable to subsequent specification sections.
 3. He has visited the site, has familiarized himself with the local conditions under which the work is to be performed and has correlated his observations with the requirements of the proposed Contract Documents.
 4. He agrees to comply with the requirements of the following paragraph. Any Offeror who subsequently does not agree to comply with these requirements will automatically disqualify himself from proposing or receiving award of the contract.
- B. He agrees that:
1. Work on the project will begin immediately upon receipt of an executed District Purchase Order ONLY.
 2. Offeror will participate as a team member in cooperation with the Project Architect, Engineers, Owner, and Owners agents and/or consultants.

3. The Offeror will assign a competent full-time superintendent, to the project, and that superintendent shall be maintained on the project for the duration of the project, subject only to his continuous employment.
4. The Offeror will furnish and pay for a proposal bond in the amount of five percent (5%) of the contract amount.
5. If awarded, the Offeror shall furnish and pay for a Performance Bond and a Payment Bond each in the full contract amount.
6. Offeror shall carry and keep in full force for the duration of the Project, insurance coverage for builder's risk, workmen's compensation, comprehensive general liability, and automobile liability as required by the General Conditions and/or Supplementary General Conditions of the Specifications.
7. Each Offeror by making his Proposal represents that his Proposal includes only material and equipment specified in the Proposal Documents and supplemented, if necessary, for a complete and operating system.
8. Where subcontract work is involved and where Acceptable Subcontractors are designated for particular sections or phases of the Work, each Offeror by making his Proposal represents that his Proposal includes only firms designated as Acceptable Subcontractors.
9. That no asbestos PCBs or lead building materials shall be used, and that each Offeror (and sub-offeror or supplier submitting a proposal to an Offeror) shall submit an affidavit at Project Close-out stating that no asbestos, PCB's or lead building materials has been used on the Project.

1.3 PROPOSAL DOCUMENTS

- A. Proposal Documents include the Request for Competitive Sealed Proposals, Instructions to Offerors, the Proposal Form, and the proposed Contract Documents, including any Addenda issued prior to receipt of proposals, any Humble ISD required forms, and any submissions through the District's online bidding system.
- B. Contract Documents for the work consist of the Owner-Contractor Agreement, the Conditions of the Contract (General, Supplementary and other Conditions), the Drawings, the Specifications, and all Addenda issued prior to receipt of proposals.

1.4 PROPOSAL PROCEDURES

- A. A proposal is invalid if it has not been received at the designated location prior to the time and date for receipt of proposals indicated in the Request for Competitive Sealed Proposals, or prior to any extension thereof issued to the Offerors by Addenda.
- B. All requested Alternates shall be proposed. If no change in the Base Proposal is required, enter "0".
- C. Prior to the receipt of Proposals, Addenda will be forwarded by the Architect and will be available for inspection wherever the proposal documents are kept available for that purpose.
- D. Proposals must be received via the District's online bidding system on the Proposal Form located on the Line Items tab for the work as indicated by the Proposal Documents.
- E. The CSP Response must be accompanied by Proposal Bond, uploaded to the District's online bidding system or Certified Check in the amount of 5% of the proposal.
- F. All proposals must be submitted via the District's online bidding system, before the scheduled time and date for proposal opening.

- G. A proposal may be withdrawn only upon request by the Offeror or his duly authorized representative, provided such request is received by the Owner at the place designated for receipt of proposals and prior to the time fixed for the opening of proposals. A withdrawal of a proposal shall not be effective unless a written confirmation of the withdrawal is received by the Owner at said place within 48 hours before the time fixed for the opening of proposals. The Proposal Bond will be returned with the proposals if withdrawn in accordance with the above. The withdrawal of a proposal does not prejudice the right of the Offeror to file a new proposal at the time and place stated. No proposal may be withdrawn after the time fixed for the opening of proposals for a period of **90 days**.
- H. Certain references to Owner's Documents will be obsolete due to the new online bidding procedure of submission of proposal and forms through Humble ISD's online bidding system. Offerors intending to submit proposals for this Project should visit the website for the District's online bidding system at <http://humbleisd.ionwave.net/Login.aspx> to register and access all of the Owner's required forms, certifications and enter Base Proposal, Alternates Proposal, Unit Pricing and other required items.
- I. The A305 Document must be accompanied by a listing of the Offeror's projects of similar size and scope during the past five (5) years. The listing shall include the project name, address, building area, contract sum, contract date, contract completion date(s), substantial completion date(s), Owner representative's name, telephone number, e-mail address and the names of the Contractor's project staff assigned to the project. In addition, see 00 45 00 as the General Contractor shall include in this submission the following information regarding the Contractor's Proposed Project Team:
1. Name of the Proposed Project Executive.
 2. Name of the Proposed Project Manager.
 3. Names of Proposed Assistant Project Managers or Project Engineers.
 4. Name of Proposed Project Superintendent.
 5. Name of Proposed Assistant Project Superintendent.
 6. Name of Proposed Field Engineer.
 7. Names of any proposed project support staff.

The General Contractor shall include a resume of qualifications for each of the project personnel proposed.

In addition, include a written summary describing the roles each person will have on the project team and what percentage of time each person will dedicate to this project on a weekly basis. In addition, the contractor shall indicate where each staff member will office (onsite or main office).

A PDF copy of the completed A305 document must be submitted with Proposal on the District's online bidding system

- J. The CSP Response must be accompanied with a bar chart construction schedule for this project with projected milestone dates and respective phasing as described by the contract documents (complete foundation, complete steel erection, dry-in, HVAC start-up, etc.).
- K. The Contract shall be awarded to the Contractor offering the "best value" to the Owner, in addition to the purchase price, based on the published selection criteria and on its ranking evaluation.

1.5 INTERPRETATION OF PROPOSAL DOCUMENTS

- A. Offerors and sub-offerors requiring clarification or interpretation of the Proposal Documents shall make a written request through the District's online bidding system. Deadline for questions is January 10, 2025 at 4:00 PM.
- B. Any interpretation, correction or change of the Proposal Documents will be made by Addendum. Interpretations, corrections or changes of the Proposal Documents made in any other manner will not be binding.
- C. With submission of Proposal response, Offeror agrees to selection process set forth by Humble ISD.

1.6 SUBSTITUTIONS OF MATERIALS AND EQUIPMENT

- A. The materials, products and equipment described in the Proposal Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability or record of satisfactory performance. It is not intended to preclude the use of equal or better materials or equipment provided that same meets the requirements of the particular project and is approved in an addendum as a substitution prior to the submission of proposals.
- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect at least seven (7) days prior to the date for receipt of proposals as described in Section 01 25 13 – Products and Substitutions. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance and test data and any other information necessary for an evaluation. The Architect's decision of approval or disapproval of a proposed substitution shall be final.
- C. If the Architect approves any proposed substitution prior to receipt of proposals, such approval will be set forth in an Addendum. Offerors shall not rely upon approvals made in any other manner.
- D. No substitutions will be considered after the Contract award.

1.7 REJECTION OF PROPOSALS

- A. The Owner shall have the right to reject any or all proposals and to reject a proposal not accompanied by any required proposal security, or by other data required by the Proposal Documents, or to reject a proposal which is in any way incomplete or irregular. The District's online bidding system does not allow an incomplete proposal to be submitted. Please allow ample time to complete all required documentation and uploads.
- B. The Owner reserves the right to reject any or all proposals and to waive any formalities or irregularities and to make the award of the contract in the best interest of the Owner.
- C. The Owner reserves the right to reject any proposal if the evidence submitted by, or investigation of, such offeror fails to satisfy the Owner that such offeror is properly qualified to carry out the obligations of the contract and to complete the work therein. Award may be made to other than the low-dollar offeror and given the one offering the "best value" to the school district, in addition to the purchase price, based on the published selection criteria and on its ranking evaluation.

- D. Do not submit voluntary alternates. The Owner reserves the right to reject any proposal which is accompanied by conditional or qualifying statements, or “voluntary alternates”.

1.8 INSURANCE

- A. Each Offeror shall include in his proposal the complete cost and shall carry and keep in full force for the duration of the project, insurance coverage required under the General Conditions and Document CB - Supplementary Conditions.

1.9 PERFORMANCE BOND AND PAYMENT BOND

- A. Each Offeror shall include in this proposal the premium costs for 100% Performance Bond and 100% Payment Bond. These bonds shall cover the faithful performance of the contract and payment of all obligations arising thereunder in such form as the Owner may prescribe. The bonding companies must be acceptable to the Owner. The selected Offeror shall deliver the required bonds to the Owner not later than the date of execution of the Contract.

1.10 PROPOSAL SECURITY

- A. No proposal will be considered unless it is submitted through the District’s online bidding system and accompanied by an uploaded Proposal Bond or Certified or Cashier’s Check. In either case the amount shall be not less than five percent (5%) of the greatest amount proposed (considering alternates, if any). The proposal security shall insure the execution of the contract and the furnishing of an acceptable Performance Bond and Payment Bond by the successful Offeror within ten (10) days after notification of award to such Offeror and that this proposal will not be withdrawn within 90 days after date of opening of proposals without the consent of the Owner. Proposal Bond shall be prepared in the identical form of AIA Document A310.

1.11 SUBMISSION OF POST PROPOSAL INFORMATION

- A. The Selected Offeror shall within five (5) days after receipt of properly executed District Purchase Order shall submit the following:
 - 1. A statement of costs for each major item of work included in the proposal as described in Section 01 29 73 – Schedule of Values. Each section of specifications will be considered a major item of work and shall be shown as a separate cost item.

1.12 AWARD OF CONTRACT

- A. The Offeror to whom the award is made will be promptly notified. If an Offeror (a) withdraws his proposal within 90 days after the date of time fixed for the opening of proposals in the Request for Competitive Sealed Proposals, or (b) fails or refuses to execute the Agreement, or other required forms within ten (10) days after the same are presented to him for signature, or (c) fails or refuses to furnish properly executed Performance Bond and Certification of Required Insurance within 15 calendar days of execution date of the Agreement, the Owner may award the work to another Offeror or Offerors or may call for new proposals.
- B. The Offeror will be required to (a) submit his Proposal and Proposal Bond, (b) execute Contract and Performance and Payment Bonds, and (c) submit Certification of required insurances, all using the Owner's own forms for such respective purposes.
- C. Proposal Bond is forfeited if proposal is withdrawn after the proposal opening, or Contract Documents are not executed in accordance with the above.

1.13 NOTICE TO PROCEED

- A. The Offeror shall not commence work under this Contract until after receipt of properly executed District Purchase Order and the Contract is duly signed by the Owner.

1.14 COMPLETION TIME

- A. Offerors shall familiarize themselves with the Owners requirements concerning the project schedule as described in Section 01 10 00 of this Project Manual.
- B. Having thoroughly familiarized himself with the conditions as they exist at the building sites and acquainted himself with the labor supply and the material market, the Offeror will state in his proposal that he agrees to be substantially complete with the work by the date stated above.
- C. It is therefore expressly agreed as a part of the consideration inducing the Owner to execute this contract that the Owner may deduct liquidated damages from the final payment made to the Contractor for each and every calendar day beyond the agreed date which the Contractor shall require for Substantial Completion of the work included in this contract. It is expressly understood that the said sum per day is agreed upon as a fair estimate of the pecuniary damages which will be sustained by the Owner in the event that the work is not completed within the agreed time, or within the legally extended time, if any, otherwise provided for herein. Said sum shall be considered as liquidated damages only and in no sense shall be considered a penalty, said damage being caused by additional compensation to personnel, for loss of interest on money and other miscellaneous increased costs, all of which are difficult of exact ascertainment. Also, any disruption of Owner's use of the existing facilities or newly completed facilities will also be subject to liquidated damages. Refer to Section 01 32 16 for additional requirements. Delays, disruption of use, failures to complete, and liquidated damages are fully described under Article 8.3 of the Supplementary Conditions.

The definition of Substantial Completion is found in Article 9.8.1 of the AIA General Conditions and Supplementary Conditions bound herein.

1.15 FELONY CONVICTION NOTIFICATION

- A. Section 44.034, of the Texas Education Code requires a person or business entity that enters into a contract with a school district must give advance notice to the district if the person or an owner or operator of the business entity has been convicted of a felony. The notice must include a general description of the conduct resulting in the conviction of a felony. Subsection (b) states "a school district may terminate a contract with a person or business entity if the district determines that the person or business entity failed to give notice as required by Subsection (a) or misrepresented the conduct resulting in the conviction. The district must compensate the person or business entity for services performed before the termination of the contract." Subsection (c) states "this section does not apply to a publicly held corporation."
- B. The Offeror must acknowledge their agreement with this requirement as directed under the "Attributes" tab in the District's online bidding system.

1.16 AFFIDAVIT OF NON-DISCRIMINATORY EMPLOYMENT

- A. The Offeror, and sub-offerors, shall agree to refrain from discrimination in terms and

conditions of employment to the basis of race, color, religion, sex, or national origin, and agrees to take affirmative action as required by Federal Statutes and Rules and Regulations issued in order to maintain and insure non-discriminatory employment practices.

- B. The Offeror must acknowledge their agreement to this requirement as directed under the "Attributes" tab in the District's online bidding system.

1.17 LIST OF SUBCONTRACTORS

- A. The Offeror shall supply a list of major subcontractors:
- B. The Offeror **must** execute the List of Subcontractors and submit with their Proposal on the District's online bidding system.

1.18 AFFIDAVIT OF NON-ASBESTOS, LEAD, AND PCB USE IN PROJECT

- A. The use of any construction process or the installation of any asbestos, lead and PCBs or material containing asbestos, lead and PCBs is strictly prohibited for this Project.
- B. The Offeror must execute the Asbestos Short Term Worker Form with their Proposal on the District's online bidding system.
- C. The Offeror, and sub-offerors shall agree to refrain from using products which are known to contain asbestos, lead, and PCB containing materials as applicable to the project. They shall also affirm that lead or lead bearing materials have not been incorporated into potable water systems, and that lead sheet flashing used in through roof plumbing penetration applications is the only lead on the Project.
- D. The Selected Offeror (Contractor) **must** execute Document 00 45 23 AY, Affidavit of Non-Asbestos, Lead, and PCB Use and submit at Project Closeout. The Subcontractors to the Contractor **must** execute Close-out Form "C", attached to section 01 77 00, Subcontractors Hazardous Material Certificate and submit at Project Closeout.

1.19 AFFIDAVIT OF NON-COLLUSION

- A. By submitting a proposal, each offeror agrees to waive any claim it has or may have against the District and its respective employees, the Program Manager and their respective employees, the Architect/Engineer and consultants, and their respective employees, arising out of or in connection with the administration, evaluation, or recommendation of any proposal; waiver of any requirements under the Proposal Documents, acceptance or rejection of any proposals; and award of the contract.
- B. The Offeror must acknowledge their agreement with this requirement as directed under the "Attribute" tab in the District's online bidding system.

1.20 CRIMINAL HISTORY RECORDS

- A. Prior to commencing any work on this Project, The Offeror must acknowledge their agreement with this requirement as directed under the "Attribute" tab in the District's online bidding system, that for each of its employee who will have direct contact with students, the Selected Contractor has obtained, as required by Texas Education Code Section 22.0834:

1. National criminal history record information from a law enforcement or criminal justice agency for each employee of the Selected Contractor hired before January 1, 2008 who will have direct contact with students; and
 2. National criminal history record information from the Texas Department of Safety for each employee of the Selected Contractor hired on or after January 1, 2008 who will have direct contact with students; Fingerprinting is required and shall be provided by the contractor (applicant) and administered through FAST (Fingerprint Applicant Services of Texas) which will be recorded by the District in the FACT (Fingerprint-based Applicant Clearinghouse of Texas). Currently applicant must obtain fingerprinting from L-1 Identity Solutions Company, (888) 467-2080, or schedule an appointment online at: <https://tx.ibtfingerprint.com/>.
- B. Any personnel who will have direct contact with students must not have been convicted of an offense identified in Texas Education Code Section 22.085.
- C. At this time, Senate Bill 9 applies only to contractors with direct contracts with the District. This requirement does not apply to sub-contractors of the Contractor, material suppliers, or a one-time service provider such as a service technician, delivery person, testing agent, code official, or similar personnel. However, changes to these requirements are anticipated and may require the acquisition and submittal of additional background checks to the District during the course of the Work.
- D. The Offeror must acknowledge their agreement with this requirement as directed under the "Attributes" tab in the District's online bidding system
- E. Furthermore, an updated Schedule 'B' shall be submitted weekly to the District indicating changes to contractor personnel with accompanying certifications and criminal history records. Any fingerprinting and photographing required by the aforementioned code will be the responsibility of the Contractor-Employer.

1.21 CONFLICT OF INTEREST QUESTIONNAIRE

- A. According to Local Government Code, Chapter 176, a person or an agent of a person who contracts or seeks to contract for the sale or purchase of property, goods, or services with any government agency must file a completed Conflict of Interest Questionnaire with the records administrator of the local government not later than the seventh business day after the date that the person begins contract discussions or negotiations with the District or submits to the District an application, response to a request for proposals or bids, correspondence, or another writing related to a potential agreement with the District.
- B. The Offeror must execute the Conflict of Interest Questionnaire with their Proposal on the District's online bidding system.

1.23 AVAILABILITY OF MATERIALS AND SYSTEMS

- A. A serious effort has been made to select only materials that are systems that are readily available. As far as is known at proposal time all items are either available "off the shelf" or within a relatively short period of time. If during the proposal period, an Offeror becomes aware of an availability or delivery problem with any of the specified systems or materials, he should notify the Architect immediately. The Architect will promptly explore possibilities for

selecting other systems or materials which would circumvent the problem and notify Offerors of any changes in an addendum, otherwise it will be understood that only specified systems and materials that are readily available are included in the proposals.

1.24 DETERMINATION OF SUCCESSFUL RESPONDENT AND AWARD OF CONTRACT

- A. In determining the award of a contract, the district shall consider and apply:
 - 1. Any existing laws, including any criteria, related to historically underutilized businesses; and
 - 2. Any existing laws, rules, or applicable municipal charters, including laws applicable to local governments, related to the use of women, minority, small, or disadvantaged businesses.
- B. The Selection Committee consisting of Humble ISD administrators, program managers, architects, consultants and other staff will make an initial evaluation of the proposals. The committee's recommendation will be considered by the Humble ISD Board of Trustees ("Board"). The District reserves the right to review the recommendation with the Executive Director of Facilities Construction and others deemed appropriate by the District prior to review by the entire Board. The final decision-making authority on the proposal's rests with the full Board. Decision-making authority has not been delegated to any person or entity other than the Board.
- C. The District will make such investigations as it deems necessary to determine the ability of the offeror to perform the Work, and the offeror shall furnish all such information and data for this purpose as may be requested. The District reserves the right to reject any proposal if the evidence submitted by, or investigation of, such offeror fails to satisfy the District that such offeror is properly qualified to carry out the obligations of the Contract and to complete the Work contemplated therein.
- D. The District reserves the right to reject any or all proposals and to waive any formalities or irregularities and to make the award of the contract in the best interest of the District.
- E. A decision regarding determination of the successful Offeror will be made by the District as soon as practical.

1.25 USE OF ASBESTOS FREE MATERIALS, PRODUCTS AND SYSTEMS

- A. The Offeror is reminded to refer to the Paragraph above for requirements during the Proposal period and the following requirements during performance of the Work regarding the use of asbestos free materials, products and systems in the Project.
 - 1. Since many materials, products and systems are proprietary, it is not possible to know all of the materials or components which go into producing such material, product or system without the manufacturer divulging trade secrets or patent information. Every effort has been made to specify materials, products or systems, which either as an "off the shelf" material, product or system or as a custom material, product or system do not contain asbestos.
 - 2. It is the Contractor's responsibility to submit an affidavit from the manufacturer to ascertain that every material, product or system used in the Project does not contain asbestos. In the event the material, product or system is found to contain asbestos, the Contractor shall offer for the Architect's consideration a substitution which he knows does not contain asbestos.

3. Even though a material, product or system is specified or a specification is based on a particular material, product or system, the Contractor will not be relieved from the responsibility to ascertain that materials, products and systems used in the Project do not contain asbestos. Under no circumstances shall a material, product or system which is known, suspected or found to contain asbestos be used on the Project.
4. If a material, product or system containing asbestos is used, the Contractor shall remove and replace the material, product or system with one which is asbestos free at no additional expense to the Owner, including removal and replacement of other materials affected by the removal of the asbestos bearing material, product or system, i.e. gypsum wallboard removed, replaced, and repainted on account of insulation being removed, etc.

END OF DOCUMENT

DOCUMENT 00 31 00 - AFFIDAVIT OF NON-ASBESTOS, LEAD, AND PCB USE IN PROJECT

Upon completion of this form, return to the Architect upon close-out of the project.

PROJECT:
Humble High School Additions and Renovations
Phase Two
1700 Wilson Road
Humble, Texas 77338

ARCHITECT:
PBK
11 Greenway Plaza, 22nd Floor
Houston, Texas 77046

ARCHITECT'S PROJECT NO. 220537

CONTRACTOR: _____

DATE: _____

(Name, address) _____

AFFIDAVIT

The undersigned affirms and certifies that "to the best of their knowledge and belief asbestos, lead, and PCB containing materials have not been used or incorporated into the Work and lead or lead bearing materials have not been incorporated into potable water systems", including, but not limited to those water systems for drinking fountains, all sinks, showers, bath tubs, residential and commercial kitchen equipment, ice machines, and hose bibbs, as applicable to the project, and that lead sheet flashing used in through roof plumbing penetration applications is the only lead on the Project.

Company

Printed Name

Signature

STATE OF TEXAS)
)
COUNTY OF _____)

Sworn to and subscribed before me at _____, Texas, this the _____ day of _____, 20__.

Notary Public in and for _____ County, Texas

END OF DOCUMENT 00 31 00

NOTE: THIS DOCUMENT MUST BE EXECUTED AND SUBMITTED AT PROJECT CLOSE-OUT

SECTION 00 31 32 - GEOTECHNICAL DATA

PART 1 - GENERAL

1.1 GEOTECHNICAL REPORT

- A. Geotechnical Report: A report of a geotechnical investigation entitled Humble ISD Humble High School Building Additions Geotechnical Engineering Report, project number 92235614, dated January 24, 2024, has been prepared for Humble Independent School District, Harris County, Texas by the Geotechnical Consultant, Terracon Consultants, Inc, Houston, Texas (713) 690-8787, based on soil boring samples obtained at the Project site on December 19, 2023, through December 21, 2023.
- B. Boring Logs: Excerpts from the Geotechnical Report, including a Boring Plan, Boring Logs describing strata for each test hole, and results of laboratory tests, are bound herein, or if not bound herein, will be made available to Offerors by the Owner upon request.
- C. The Drawings and Specifications govern the construction of the Project. Boring Logs and the Geotechnical Report are made available for the information and convenience of Offerors. The findings and recommendations are the responsibility of the preparer, and are not part of the Contract Documents.

1.2 SUBSURFACE CONDITIONS

- A. Subsurface conditions indicated in the report were found to exist at the locations shown on the dates the samples were taken and the tests performed. Since subsurface conditions, including but not limited to the presence of groundwater, may vary significantly from time to time, no representation or warranty is made that the conditions described in the Geotechnical Report describe the actual conditions that will be extant during the performance of the Work of This Contract.
- B. Offerors shall visit the site and become fully acquainted with the conditions affecting the Work of This Contract.

PART 2 - PRODUCTS *(Not Used)*

PART 3 - EXECUTION *(Not Used)*

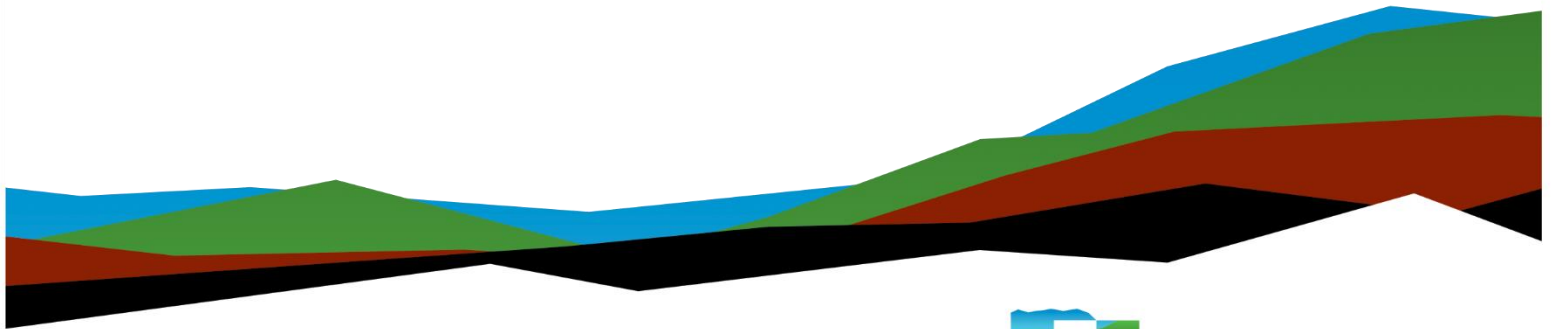
END OF SECTION 00 31 32

Humble ISD Humble High School Building Additions

Geotechnical Engineering Report

Prepared for:

Humble Independent School District
1703 Wilson Road
Humble, Texas 77396



Nationwide
Terracon.com

- Facilities
- Environmental
- Geotechnical
- Materials



11555 Clay Road, Suite 100
Houston, TX 77043
P (713) 690-8787
Terracon.com

January 24, 2024

Humble Independent School District
1703 Wilson Road
Humble, Texas 77396

Attn: Thomas Haggerty – Executive Director of Construction
P: (281) 782-8217
E: txhagger@humbleisd.net

Re: Geotechnical Engineering Report
Humble ISD Humble High School Building Additions
1700 Wilson Road
Humble, Texas
Terracon Project No. 92235614

Dear Mr. Haggerty:

Terracon Consultants, Inc. (Terracon) is pleased to submit our geotechnical engineering report for the project referenced above in Humble, Texas. We trust that this report is responsive to your project needs.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,

Terracon

Jonathan N. Han, E.I.T.
Staff Geotechnical Engineer

Ranadeep Ravula, P.E.
Group Manager

Kierstyn M. Burrell, P.E.
Geotechnical Services Manager



Table of Contents

Introduction	1
Site Conditions	1
Project Description	2
Geotechnical Characterization	3
Geology	3
Subsurface Profile	3
Groundwater Conditions.....	4
Geotechnical Overview	5
Earthwork	7
Site Preparation.....	7
Fill Material Types	8
Fill Compaction Requirements	8
Utility Trench Backfill	9
Grading and Drainage.....	9
Wet Weather/Soft Subgrade Considerations	10
Foundation Systems	10
Design Recommendations – Shallow Spread/Strip Footings	11
Construction Considerations – Shallow Spread/Strip Footings	12
Design Recommendations – Drilled Straight Shaft Foundations	12
Construction Considerations – Drilled Straight Shafts	13
Foundation Construction Monitoring	15
Connection of Building Addition to Existing Building.....	16
Floor Slabs	16
Grade-Supported Floor Slab System	16
Structurally Suspended Floor Slab System	17
Pavements	17
General Comments	22

Figures

GeoModel


Attachments

Exploration and Testing Procedures

Site Location and Exploration Plans

Exploration and Laboratory Results

Supporting Information

Note: This report was originally delivered in a web-based format. **Blue Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the  Terracon logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

Refer to each individual Attachment for a listing of contents.

Introduction

The report represents the results of our subsurface exploration and geotechnical engineering service performed for the proposed improvements within the existing Humble High School campus located at 1700 Wilson Road, Humble Texas. This project was authorized by Mr. William A. Beattie, Chief Financial Officer of Humble Independent School District (Humble ISD) under the existing Amendment to Contracted Services Agreement, dated April 18, 2023, between Humble ISD and Terracon and through the issuance of Purchase Order No. 90452683, on December 8, 2023. The project was performed in general accordance with Terracon Document No. P92235614, dated November 29, 2023.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Earthwork recommendations including site/subgrade preparation;
- Foundation design parameters and construction recommendations; and
- Pavement design guidelines.

The geotechnical engineering Scope of Services for this project included the advancement of 12 test borings to depths that ranged from approximately 15 to 30 feet below existing grade.

Maps showing the site and boring locations are shown in the [Site Location](#) and [Exploration Plan](#) sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs in the [Exploration Results](#) section.

Site Conditions

The following description of site conditions was derived from our site visit in association with the field exploration.

Item	Description
Project Location	The project is within the existing Humble High School campus located at 1700 Wilson Road in Humble, Texas. See Site Location .
Existing Improvements	The site was occupied by an existing two-story high school building and associated pavements at the time of our field exploration program.

Item	Description
Current Ground Cover	Grass, weeds, concrete pavement, and exposed subgrade.
Existing Topography	Relatively level.

Project Description

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Proposed Improvements^{1,2}	<ul style="list-style-type: none"> Three 2-story building additions with footprint areas ranging from approximately 7,500 square feet (sf) to 18,800 sf. Associated surface pavements and driveways on the southeast side of the site.
Building Construction	Either steel-frame or concrete masonry unit (CMU) construction with either a structurally suspended and supported floor slab system or a grade-supported floor slab.
Finished floor Elevation	Within approximately one foot above existing grade and to match the finished floor elevation of the existing building.
Maximum Loads	<p>Grade Supported Floor Slab:</p> <ul style="list-style-type: none"> Total column loads: 350 kips¹ Wall loads: 2 to 4 kips per linear foot (klf)¹ Floor slab pressure: 125 pounds per square foot (psf) <p>Structurally Suspended and Supported Floor Slab System:</p> <ul style="list-style-type: none"> Total column loads: 450 kips¹ Wall loads: 4 to 6 kips per linear foot (klf)¹ Floor slab pressure: 125 pounds per square foot (psf)
Planned Foundation System	<ul style="list-style-type: none"> Grade Supported Floor Slab: Shallow spread/strip footings Structurally Suspended and Supported Floor Slab System: Drilled straight shafts

Item	Description
<p>Pavements</p>	<p>We understand both rigid (concrete) and flexible (asphalt) pavement sections are being considered. We anticipate that traffic will consist primarily of passenger vehicles in the parking areas and passenger vehicles combined with garbage trucks, buses, and large multi-axle delivery trucks from time-to-time in driveway areas.</p>
<ol style="list-style-type: none"> 1. Based on the information provided by Kubala Engineers 2. We understand that utilities are planned within the driveway area and that general subsurface information is requested by the client. Utility recommendations are currently not requested at this time. 	

Geotechnical Characterization

Geology

Based on the geologic maps published by the Bureau of Economic Geology, the site for the proposed construction is located on the Beaumont formation, a deltaic nonmarine Pleistocene deposit. The Beaumont formation is heterogeneous containing thick interbedded layers of clay, fine sand, and silt.

The clay fraction is primarily composed of montmorillonite, illite, kaolinite, and finely ground quartz. The clay present in the formation has been preconsolidated by a process of desiccation. Numerous wetting and drying cycles have produced a network of small randomly oriented, closely-spaced joints within some depth zones. These small joints frequently have a shiny appearance and the clays are called slickensided in these cases. The joint pattern may have an influence on the construction and engineering behavior of the soil.

The coastal plain in this region has a complex tectonic geology, several major features of which are: Gulf Coastal geosyncline, salt domes, and major sea level fluctuations during the glacial stages, subsidence and geologic faulting activities. Most of these geologic faulting activities have ceased for millions of years, but some are still active. A detailed geologic fault investigation and study of the site geology are beyond the scope of this report.

Subsurface Profile

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of

our geotechnical calculations and evaluation of the site. Conditions observed at each exploration point are indicated on the individual logs. The individual logs can be found in the [Exploration Results](#) and the GeoModel can be found in the [Figures](#) attachment of this report.

Concrete pavement was observed at the ground surface at borings B-1, B-3, and B-7 and was measured to range from approximately 12 to 16 inches thick. Two inches of crushed stone material was observed underlying the concrete pavement at boring B-1.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

Model Layer	Layer Name	General Description
1	Fill: Sandy Lean Clay and Fat Clay	dark gray, with sand pockets, scattered roots and gravel, and ferrous stains
2	Sandy Silty Clay, Lean Clay, and Sandy Lean Clay	gray, tan, and reddish brown, very soft to very stiff, with sand pockets, calcareous nodules, and ferrous stains
3	Fat Clay and Sandy Fat Clay	reddish brown and light gray, medium stiff to very stiff, with sand pockets, calcareous nodules, ferrous stains, and slickensides
4	Silty Sand and Poorly Graded Sand with Silt	light gray and tan, medium dense to very dense, with clay pockets

Groundwater Conditions

Borings B-1 through B-12 were advanced using dry drilling techniques to their termination depths (about 15 to 30 feet) in an effort to evaluate groundwater conditions at the time of our field program. Upon reaching groundwater, drilling was suspended for a period of about 15 minutes to allow the groundwater to rise and the groundwater levels to be recorded. The water levels observed in the boreholes can be found on the boring logs in [Exploration Results](#) and are summarized below.

Summary of Groundwater Level Observations ¹					
Boring No.	Approximate Boring Depth (feet) ²	Approximate Depth of Groundwater (feet) ²			
		Initial/ During Dry Drilling	After 5 Minutes	After 10 Minutes	After 15 Minutes
B-1	30	20	17	16	16
B-2	30	20	16.5	15½	15
B-3	30	22	18	17	16
B-4	30	20	17	16	16
B-5	30	20	17½	16½	16
B-6	30	20	16	15	15
B-7	30	22	17	16	15
B-8	30	20	14	12	10
B-9	30	20	14½	12½	12½
B-10	15	No free water observed			
B-11	15	15	11	10	9
B-12	15	No free water observed			

1. Groundwater readings were obtained from December 19, 2023 to December 21, 2023.
 2. Below existing grade.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the proposed building additions may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project and should be evaluated prior to construction.

Geotechnical Overview

Based on the information obtained from our subsurface exploration, the site can be developed for the proposed project. A summary of our findings and recommendations is provided below.

- Fill soils were observed at the ground surface at borings B-2 , B-4 through B-6, and B-8 through B-12 and extended to depths that ranged from about 2 to 6 feet. Fill

soils may be present at varying depths and at other locations not explored during our field program. Support of the foundation elements, slabs, flatworks, and pavements on or above fill soils is discussed in this report. However, even with the recommended construction testing services, an inherent risk exists for the owner that compressible fill or unsuitable material within or buried by the fill will not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill.

- Due to the amount of fill observed at this site, the fill soils should be over-excavated and completely removed within the proposed building addition areas to expose the underlying native subsurface soils. Select fill soils should be used to raise grade up in the proposed building addition areas.
- A foundation system consisting of either shallow spread/strip footings or drilled straight shafts may be utilized to support the proposed building additions planned at this site.
- For a grade supported floor slab, a minimum 12-inch thick select fill pad should be placed under the proposed building additions to provide uniform support to the floor slab.
- For a structurally suspended floor slab system at this site, we recommend a 6-inch void space be provided beneath the floor slab and grade beams, and the foundation system be designed to carry additional loads.
- Pavement areas placed upon the deeper fill soils will be subject to future settlement of the fill. Complete excavation, removal, and recompaction of the fill soils in the pavement areas would reduce the potential for future settlement; however, complete excavation and removal of the fill soil within the proposed pavement areas would likely not be feasible. As an alternative, the settlement potential can be reduced by reworking the upper three feet of fill below the pavement areas (or up to the underlying native soils, whichever occurs first) to reduce differential settlements, with the understanding that some settlement (which will likely result in increased maintenance of pavements) will likely occur.
- Flexible pavement sections vary from 2.0 to 2.5 inches of asphaltic concrete over 8.0 to 10.0 inches of base material with chemically treated subgrade.
- Rigid pavement sections vary from 5.0 to 7.0 inches of reinforced concrete with chemically treated subgrade.

This summary should be used in conjunction with the entire report for design purposes. Details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **General Comments** should be read for an understanding of the report limitations.

Earthwork

Earthwork is anticipated to include clearing and grubbing, excavations, and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations, floor slabs, and pavements.

Site Preparation

Construction areas should be stripped of vegetation, topsoil, existing pavements (including crushed stone material) and other debris/unsuitable surface material. Proper site drainage should be maintained during construction so that ponding of surface runoff does not occur and cause construction delays and/or inhibit site access.

Pavement areas placed upon the deeper fill soils, such as observed at boring B-10, will be subject to future settlement of the fill. Complete excavation, removal, and recompaction of the fill soils in the pavement areas would reduce the potential for future settlement; however, complete excavation and removal of the fill soil within the proposed pavement areas would likely not be feasible. As an alternative, the settlement potential can be reduced by reworking the upper three feet of fill below the pavement areas (or up to the underlying native soils, whichever occurs first) to reduce differential settlements, with the understanding that some settlement (which will likely result in increased maintenance of pavements) will likely occur.

Due to the amount of the fill observed at portions of the site, we recommend that the fill soils be over-excavated and completely removed within the proposed building addition areas to expose the underlying native subsurface soils. Select fill soils should be used to raise grade up in the proposed building addition areas.

Once final subgrade elevations have been achieved, the exposed subgrade should be carefully proofrolled with a 20-ton pneumatic roller or equivalent equipment, such as a fully loaded dump truck, to detect weak zones in the subgrade. Special care should be exercised when proofrolling areas containing fill soils in an attempt to observe soft/weak zones within the fill soils. Weak areas detected during proofrolling, as well as zones of fill containing organic matter and/or debris, should be removed and replaced with soils exhibiting similar classification, moisture content, and density as the adjacent in-situ soils. Proofrolling should be performed under the direct observation of the geotechnical engineer or his/her representative.

Removal of existing fill and proofrolling in the building addition areas is not required if a structurally suspended and supported floor slab system is utilized for the proposed building additions.

Subsequent to proofrolling, and just prior to placement of fill, the exposed subgrade within the construction area should be evaluated for moisture and density. If the moisture and/or density do not meet the criteria described in **Fill Compaction Requirements** for on-site soils, the subgrade should be scarified to a minimum depth of 6 inches, moisture adjusted, and compacted to at least 95 percent of the Standard Effort (ASTM D 698) maximum dry density.

Fill Material Types

Select fill and on-site soils to be used at this site for grade adjustments should meet the following criteria:

Fill Type ¹	USCS Classification	Acceptable Location for Placement
Select Fill Soils	CL and/or SC (10 ≤ PI ≤ 20)	Must be used to construct the select fill pad under the grade-supported slabs and for all grade adjustments within the building addition areas.
On-site Soils	Varies	The on-site soils, including the undocumented fill soils, appear suitable for use as fill within the pavement areas, provided they are free of organics and debris.

If blended or mixed soils are intended for use as select fill, Terracon should be contacted to provide additional recommendations. Blended or mixed soils do not occur naturally. These soils are a blend of sand and clay and will require mechanical mixing at the site with a pulvimixer. If these soils are not mixed thoroughly to break down the clay clods and blend-in the sand to produce a uniform soil matrix, the fill material may be detrimental to the performance of the foundations. If blended soils are used, we recommend that additional samples of the blended soils as well as the clay clods, be obtained prior to and during earthwork operations to evaluate if the blended soils can be used in lieu of select fill. The actual type and amount of mechanical mixing at the site will depend on the amount of clay and sand, and properties of the clay.

Fill Compaction Requirements

Item	Description
Fill Lift Thickness	The fill soils should be placed on prepared surfaces in lifts not to exceed 8 inches loose measure, with compacted thickness not to exceed 6 inches.

Item	Description
<p align="center">Compaction Requirements</p>	<p>The select fill and on-site soils should be compacted to at least 95 percent of the Standard Effort (ASTM D 698) maximum dry density and should be moisture adjusted to within 2 percent of the optimum moisture content.</p>

If a structurally suspended and supported floor slab is desired for the proposed building additions, clean on-site soils may be used for grade adjustments under the floor slab. The on-site soils should be compacted to at least 90 to 92 percent of the Standard Effort (ASTM D698) maximum dry density to aid in earth-forming of grade beams, etc. for the structurally suspended floor slab.

Prior to any filling operations, samples of the proposed borrow and on-site materials should be obtained for laboratory moisture-density testing. The tests will provide a basis for evaluation of fill compaction by in-place density testing. A qualified soil technician should perform sufficient in-place density tests during the filling operations to evaluate that proper levels of compaction, including dry unit weight and moisture content, are being attained.

Utility Trench Backfill

Utility trenches are a common source of water infiltration and migration. All utility trenches that penetrate beneath the structure should be effectively sealed to restrict water intrusion and flow through the trenches that could migrate below the building additions. We recommend constructing an effective clay “trench plug” that extends at least 5 feet out from the face of the building exterior. The plug material should consist of clay compacted at a water content at or above the soils optimum water content. The clay fill should be placed to completely surround the utility line and be compacted in accordance with recommendations in this report.

Grading and Drainage

All grades must provide effective drainage away from the building additions during and after construction. Water permitted to pond next to the building additions can result in distress in the building additions. These greater movements can result in unacceptable differential floor slab movements, cracked slabs and walls, and roof leaks. Building slab and foundation performances described in this report are based on effective drainage for the life of the structures and cannot be relied upon if effective drainage is not maintained.

Exposed ground should be sloped away from the building additions for at least 10 feet beyond the perimeter of the building additions. After building construction and landscaping, we recommend verifying final grades to document that effective drainage has

been achieved. Grades around the building additions should also be periodically inspected and adjusted as necessary, as part of the building additions' maintenance program.

Planters located within 10 feet of the proposed building additions should be self-contained to prevent water accessing the building and pavement subgrade soils. Locate sprinkler mains and spray heads a minimum of 5 feet away from the building lines. Low-volume, drip-style landscaped irrigation should not be used near the building additions. Collect roof runoff in drains or gutters. Discharge roof drains and downspouts onto pavements and/or flatworks which slope away from the proposed building additions or extend down spouts a minimum of 10 feet away from building additions.

Flatworks and pavements will be subject to post construction movement. Maximum grades practical should be used for paving and flatwork to prevent water from ponding. Allowances in final grades should also consider post-construction movement of flatwork, particularly if such movement would be critical. Where paving or flatwork abuts the building, effectively seal and maintain joints to prevent surface water infiltration.

Wet Weather/Soft Subgrade Considerations

Construction operations may encounter difficulties due to wet or soft surface soils becoming a general hindrance to equipment, especially following periods of wet weather. If the subgrade cannot be adequately compacted to the minimum densities as described previously, one of the following measures will be required: 1) removal and replacement with select fill, 2) chemical treatment of the soil to dry and improve the condition of the subgrade, or 3) drying by natural means if the schedule allows. Based on our experience with similar soils in this area, chemical treatment is generally an efficient and effective method to improve the condition of wet and weak subgrade. Terracon should be contacted for additional recommendations if chemical treatment is planned to be utilized due to soft and wet subgrade.

Foundation Systems

Based on the subsurface conditions observed during our field and laboratory programs, a foundation system consisting of either shallow spread/strip footings or drilled straight shafts may be utilized to support the proposed building additions planned at this site, provided the subgrade is properly prepared as described in this report. Recommendations for these types of foundation systems are provided in the following sections, along with other geotechnical considerations for this project.

Design Recommendations – Shallow Spread/Strip Footings

Item	Description
Minimum Embedment Depth ¹	6 feet below existing grade (grade at the time of our field program)
Allowable Bearing Pressures (Individual Footings) ²	Net dead plus sustained live load – 1,500 psf Net total load – 2,300 psf
Allowable Bearing Pressure (Strip Footing) ³	Net dead plus sustained live load – 1,200 psf Net total load – 1,900 psf
Approximate Post-Construction Settlement ⁴	Approximately one inch
Estimated Post-Construction Differential Settlement ⁵	Approximately ½ of post-construction settlement
Allowable Passive Pressure ⁶	500 psf
Allowable Frictional Resistance ⁷	250 psf
Uplift Resistance ⁸	Foundation Weight (150 pcf) & Soil Weight (120 pcf)

1. The footings should bear upon undisturbed clay soils
1. Whichever condition yields a larger bearing area.
2. Defined as a footing at least twice as long as it is wide.
3. This estimated post-construction settlement of the shallow footings is without considering the effect of stress distribution from adjacent foundations and assuming proper construction practices are followed. A clear distance between footings of one footing size of the larger of the two footings should not produce overlapping stress distributions and would essentially behave as independent foundations.
4. The post-construction differential settlements may result from variances in subsurface conditions, loading conditions, and construction procedures. The settlement response of the footings will be more dependent upon the quality of construction than upon the response of the subgrade to the foundation loads.
5. The passive pressure along the exterior face of the footings should be neglected within the upper 4 feet due to surface effects and the presence of fill unless pavement is provided up to the edge of the structures. For interior footings, the allowable passive pressure may be used for the entire depth of the footing.
6. To be utilized on the base of the footings.
7. Structural uplift loads on the shallow footings may be resisted by the weight of the foundation plus the weight of any soil directly above the foundation. The ultimate uplift capacity of shallow footings should be reduced by an appropriate factor of safety to compute allowable uplift capacity.

Construction Considerations – Shallow Spread/Strip Footings

Excavations for shallow footings should be performed with equipment capable of providing a relatively clean bearing area. The bottom 6 inches of the foundation excavations should be completed with a smooth-mouthed bucket or by hand labor. The excavations should be neatly excavated and properly formed. Debris in the bottom of the excavation should be removed prior to steel placement. Based on the groundwater observations obtained during our field program (refer to **Groundwater Conditions**), significant groundwater seepage is not anticipated for shallow footings at the recommended bearing depth. However, water should not be allowed to accumulate at the bottom of the foundation excavations. To reduce the potential for groundwater seepage into the excavations and to minimize disturbance to the bearing area, we recommend that concrete and steel be placed as soon as possible after the excavations are completed. Excavations should not be left open overnight. The bearing surface of the shallow footings should be evaluated immediately prior to placing concrete or a seal slab.

A thin seal slab of lean concrete (approximately 2 to 4 inches thick) should be placed at the bottom of the footing excavation to protect the bearing surface of the footings from disturbance and/or infiltration of ground/surface water if the footing cannot be poured within the same day of excavation.

Design Recommendations – Drilled Straight Shaft Foundations

Allowable skin friction and end bearing values for drilled straight-shaft footings are presented in the following table. These design parameters were computed based on a generalized soil profile and engineering properties of the subsurface soils observed within the depths explored at this site.

Design Parameters for Drilled Straight Shaft Footings		
Below Existing Grade (feet) ¹	Allowable Unit Skin Friction Resistance (psf)	Allowable End Bearing Pressure (psf)
0 to 4	Disregard	Disregard
4 to 8	200	Disregard
8 to 18	275	3,000
18 to 30	400	4,500

1. Grade at the time of our field program.

A minimum penetration of 2 feet into the desired bearing strata with a minimum of 4 feet of the selected bearing stratum below the bottom of the shaft is required to achieve the recommended allowable end bearing values provided in the above table. The drilled straight-shaft foundations should extend through any fill soils and be placed to bear within

the native clay soils. Design of drilled straight shafts should also include an evaluation of the structural capacity of the foundation element which may limit the allowable capacity.

There are numerous factors which contribute to the behavior of groups subjected to axial load. Several of these factors are foundation type, size and length, spacing, overall group size, loading conditions, installation procedures and soil type and strength. We recommend a minimum spacing of three diameters, center-to-center, for shafts or piles placed in groups beneath square or rectangular caps. However, for shafts or piles placed in a linear pattern beneath load bearing walls, a minimum spacing of two diameters, center-to-center, would generally be acceptable. Closer spacing than three diameters in groups or two diameters in rows could result in increased group settlement and a reduction of load-carrying capacity of individual foundation elements.

Settlement of a single, isolated shaft will depend on the elastic properties of the foundation, the applied load, and the interaction of the soil and foundation. Settlement is anticipated to be primarily elastic and will occur relatively soon as load is applied. Significant consolidation settlement due to applied load is not anticipated for the allowable capacities. Our experience indicates that a single, isolated foundation loaded to about one-half of its ultimate capacity will result in settlements of about one inch or less. Groups generally undergo more settlement than single, isolated foundation elements for the same applied load. Based on the above recommended spacing, we anticipate that settlement of a group will be on the order of one inch under working loads with differential settlement between foundations to be about one-half inch.

The drilled straight-shaft foundations will provide resistance to lateral loads through the passive earth pressure acting on the side of the foundation. A detailed lateral load analysis of the proposed straight-shaft footings was beyond the scope of this project. If requested, a detailed lateral load analysis of the proposed drilled straight-shaft foundations can be performed by Terracon. Lateral loads should not exceed the structural capacity of the individual drilled straight-shaft.

Drilled straight-shaft foundations will provide resistance to structural uplift loads through the mobilization of the skin friction acting at the interface of the shaft sidewall and the adjacent soils. The allowable skin friction values provided in the previous table may be used to calculate the uplift resistance for the shafts.

Construction Considerations – Drilled Straight Shafts

The drilling contractor should be experienced in the subsurface conditions observed at the site, and the excavations should be performed with equipment capable of providing a clean bearing area. The drilled straight-shaft foundation should be installed in general accordance with the procedures presented in "Drilled Shafts: Construction Procedures and LRFD Design Methods," by Brown, D.A., Turner, J.P., and Castelli, R.J., FHA Publication

No. FHWA-NHI-10-016, 2010 and "Standard Specification for the Construction of Drilled Piers", ACI Publication No. 336.1-01, 2001.

The successful completion of the drilled straight-shaft will depend to a large extent on the suitability of the equipment and the operator's skills. The operation sequence should be scheduled so that the shaft excavation can be completed, reinforcing steel placed, and the concrete poured in a continuous, rapid, and orderly manner to minimize the time the excavation is open. Concrete should be placed as soon as practical and in all instances should be placed within the same day in order to use the side friction values recommended in this letter report.

Based on the subsurface conditions observed, the installation of drilled straight shafts will likely require the use of the Slurry Displacement Method and/or temporary steel casing due to the presence of sandier/siltier zones. If drilled shaft installation is attempted without utilizing Slurry Displacement Method or temporary casing, zones of sloughing soils and/or groundwater inflow may occur during construction. Therefore, we recommend that provisions be incorporated into the plans and specifications to utilize slurry or casing to control sloughing and/or groundwater seepage during shaft construction.

The need for casing or slurry will depend on the depth of the drilled shaft and the groundwater conditions at the time of construction. If casing is used and seepage persists, the water accumulating in the foundation excavation should be pumped out. The condition of the bearing surface should be evaluated immediately prior to placing concrete, if casing is used in lieu of slurry. If groundwater inflow is too severe to be controlled by the use of casing and pumping or significant sloughing of the sidewalls occurs, the slurry method of construction should be utilized to complete the foundation installation.

Where casing is used, removal of the casing should be performed with extreme care and under proper supervision to minimize mixing of the surrounding soil and water with the fresh concrete. Rapid withdrawal of the casing may develop a suction that could cause the soil and water to flow into the excavation. An insufficient head of concrete in the casing during withdrawal could also allow the water to intrude into the wet concrete. Under no circumstances should loose soil be placed in the annulus between the casing and the drilled shaft sidewalls. The casing must be removed in order to utilize the skin friction values previously provided.

During slurry displacement, the foundation excavation is filled with a slurry mixture. The level of slurry should be maintained above the groundwater level to maintain a positive head in the foundation excavation. Therefore, the slurry tends to seep out of the excavation, rather than the groundwater seeping into the open excavation. The slurry must be maintained in the foundation excavation until design termination depth is achieved and should be removed only as concreting proceeds. The properties of the slurry including the density, viscosity, and pH must be carefully controlled and should be in

accordance with Item 416 of Texas Department of Transportation (TXDOT) Standard Specifications for Construction of Highways, Streets, and Bridges.

Slurry left in place for long periods of time will build up on the sides of the shaft causing a reduction in skin friction.

The following procedures and equipment are recommended for installation of drilled shafts by the Slurry Displacement Method:

- The bottom of the drilled straight-shaft should be cleaned as well as practical just prior to concreting to remove cuttings.
- The concrete should be placed by means of a tremie with a one-way valve to prevent slurry from entering the pipe. The tremie should extend to the bottom of the drilled shaft to allow displacement of the slurry during concrete placement.
- During concrete placement, the end of the tremie should remain several feet within the concrete mass to reduce the entrapment of slurry. A tremie embedment of 5 to 10 feet is generally considered acceptable.
- The concrete should be relatively fluid to reduce the entrapment of slurry. We recommend that concrete with a slump of 6 to 8 inches be used.
- The upper few feet of concrete should be expunged from the shaft excavation if found to be contaminated with slurry or soil.

A surface casing may be required in addition to the slurry for shaft installation at this site if sloughing of near surface soils occurs. Where casing is used, removal of the casing should be performed with extreme care as previously discussed in this section.

Production shaft installation should be observed by a qualified technician experienced in drilled shaft installation techniques. At a minimum, the technician should observe shaft excavation, note any unusual installation occurrences, observe slurry properties and/or casing installation and removal, observe concrete placement and generally evaluate if shaft installation is being performed in accordance with project specifications.

Foundation Construction Monitoring

The performance of the foundation system for the proposed building additions will be highly dependent upon the quality of construction. Thus, we recommend that fill pad compaction and foundation installation be observed full time by an experienced Terracon soil technician under the direction of our geotechnical engineer. During foundation installation, the base of the footing excavations should be observed to evaluate the condition of the subgrade. We would be pleased to develop a plan for compaction and

foundation installation observation to be incorporated in the overall quality control program.

Connection of Building Addition to Existing Building

Based on the information provided to us, we understand that the new building additions are planned to be built immediately adjacent and connected to the existing building. Due to the independence of the existing and proposed foundations systems, differential movements may occur between the foundation systems. The magnitude of the differential movement will be primarily dependent upon the stability of the moisture content of the near-surface soils, the quality of foundation construction and subgrade preparation utilized for the building addition, and the performance of the foundation system of the existing structure. Therefore, any members or connections of the new building addition which are common to the adjacent existing structure should be designed such that they are tolerant to differential movements whenever possible.

Floor Slabs

Planned finished grades for the proposed building additions were not available at the time of this report. We anticipate that the finished floor elevation of the proposed building additions are planned to be within about one foot above existing grade and to match the finished floor elevation of the existing building. If the grading is planned to be altered from what has been previously described, Terracon should be notified to review and/or modify our recommendations given in this subsection.

The near surface soils observed within the area of the proposed buildings generally exhibit a low to medium expansion potential. Based on the information developed from our field and laboratory programs and on method TEX-124-E in the Texas Department of Transportation (TxDOT) Manual of Testing Procedures, we estimate that the subgrade soils at this site exhibit a Potential Vertical Rise (PVR) of up to approximately one inch.

Grade-Supported Floor Slab System

Due to the amount of the fill observed at portions of the site, we recommend that the fill soils be over-excavated and completely removed within the proposed building addition areas to expose the underlying native subsurface soils. Select fill soils should be used to raise grade up in the proposed building addition areas.

To provide uniform support to the floor slabs, we recommend that a minimum 12 inches of properly placed and compacted select fill material be constructed immediately beneath the floor slabs. The building pad should extend a minimum of 3 feet beyond the edge of the proposed building areas. The overbuild requirement may be omitted where the building

addition is located immediately adjacent to the existing building addition. The final exterior grade adjacent to the structures should be sloped to promote effective drainage away from the building.

Select fill should be utilized for all grade adjustments within the proposed building addition areas. The subgrade and select fill soils should be prepared as outlined in the **Earthwork** section of this report, which contains material and placement requirements for select fill, as well as other subgrade preparation recommendations.

Structurally Suspended Floor Slab System

As stated previously, we understand that a structurally suspended and supported floor slab system is being considered for this project. If a structurally suspended floor slab system at this site is desired, we recommend a minimum 6-inch void space be provided beneath the floor slab and grade beams and that the drilled footing foundation system be designed to carry the additional loads.

We also recommend that measures be taken to reduce the possibility of water accumulation in the void space areas below the floor slab and grade beams. In addition, proper ventilation should be provided to minimize the possibility that a high humidity environment could develop in the void space areas.

Proper construction of void space and soils retainers is very important. If a cardboard carton system is used on this project, we recommend that the carton form supplier provide, during initial concrete operations, a representative to instruct the work force on the proper installation methods for both the form and the concrete.

Pavements

Once the subgrade is properly prepared, both flexible pavement systems (consisting of asphaltic concrete and base material) and rigid pavement systems may be considered for this project. Detailed traffic loads and frequencies were not available. However, we anticipate that traffic will consist primarily of passenger vehicles in the parking areas and passenger vehicles combined with garbage trucks and large multi-axle delivery trucks from time-to-time in driveway areas.

Tabulated in the following table are the assumed traffic frequencies and loads used to design pavement sections for this project. When actual traffic conditions have been determined Terracon should be contacted to review the information to consider a need for revision of the pavement designs and related recommendations.

Pavement Area	Traffic Design Index ¹	Description
Automobile Parking Areas	DI-1	Light traffic (Few vehicles heavier than passenger cars, no regular use by heavily loaded two axle trucks/buses.) (EAL ² < 6)
Driveways (Light Duty)	DI-2	Medium to light traffic (Similar to DI-1 including not over 50 loaded two axle trucks/buses or lightly loaded larger vehicles per day. No regular use by heavily loaded trucks with three or more axles.) (EAL = 6-20)
Driveways and Truck Traffic Areas (Medium Duty)	DI-3	Medium traffic (Including not over 300 heavily loaded two axle trucks/buses plus lightly loaded trucks with three or more axles and no more than 30 heavily loaded trucks with more than three axles per day.) (EAL = 21-75)

1. Based on NSSGA traffic design indices.
2. Equivalent daily 18-kip single-axle load applications.

The top 6 inches of the finished subgrade soils directly beneath the pavements be chemically treated with lime or a mixture of lime-flyash. The decision about the type and proper amount of additive should be made after the subgrade is open for inspection. Chemical treatment will increase the supporting value of the subgrade and decrease the effect of moisture on subgrade soils. These 6 inches of treatment is a required part of the pavement design and is not a part of the site and subgrade preparation for wet/soft subgrade conditions.

Listed below are pavement component thicknesses, which may be used as a guide for pavement systems at the site for the traffic classifications stated herein. These systems were derived based on general characterization of the subgrade. Specific testing (such as CBR's, resilient modulus tests, etc.) was not performed for this project to evaluate the support characteristics of the subgrade.

Flexible Pavement System		
Component	Material Thickness, Inches	
	DI-1	DI-2
Asphaltic concrete	2.0	2.5
Base material	8.0	10.0

Flexible Pavement System		
Component	Material Thickness, Inches	
	DI-1	DI-2
Treated subgrade	6.0	6.0

Rigid Pavement System			
Component	Material Thickness, Inches		
	DI-1	DI-2	DI-3
Reinforced concrete	5.0	6.0	7.0
Treated subgrade	6.0	6.0	6.0

Waste dumpster areas should be constructed of at least 7 inches of reinforced concrete pavement. The concrete pad areas should be designed so that the vehicle wheels of the collection truck are supported on the concrete while the dumpster is being lifted to support the large wheel loading imposed during waste collection.

Presented below are our recommended material requirements for the various pavement sections.

Reinforced Concrete Pavement – The materials and properties of reinforced concrete pavement should meet applicable requirements in the ACI Manual of Concrete Practice. The portland cement concrete mix should have a minimum 28-day compressive strength of 3,500 psi.

If river gravel is planned to be utilized in the portland cement concrete mix, Terracon should be contacted for additional services. The presence of river gravel in the portland cement concrete mix can result in excessive cracking and distress to the concrete pavement as a result of differing thermal expansion properties between the river gravel and cement paste. Special care should be taken in developing the project’s portland cement concrete mix design, joint layout, and placement to help reduce the potential for excessive cracking and distress if river gravel is planned to be utilized for the project.

Reinforcing Steel – ACI recommendations indicate that distributed steel reinforcement is not necessary when the pavement is properly jointed to form short panel lengths that will help reduce intermediate cracking. Provided the concrete pavement is designed and constructed as stated herein, the installation of reinforcing steel is optional and should be

evaluated by the design team. Proper layout and installation of the joints within the pavement is critical to help control intermediate cracking.

If reinforcing steel is planned to be utilized in the concrete pavement by the design team, the following amount of reinforcing steel should be used as a guideline:

DI-1: #3 bars spaced at 18 inches or #4 bars spaced at 24 inches on centers in both directions.

DI-2: #3 bars spaced at 12 inches or #4 bars spaced at 18 inches on centers in both directions.

DI-3: #4 bars spaced at 18 inches on centers in both directions.

Control Joint Spacing – ACI recommendations indicate that control joints should be spaced at a maximum spacing of 30 times the thickness of the pavement for unreinforced parking lot pavements. Furthermore, ACI recommends a maximum control joint spacing of 12.5 feet for 5-inch pavements and a maximum control joint spacing of 15 feet for 6-inch or thicker pavements. Sawcut control joints should be cut within 4 to 12 hours of concrete placement to help control the formation of plastic shrinkage cracks as the concrete cures. The depth of the joint should be at least one-quarter of the slab depth when using a conventional saw or one inch when using early entry saws. The width of the cut should be in accordance with the joint sealant manufacturer recommendations.

Expansion Joint Spacing – ACI recommendations indicate that regularly spaced expansion joints may be deleted from concrete pavements. Therefore, the installation of expansion joints is optional and should be evaluated by the design team.

Construction Joints – When concrete is planned to be placed at different times, we recommend the use of a construction joint between paving areas. The construction joint should consist of a butt joint (not a keyway joint).

Concrete Curing Compound – A concrete curing compound, such as a Type 2 membrane curing compound conforming to TxDOT DMS-4650, “Hydraulic Cement Concrete Curing Materials and Evaporation Retardants” or equivalent, should be applied to the concrete surface immediately after placement of the concrete in accordance with TxDOT 2014 Standard Specifications Item 360.

Dowels at Expansion/Construction Joints – The smooth dowels at expansion/construction joints should be spaced at 12-inch centers and consist of the following:

DI-1: 5/8-inch diameter, 12-inches long with 5-inch embedment.

DI-2: 3/4-inch diameter, 14-inches long with 6-inch embedment.

DI-3: 7/8-inch diameter, 14-inches long with 6-inch embedment.

One end of the dowels should either be greased or sleeved to allow for lateral movement to occur.

Hot Mix Asphaltic Concrete Surface Course – The asphaltic concrete surface course should be plant mixed, hot laid Type D (Fine Graded Surface Course) meeting the requirements in TxDOT 2014 Standard Specifications Item 340. Specific criteria for the job specifications should include compaction to within an air void range of 3.8 to 8.5 percent calculated using the maximum theoretical specific gravity of the mix measured by TxDOT Tex-227-F. The asphalt cement content by percent of total mixture weight should be within ± 0.5 percent asphalt cement from the job mix design.

Base Material – Base material should be composed of crushed limestone or crushed concrete meeting the requirements of TxDOT 2014 Standard Specifications Item 247, Type A or D, Grade 1 or 2. The base material should be compacted to at least 95 percent of the Modified Effort (ASTM D1557) maximum dry density at moisture content within 2 percent of the optimum moisture content.

Lime-Flyash Treated Subgrade – The low to medium plasticity clay soils ($PI < 15$) should be treated with lime-flyash in accordance with TxDOT 2014 Standard Specifications Item 265. Based on the classification test results, we recommend about 2 to 3 percent lime and 7 to 8 percent flyash by dry weight be used for estimating and planning. The percentages are given as application by dry weight and are typically equivalent to about 10 to 15 pounds of lime and 35 to 40 pounds of flyash per square yard per 6-inch depth. Lime-flyash is also available pre-mixed, typically in percentages of 20 to 30 percent lime and 70 to 80 percent flyash. These pre-mixed products may be used if preferred at a rate of 50 pounds per square yard per 6-inch depth. The actual quantity of lime-flyash should be determined at the time of construction based on laboratory testing conducted using bulk samples of the subgrade soils. The subgrade should be compacted to at least 95 percent of the Standard Effort (ASTM D 698) maximum dry density at a moisture content within 2 percent of the optimum moisture content.

Lime Treated Subgrade – The medium to high plasticity clay fill soils ($PI \geq 15$) should be treated with lime in accordance with the TxDOT 2014 Standard Specifications Item 260. The amount of lime should be determined for subgrade soils by conducting laboratory tests just prior to construction. Based on the classification test results, we recommend that about 5 to 7 percent lime by dry weight be used for estimating and planning. The percentages are given as application by dry weight and are typically equivalent to about 25 to 35 pounds of lime per square yard per 6-inch depth. The actual quantity of lime should be determined at the time of construction based on lime determination tests conducted using bulk samples of the subgrade soils. The pulverization, mixing and curing of the lime treated subgrade is of particular importance in these clays. The subgrade should be compacted to a minimum of 95 percent of the Standard Effort (ASTM D 698) maximum dry density at a moisture content between optimum and 4 percent wet of the optimum moisture content.

Preferably, traffic should be kept off the treated subgrade for 7 days to facilitate curing of the soil-chemical mixture. In addition, the subgrade is not suitable for heavy construction traffic prior to paving.

Post-construction subgrade movements and some cracking of pavements are not uncommon for clay subgrade conditions such as those observed at this site. Although chemical treatment will help to reduce such movement/cracking, this movement/cracking cannot be feasibly eliminated.

Related civil design factors such as subgrade drainage, shoulder support, cross-sectional configurations, surface elevations and environmental factors which will significantly affect the service life must be included in the preparation of the construction drawings and specifications. Normal periodic maintenance will be required.

Long-term pavement performance will be dependent upon several factors, including maintaining subgrade moisture levels and providing for preventative maintenance. The following recommendations should be implemented to help promote long-term pavement performance:

- The subgrade and the pavement surface should be designed to promote proper surface drainage, preferably at a minimum grade of 2 percent;
- Install joint sealant and seal cracks immediately;
- Extend curbs into the treated subgrade for a depth of at least 4 inches to help reduce moisture migration into the subgrade soils beneath the pavement section; and
- Place compacted, low permeability clayey backfill against the exterior side of the curb and gutter.

Preventative maintenance should be planned and provided for the pavements at this site. Preventative maintenance activities are intended to slow the rate of pavement deterioration, and consist of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Prior to implementing any maintenance, additional engineering observations are recommended to determine the type and extent of preventative maintenance.

General Comments

Our work is conducted with the understanding of the project as described in the proposal and incorporates collaboration with the design team as we completed our services to verify assumptions. Revision of our understanding to reflect actual conditions important to our work was based on these verifications and it is reflected in this report. The design team

should collaborate with Terracon to confirm these assumptions and to prepare the final design plans and specifications. This facilitates the incorporation of our opinions related to implementation of our geotechnical recommendations. Any information conveyed prior to the final report is for informational purposes only and should not be considered or used for decision-making purposes.

Our analysis and opinions are based upon our understanding of the geotechnical conditions in the area, the data obtained from our site exploration and from our understanding of the project. Variations will occur between exploration point locations, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in the final report, to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other services should be undertaken.

Our services and any correspondence are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third party beneficiaries intended. Any third party access to services or correspondence is solely for information purposes only. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing.

Geotechnical Engineering Report

Humble ISD Humble High School Building Additions | Humble, Texas
January 24, 2024 | Terracon Project No. 92235614

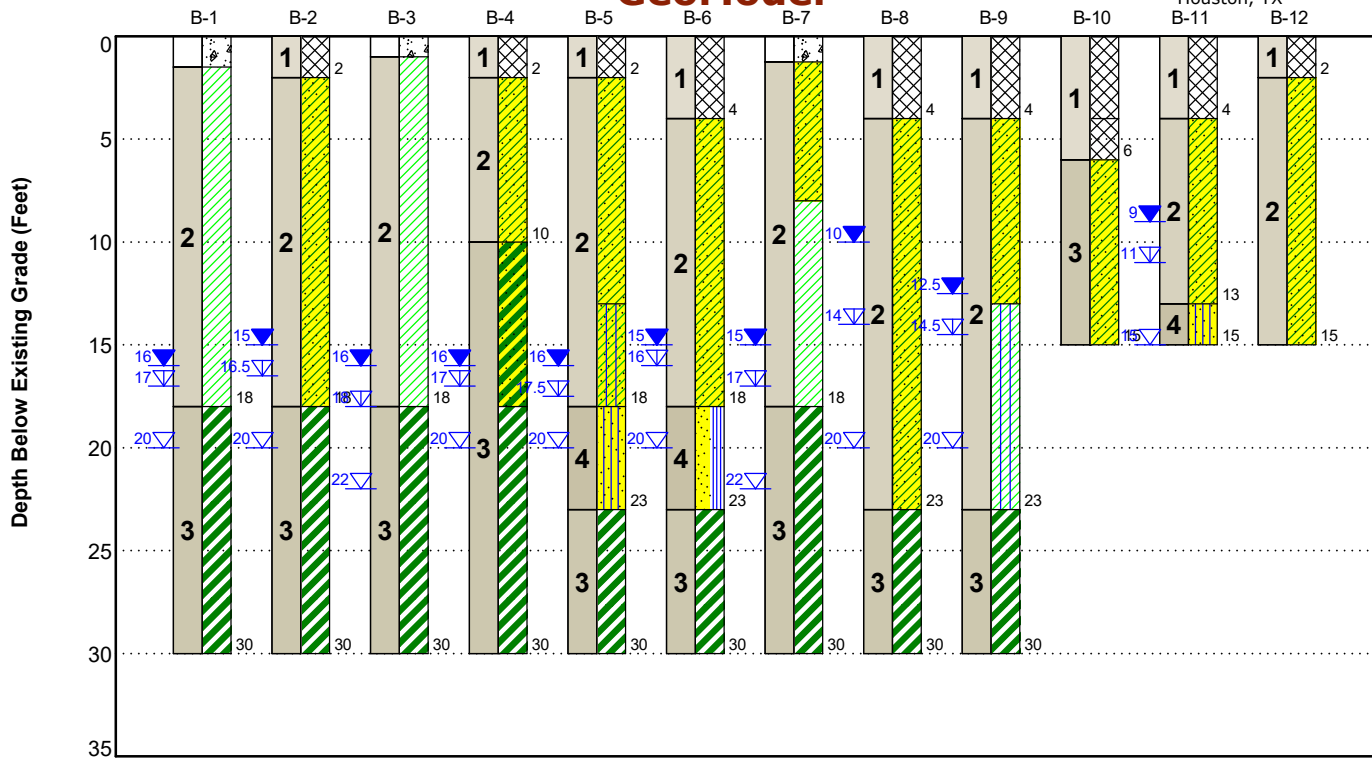


Figures

Contents:

GeoModel

GeoModel



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Fill: Sandy Lean Clay and Fat Clay	dark gray, with sand pockets, scattered roots and gravel, and ferrous stains
2	Sandy Silty Clay, Lean Clay, and Sandy Lean Clay	gray, tan, and reddish brown, very soft to very stiff, with sand pockets, calcareous nodules, and ferrous stains
3	Fat Clay and Sandy Fat Clay	reddish brown and light gray, medium stiff to very stiff, with sand pockets, calcareous nodules, ferrous stains, and slickensides
4	Silty Sand and Poorly Graded Sand with Silt	light gray and tan, medium dense to very dense, with clay pockets

LEGEND

- Pavement
- Fill
- Sandy Silty Clay
- Silty Clay
- Lean Clay
- Sandy Lean Clay
- Silty Sand
- Fat Clay
- Sandy Fat Clay
- Poorly-graded Sand with Silt

- First Water Observation
- Second Water Observation
- Third Water Observation

The groundwater levels shown are representative of the date and time of our exploration. Significant changes are possible over time. Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:

Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

Geotechnical Engineering Report

Humble ISD Humble High School Building Additions | Humble, Texas

January 24, 2024 | Terracon Project No. 92235614



Attachments

Exploration and Testing Procedures

Field Exploration

Number of Borings	Approximate Boring Depth (feet) ¹	Location
9 (B-1 through B-9)	30	Building addition areas
3 (B-10 through B-12)	15	Parking and driveway areas

1. Below existing grade.

Boring Layout and Elevations: We used handheld Global Positioning System (GPS) equipment to locate the approximate latitude and longitude of the borings with an accuracy of +/-25 feet. The boring depths were measured from the existing ground surface at the time of our field activities.

Subsurface Exploration Procedures: We advanced soil borings with an all-terrain vehicle (ATV) mounted drill rig using solid stem continuous flight augers. Samples were obtained at 2-foot intervals in the upper 12 feet of each boring and at intervals of 5 feet thereafter. Soil sampling was typically performed using open-tube and/or split-barrel sampling procedures.

Cohesive soil samples were generally recovered using open-tube samplers. Hand penetrometer tests were performed on samples of cohesive soils in the field to serve as a general measure of consistency.

Granular soils and soils for which good quality open-tube samples could not be recovered were sampled by means of the Standard Penetration Test (SPT). This test consists of measuring the number of blows (N) required for a 140-pound hammer free falling 30 inches to drive a standard split-spoon sampler 12 inches into the subsurface material after being seated six inches. This blow count or SPT "N" value is used to evaluate the stratum. A conventional safety hammer operated with a cathead and rope was used in advancing the split-spoon sampler.

The samples were placed in appropriate containers, taken to our soil laboratory for testing, and classified by a geotechnical engineer. In addition, we observed and recorded groundwater levels during drilling and sampling.

Our exploration team prepared field boring logs as part of standard drilling operations including sampling depths, penetration distances, and other relevant sampling information. Field logs include visual classifications of materials observed during drilling, and our interpretation of subsurface conditions between samples. Final boring logs, prepared from field logs, represent an interpretation of the field logs by a geotechnical engineer and include modifications based on laboratory observation and tests on select samples.

Property Disturbance: We cored through the existing pavement in order to access the underlying subgrade soils, as applicable. We backfilled the boring with auger cuttings and patched at the surface with concrete, where appropriate, upon completion. Excess auger cuttings were dispersed in the general vicinity of the boring. Our services do not include repair of the site beyond backfilling our borings, and cold patching the existing pavements. Because backfill material often settles below the surface after a period, we recommend borings be periodically checked and backfilled, if necessary. We can provide this service for additional fees at your request.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil strata, as necessary, for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods were applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D7263 Standard Test Methods for Laboratory Determination of Density (Unit Weight) of Soil Specimens
- ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D1140 Standard Test Method for Determining the Amount of Materials Finer than No. 200 Sieve in Soils by Washing
- ASTM D2166/D2166M Standard Test Method for Unconfined Compressive Strength of Cohesive Soil

The laboratory testing program included observation of soil samples by an engineer. Based on the results of our field and laboratory programs, we described and classified the soil samples in accordance with the Unified Soil Classification System (USCS).

Samples not tested in the laboratory will be stored for a period of 30 days subsequent to submittal of this report and will be discarded after this period, unless we are notified otherwise.

Geotechnical Engineering Report

Humble ISD Humble High School Building Additions | Humble, Texas
January 24, 2024 | Terracon Project No. 92235614



Site Location and Exploration Plans

Contents:

Site Location Plan
Exploration Plan

Note: All attachments are one page unless noted above.

Site Location

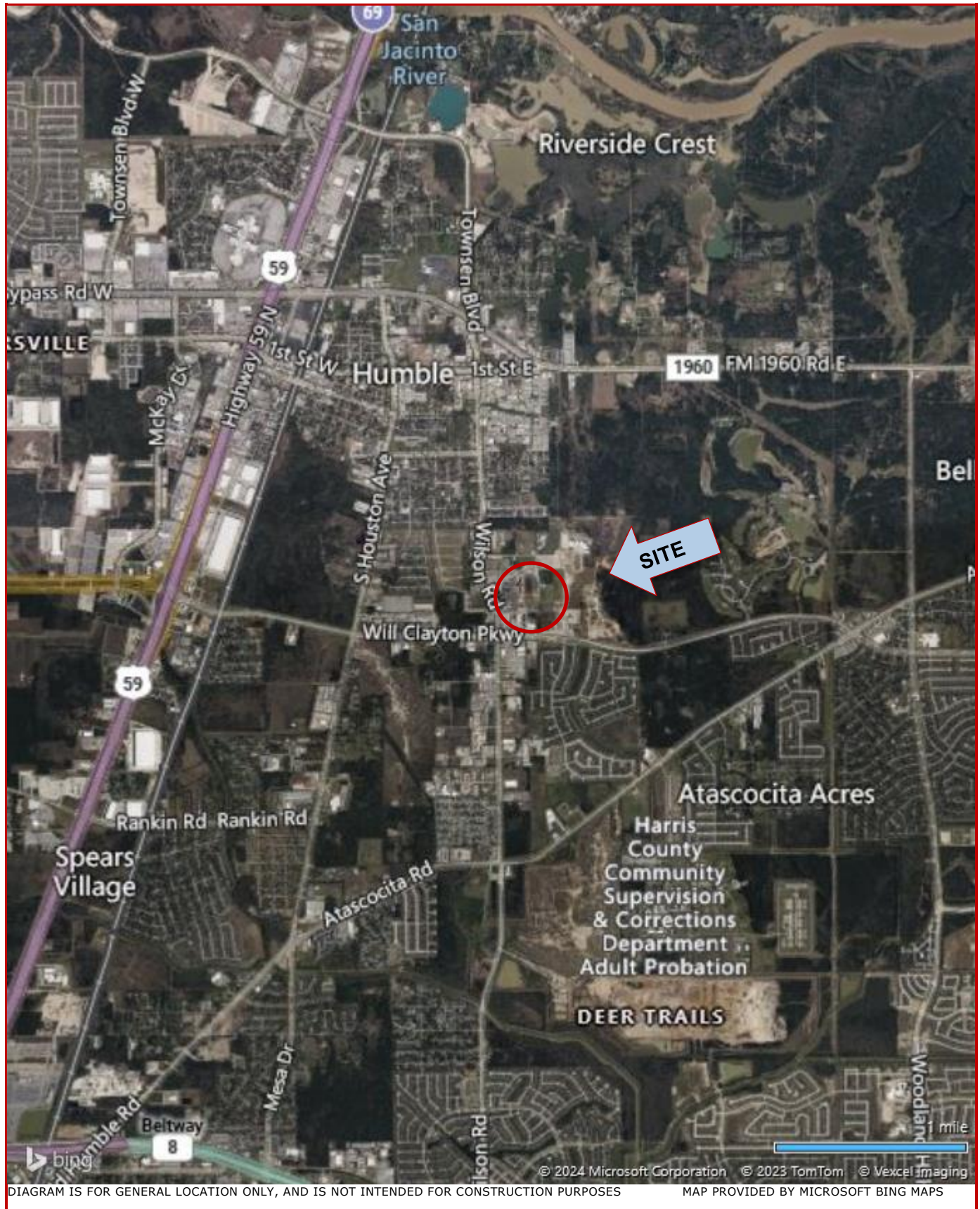


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

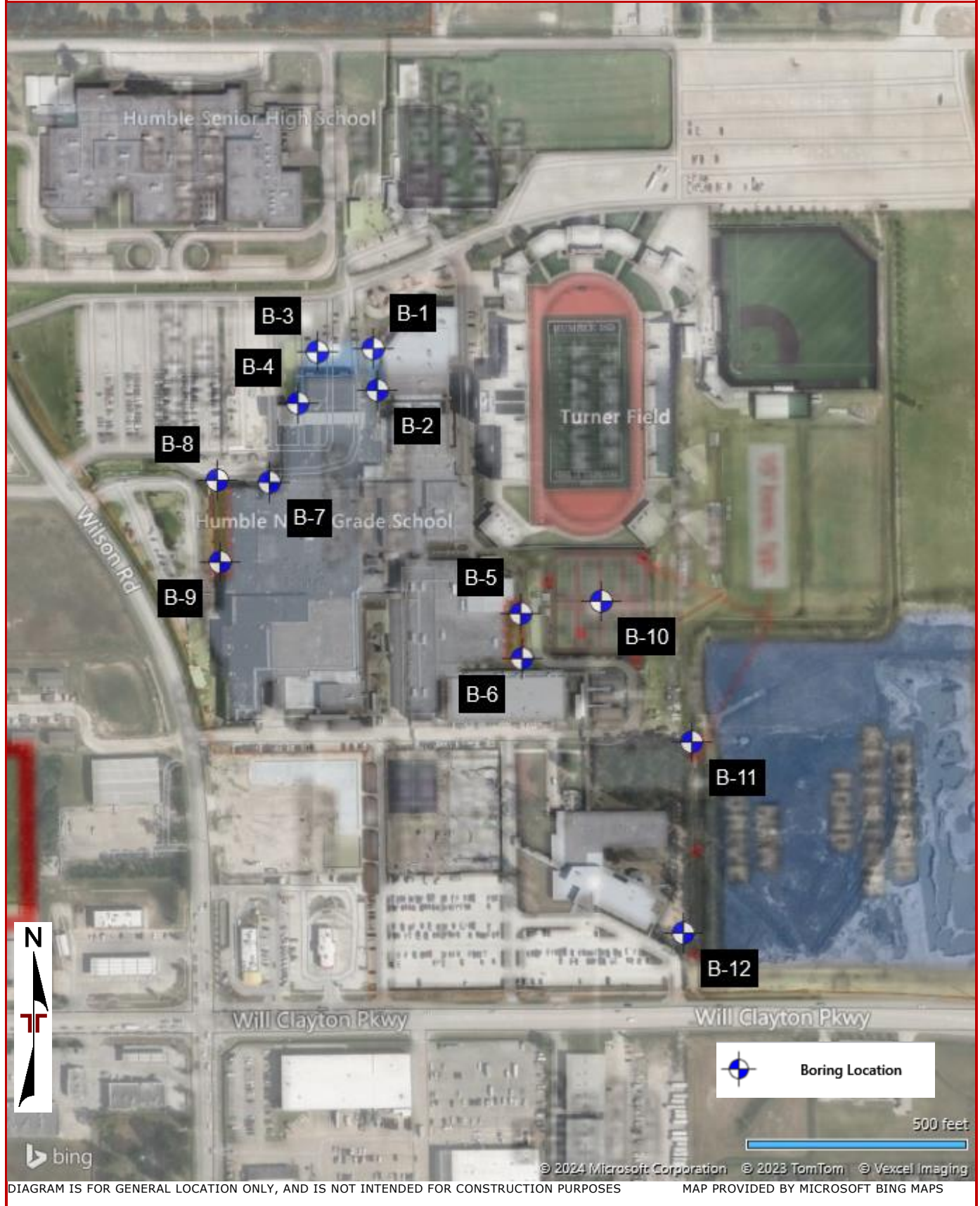
Geotechnical Engineering Report

Humble ISD Humble High School Building Additions | Humble, Texas

January 24, 2024 | Terracon Project No. 92235614



Exploration Plan



Exploration and Laboratory Results

Contents:

Boring Logs (B-1 through B-12)

Note: All attachments are one page unless noted above.

Boring Log No. B-1

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 29.9833° Longitude: -95.2472° Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test			Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
							Test Type	Compressive Strength (tsf)	Strain (%)				
	1.5	PAVEMENT , Approximately 16 inches of concrete overlying about 2 inches of crushed stone material											
2	18.0	LEAN CLAY (CL) , dark gray, medium stiff to very stiff, with sand pockets - gray and tan 2 to 4 feet - light gray and tan 4 to 18 feet				2.0 (HP)			14.5		26-15-11		
						1.5 (HP)	UC	1.45	15	17.6	111		
			5			2.5 (HP)				15.0		31-14-17	
						1.5 (HP)							
						2.25 (HP)							
			10			1.5 (HP)	UC	2.00	8.5	19.3	113		87
3	30.0	FAT CLAY (CH) , reddish brown and light gray, stiff to very stiff, with ferrous stains				2.25 (HP)							
						2.0 (HP)							
			15			3.25 (HP)	UC	1.98	14.1	18.2	110		
			2.25 (HP)										
		Boring Terminated at 30 Feet	30										

<p>See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any). See Supporting Information for explanation of symbols and abbreviations.</p>	<p>Water Level Observations</p> <ul style="list-style-type: none"> While drilling After 5 minutes After 15 minutes 	<p>Drill Rig ATV</p>
<p>Notes</p>	<p>Advancement Method Dry augered to 30 feet.</p> <p>Abandonment Method Boring backfilled with auger cuttings and patched with ready-mix concrete upon completion.</p>	<p>Driller DAS</p> <p>Logged by H. Zamudio</p> <p>Boring Started 12-19-2023</p> <p>Boring Completed 12-19-2023</p>

Boring Log No. B-2

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 29.9831° Longitude: -95.2472° Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test			Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
							Test Type	Compressive Strength (tsf)	Strain (%)				
1		FILL - SANDY LEAN CLAY (CL) , dark gray, with scattered roots	2.0			4.5 (HP)							
2		SANDY LEAN CLAY (CL) , dark gray, medium stiff, very stiff, with sand pockets - light gray and tan 6 to 18 feet	5			0.75 (HP)			14.4		25-15-10		
			5			0.75 (HP)							
			10			1.0 (HP)			18.2		35-15-20		
			10			1.25 (HP)							
			10			3.0 (HP)	UC	3.67	15	14.8	118		
			15			3.0 (HP)							
3		FAT CLAY (CH) , reddish brown and light gray, stiff to very stiff, with calcareous nodules - with ferrous stains 13 to 18 feet	18.0			1.25 (HP)							
			25			3.75 (HP)							
			30			3.0 (HP)							
			30										
Boring Terminated at 30 Feet			30										

<p>See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any). See Supporting Information for explanation of symbols and abbreviations.</p>	<p>Water Level Observations</p> <ul style="list-style-type: none"> ▽ While drilling ▽ After 5 minutes ▼ After 15 minutes 	<p>Drill Rig ATV</p>
<p>Notes</p>	<p>Advancement Method Dry augered to 30 feet.</p> <p>Abandonment Method Boring backfilled with auger cuttings upon completion.</p>	<p>Driller DAS</p> <p>Logged by H. Zamudio</p> <p>Boring Started 12-19-2023</p> <p>Boring Completed 12-19-2023</p>

Boring Log No. B-3

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 29.9833° Longitude: -95.2476° Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test			Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines	
							Test Type	Compressive Strength (tsf)	Strain (%)					
		PAVEMENT , Approximately 12 inches of concrete	1.0											
2		LEAN CLAY (CL) , dark gray, medium stiff to very stiff, with sand pockets - light gray and tan 4 to 18 feet				2.25 (HP)			16.5		26-17-9			
						3.0 (HP)	UC	2.58	6.9	15.7	116			
			5				1.0 (HP)				21.6		31-15-16	
								1.75 (HP)						
			10					2.5 (HP)	UC	1.73	7.6	16.9	115	
								1.5 (HP)						
3		FAT CLAY (CH) , reddish brown and light gray, stiff to very stiff, with calcareous nodules	15	▼										
			20	▼			2.5 (HP)	UC	1.55	6	26.0	104		
			25											
			30	▼										
		Boring Terminated at 30 Feet												

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).
 See [Supporting Information](#) for explanation of symbols and abbreviations.

Notes

Water Level Observations

- While drilling
- After 5 minutes
- After 15 minutes

Drill Rig
ATV

Driller
DAS

Logged by
H. Zamudio

Boring Started
12-20-2023

Boring Completed
12-20-2023

Advancement Method
Dry augered to 30 feet.

Abandonment Method
Boring backfilled with auger cuttings and patched with ready-mix concrete upon completion.

Boring Log No. B-4

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 29.9830° Longitude: -95.2477° Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test			Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
							Test Type	Compressive Strength (tsf)	Strain (%)				
1		FILL - SANDY LEAN CLAY (CL) , dark gray, with ferrous stains	2.0			4.5 (HP)							
2		SANDY LEAN CLAY (CL) , dark gray, soft to stiff, with calcareous nodules - light gray and tan 4 to 10	5			1.0 (HP)			15.8		39-15-24		
			5			0.5 (HP)							
			5			0.75 (HP)			17.8		29-14-15		
			10			1.25 (HP)							
3		SANDY FAT CLAY (CH) , light gray and tan, medium stiff, with sand pockets	10			0.5 (HP)	UC	0.72	15	21.0	105		
			15			1.0 (HP)							
			15	▼									
			18.0	▼									
			20	▼									
3		FAT CLAY (CH) , reddish brown and light gray, medium stiff to very stiff, with sand pockets	20			2.5 (HP)							
			25			2.0 (HP)	UC	0.93	10.5	28.2	94		
			30			3.5 (HP)							
		Boring Terminated at 30 Feet	30										

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).
 See [Supporting Information](#) for explanation of symbols and abbreviations.

Notes

Water Level Observations

- ▼ While drilling
- ▼ After 5 minutes
- ▼ After 15 minutes

Drill Rig
ATV

Driller
DAS

Logged by
H. Zamudio

Boring Started
12-20-2023

Boring Completed
12-20-2023

Advancement Method
Dry augered to 30 feet.

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Boring Log No. B-5

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 29.9817° Longitude: -95.2461° Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test			Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines	
							Test Type	Compressive Strength (tsf)	Strain (%)					
1	[Cross-hatch pattern]	FILL - SANDY LEAN CLAY (CL) , dark gray, with scattered roots	2.0			2.0 (HP)				14.0		25-14-11		
2	[Diagonal lines]	SANDY LEAN CLAY (CL) , gray, soft to very stiff, with calcareous nodules - light gray and tan 4 to 13 feet	5			0.5 (HP)	UC	0.72	11.8	18.6	111			
			5			0.5 (HP)				18.7		26-15-11		
			5			0.5 (HP)								
			10			4.5 (HP)	UC	1.78	6.1	15.9	113			
			10			4.5 (HP)								
4	[Diagonal lines]	SANDY SILTY CLAY (CL-ML) , light gray and tan, very soft	15			0.25 (HP)								
			15	▼										
			15	▼										
4	[Diagonal lines]	SILTY SAND (SM) , light gray and tan, very dense	20	▼	X	15-30-35 N=65								
			20	▼										
3	[Diagonal lines]	FAT CLAY (CH) , reddish brown and light gray, stiff to very stiff, with ferrous stains - with slickensides 23 to 28 feet	25			3.0 (HP)	UC	1.94	2.2	30.0	93		99	
			25			3.5 (HP)								
		Boring Terminated at 30 Feet	30											

<p>See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any). See Supporting Information for explanation of symbols and abbreviations.</p> <p>Notes</p>	<p>Water Level Observations</p> <ul style="list-style-type: none"> ▼ While drilling ▼ After 5 minutes ▼ After 15 minutes <p>Advancement Method Dry augered to 30 feet.</p> <p>Abandonment Method Boring backfilled with auger cuttings upon completion.</p> <p>Drill Rig ATV</p> <p>Hammer Type Rope and Cathead</p> <p>Driller DAS</p> <p>Logged by H. Zamudio</p> <p>Boring Started 12-20-2023</p> <p>Boring Completed 12-20-2023</p>
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Boring Log No. B-6

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 29.9814° Longitude: -95.2461° Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test			Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
							Test Type	Compressive Strength (tsf)	Strain (%)				
1	[Cross-hatched pattern]	FILL - SANDY LEAN CLAY (CL) , dark gray, with scattered gravel - with scattered roots 0 to 2 feet	4.0			4.0 (HP)							
			4.5			4.5 (HP)			11.3		29-13-16		
2	[Diagonal lines pattern]	SANDY LEAN CLAY (CL) , light gray and tan, medium stiff to stiff, with ferrous stains	5			1.25 (HP)							
			2.0			2.0 (HP)			17.3		29-15-14		
			1.25			1.25 (HP)							
			1.25			1.25 (HP)	UC	1.47	5.2	16.9	117		
			1.0			1.0 (HP)							
4	[Vertical lines pattern]	POORLY GRADED SAND WITH SILT (SP-SM) , light gray, medium dense, with clay pockets	20	▽	X	4-5-6 N=11			24.0			11	
3	[Diagonal lines pattern]	FAT CLAY (CH) , reddish brown and light gray, medium stiff to very stiff - with slickensides 23 to 28 feet	25			2.0 (HP)	UC	0.92	1.4	28.8	96		
			3.0			3.0 (HP)							
Boring Terminated at 30 Feet			30										

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).
 See [Supporting Information](#) for explanation of symbols and abbreviations.

Notes

Water Level Observations

- ▽ While drilling
- ▽ After 5 minutes
- ▽ After 15 minutes

Drill Rig
ATV

Hammer Type
Rope and Cathead

Driller
DAS

Logged by
H. Zamudio

Boring Started
12-20-2023

Boring Completed
12-20-2023

Advancement Method

Dry augered to 30 feet.

Abandonment Method

Boring backfilled with auger cuttings upon completion.

Boring Log No. B-7

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 29.9825° Longitude: -95.2439° Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test			Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
							Test Type	Compressive Strength (tsf)	Strain (%)				
		PAVEMENT , Approximately 15 inches of concrete											
		SANDY LEAN CLAY (CL) , dark gray, soft to very stiff, with sand pockets - light gray and tan 4 to 8 feet	1.3			4.5 (HP)			14.1		28-14-14		
			5			2.0 (HP)	UC	0.96	12.7	17.9	107		
			5			0.5 (HP)			23.8		32-14-18		
			5			0.5 (HP)							
		LEAN CLAY (CL) , light gray and tan, stiff to very stiff, with sand pockets	8.0			2.0 (HP)							
2			10			2.25 (HP)	UC	2.50	11.9	16.5	115		
			15			4.5 (HP)							
			15										
			18.0										
		FAT CLAY (CH) , reddish brown and light gray, very stiff, with calcareous nodules	18.0			3.0 (HP)							
			20										
			20										
3			25			3.5 (HP)	UC	2.58	5.4	20.3	105		
			25										
			30			3.5 (HP)							
		Boring Terminated at 30 Feet	30										

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).
 See [Supporting Information](#) for explanation of symbols and abbreviations.

Notes

Water Level Observations

- While drilling
- After 5 minutes
- After 15 minutes

Drill Rig
ATV

Driller
DAS

Logged by
H. Zamudio

Boring Started
12-20-2023

Boring Completed
12-20-2023

Advancement Method
Dry augered to 30 feet.

Abandonment Method
Boring backfilled with auger cuttings and patched with ready-mix concrete upon completion.

Boring Log No. B-8

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 29.9825° Longitude: -95.2483° Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test			Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines	
							Test Type	Compressive Strength (tsf)	Strain (%)					
1	[Cross-hatch pattern]	FILL - SANDY LEAN CLAY (CL) , dark gray	4.0			4.5 (HP)								
			4.0			4.5 (HP)			11.7		26-14-12			
2	[Diagonal lines]	SANDY LEAN CLAY (CL) , dark gray, very soft to very stiff - light gray and tan 13 to 18 feet - reddish brown and light gray, with silt pockets	5			0.5 (HP)								
			5			0.25 (HP)			21.3		30-14-16			
			10	▼			0.5 (HP)	UC	0.17	15	21.9	111		
			10			0.25 (HP)								
			15	▼			2.0 (HP)	UC	0.59	4.7	17.9	114		
			20	▼			7-8-12 N=20							
3	[Diagonal lines]	FAT CLAY (CH) , reddish brown and light gray, stiff to very stiff, with sand pockets	23.0			2.0 (HP)								
			30.0			4.0 (HP)								
		Boring Terminated at 30 Feet	30											

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).
 See [Supporting Information](#) for explanation of symbols and abbreviations.

Notes

Water Level Observations

- ▼ While drilling
- ▼ After 5 minutes
- ▼ After 15 minutes

Drill Rig
ATV

Hammer Type
Rope and Cathead

Driller
DAS

Logged by
H. Zamudio

Boring Started
12-19-2023

Boring Completed
12-19-2023

Advancement Method

Dry augered to 30 feet.

Abandonment Method

Boring backfilled with auger cuttings upon completion.

Boring Log No. B-9

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 29.9820° Longitude: -95.2483° Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test			Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines	
							Test Type	Compressive Strength (tsf)	Strain (%)					
1	[Cross-hatch pattern]	FILL - SANDY LEAN CLAY (CL) , dark gray, with scattered gravel	4.0			1.25 (HP)				10.7		23-14-9		
			4.0			2.0 (HP)								
2	[Diagonal lines]	SANDY LEAN CLAY (CL) , light gray and tan, soft to stiff - with calcareous nodules 10 to 13 feet	5.0			1.0 (HP)				18.6		34-14-20		
			7.5			0.5 (HP)								
			9.0			0.75 (HP)								
			10.0			2.25 (HP)	UC	1.98	13.6	16.6	115			
			13.0			0.25 (HP)								
3	[Diagonal lines]	SILTY CLAY (CL-ML) , light gray, very soft to soft - reddish brown 18 to 23 feet	15.0	▽		0.5 (HP)								
			20.0	▽										
			23.0											
3	[Diagonal lines]	FAT CLAY (CH) , reddish brown and light gray, very stiff, with sand pockets and ferrous stains	25.0			2.5 (HP)	UC	2.22	4.5	21.3	104			
			30.0			2.5 (HP)								
		Boring Terminated at 30 Feet	30.0											

<p>See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any). See Supporting Information for explanation of symbols and abbreviations.</p>	<p>Water Level Observations</p> <ul style="list-style-type: none"> ▽ While drilling ▽ After 5 minutes ▽ After 15 minutes 	<p>Drill Rig ATV</p>
<p>Notes</p>	<p>Advancement Method Dry augered to 30 feet.</p> <p>Abandonment Method Boring backfilled with auger cuttings upon completion.</p>	<p>Driller DAS</p> <p>Logged by H. Zamudio</p> <p>Boring Started 12-20-2023</p> <p>Boring Completed 12-20-2023</p>

Boring Log No. B-10

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 29.9817° Longitude: -95.2456° Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test			Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
							Test Type	Compressive Strength (tsf)	Strain (%)				
1	[Cross-hatched pattern]	FILL - SANDY LEAN CLAY (CL) , dark gray and tan, with sand pockets 4.0 FILL - FAT CLAY (CH) , dark gray and tan, with sand pockets 6.0	4.0			1.5 (HP)				13.9		34-14-20	
			4.0			0.25 (HP)							
3	[Diagonal hatched pattern]	SANDY LEAN CLAY (CL) , light gray and tan, stiff to very stiff, with ferrous stains 15.0	5.0			0.25 (HP)	UC	0.46	9.4	20.5	104		
			10.0			2.5 (HP)							
			10.0			2.0 (HP)							
		15.0	15	X		7-12-11 N=23							
Boring Terminated at 15 Feet													

<p>See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any). See Supporting Information for explanation of symbols and abbreviations.</p> <p>Notes</p>	<p>Water Level Observations No free water observed.</p> <p>Advancement Method Dry augered to 15 feet</p> <p>Abandonment Method Boring backfilled with auger cuttings upon completion.</p>	<p>Drill Rig ATV</p> <p>Hammer Type Rope and Cathead</p> <p>Driller DAS</p> <p>Logged by H. Zamudio</p> <p>Boring Started 12-21-2023</p> <p>Boring Completed 12-21-2023</p>
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Boring Log No. B-11

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 29.9809° Longitude: -95.2449° Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test			Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
							Test Type	Compressive Strength (tsf)	Strain (%)				
1	[Cross-hatch pattern]	FILL - SANDY LEAN CLAY (CL) , dark gray, with scattered gravel	4.0			4.0 (HP)				13.3		32-14-18	
			4.0			1.0 (HP)							
2	[Diagonal lines]	SANDY LEAN CLAY (CL) , light gray and tan, medium stiff to stiff, with sand pockets	5			1.25 (HP)							
						1.0 (HP)	UC	0.59	5.4	17.3	117		
						1.0 (HP)							
4	[Vertical lines]	SILTY SAND (SM) , light gray, medium dense, with clay pockets	13.0										
		Boring Terminated at 15 Feet	15.0			5-12-14 N=26							

<p>See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any). See Supporting Information for explanation of symbols and abbreviations.</p>	<p>Water Level Observations</p> <ul style="list-style-type: none"> ▽ While drilling ▽ After 5 minutes ▽ After 15 minutes 	<p>Drill Rig ATV</p> <p>Hammer Type Rope and Cathead</p> <p>Driller DAS</p> <p>Logged by H. Zamudio</p> <p>Boring Started 12-21-2023</p> <p>Boring Completed 12-21-2023</p>
<p>Notes</p>	<p>Advancement Method Dry augered to 15 feet</p> <p>Abandonment Method Boring backfilled with auger cuttings upon completion.</p>	

Boring Log No. B-12

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 29.9797° Longitude: -95.2450° Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test			Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
							Test Type	Compressive Strength (tsf)	Strain (%)				
1		FILL - SANDY LEAN CLAY (CL) , dark gray	2.0			2.0 (HP)				16.1		24-14-10	
2		SANDY LEAN CLAY (CL) , dark gray, very soft to stiff - with calcareous nodules 4 to 6 feet - light gray and tan below 4 feet	5			1.0 (HP) 0.25 (HP) 0.25 (HP)							
			10			1.0 (HP)	UC	0.83	11.2	16.6	113		
			15			1.25 (HP)							
Boring Terminated at 15 Feet													

<p>See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any). See Supporting Information for explanation of symbols and abbreviations.</p> <p>Notes</p>	<p>Water Level Observations No free water observed.</p> <p>Advancement Method Dry augered to 15 feet</p> <p>Abandonment Method Boring backfilled with auger cuttings upon completion.</p>	<p>Drill Rig ATV</p> <p>Driller DAS</p> <p>Logged by H. Zamudio</p> <p>Boring Started 12-21-2023</p> <p>Boring Completed 12-21-2023</p>
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
Supporting Information

Contents:

General Notes
Unified Soil Classification System

Note: All attachments are one page unless noted above.

General Notes

Sampling	Water Level	Field Tests
 Rock Core  Shelby Tube  Split Spoon	 Water Initially Encountered  Water Level After a Specified Period of Time  Water Level After a Specified Period of Time  Cave In Encountered Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	N Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer UC Unconfined Compressive Strength (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer

Descriptive Soil Classification

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

Location And Elevation Notes

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

Strength Terms

Relative Density of Coarse-Grained Soils (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		Consistency of Fine-Grained Soils (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Relative Density	Standard Penetration or N-Value (Blows/Ft.)	Consistency	Unconfined Compressive Strength Qu (tsf)	Standard Penetration or N-Value (Blows/Ft.)
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

Relevance of Exploration and Laboratory Test Results

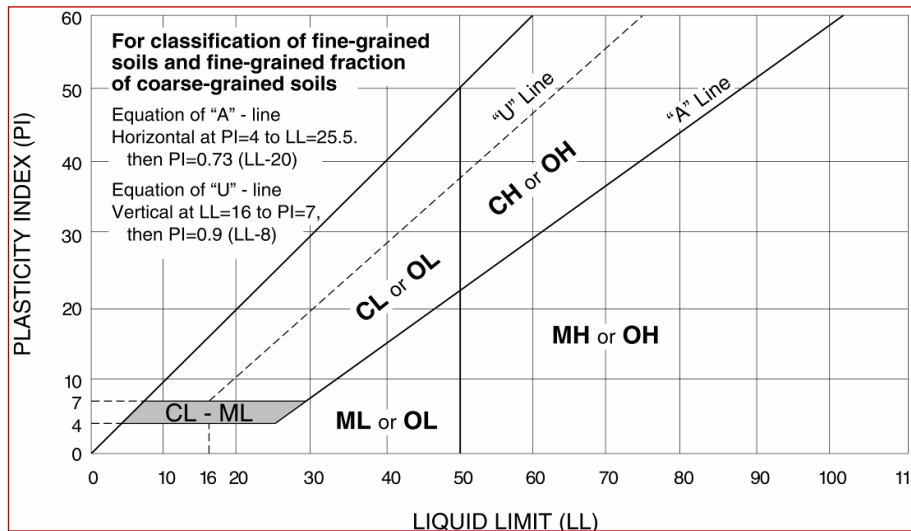
Exploration/field results and/or laboratory test data contained within this document are intended for application to the project as described in this document. Use of such exploration/field results and/or laboratory test data should not be used independently of this document.

Unified Soil Classification System

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A				Soil Classification	
				Group Symbol	Group Name ^B
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels: Less than 5% fines ^C	$Cu \geq 4$ and $1 \leq Cc \leq 3$ ^E	GW	Well-graded gravel ^F
		Gravels with Fines: More than 12% fines ^C	$Cu < 4$ and/or $[Cc < 1$ or $Cc > 3.0]$ ^E	GP	Poorly graded gravel ^F
			Fines classify as ML or MH	GM	Silty gravel ^{F, G, H}
		Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands: Less than 5% fines ^D	Fines classify as CL or CH	GC
	$Cu \geq 6$ and $1 \leq Cc \leq 3$ ^E			SW	Well-graded sand ^I
	Sands with Fines: More than 12% fines ^D		$Cu < 6$ and/or $[Cc < 1$ or $Cc > 3.0]$ ^E	SP	Poorly graded sand ^I
			Fines classify as ML or MH	SM	Silty sand ^{G, H, I}
	Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit less than 50	Inorganic:	PI > 7 and plots above "A" line ^J	CL
PI < 4 or plots below "A" line ^J				ML	Silt ^{K, L, M}
Organic:			$\frac{LL \text{ oven dried}}{LL \text{ not dried}} < 0.75$	OL	Organic clay ^{K, L, M, N} Organic silt ^{K, L, M, O}
			Silts and Clays: Liquid limit 50 or more	Inorganic:	PI plots on or above "A" line
PI plots below "A" line		MH			Elastic silt ^{K, L, M}
Organic:		$\frac{LL \text{ oven dried}}{LL \text{ not dried}} < 0.75$		OH	Organic clay ^{K, L, M, P} Organic silt ^{K, L, M, Q}
		Highly organic soils:		Primarily organic matter, dark in color, and organic odor	

- ^A Based on the material passing the 3-inch (75-mm) sieve.
- ^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
- ^C Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
- ^D Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.
- ^E $Cu = D_{60}/D_{10}$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
- ^F If soil contains $\geq 15\%$ sand, add "with sand" to group name.
- ^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

- ^H If fines are organic, add "with organic fines" to group name.
- ^I If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.
- ^J If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
- ^K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
- ^L If soil contains $\geq 30\%$ plus No. 200 predominantly sand, add "sandy" to group name.
- ^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.
- ^N PI ≥ 4 and plots on or above "A" line.
- ^O PI < 4 or plots below "A" line.
- ^P PI plots on or above "A" line.
- ^Q PI plots below "A" line.



DOCUMENT 00 40 00 - COMPETITIVE SEALED PROPOSAL FORM

This Document is for reference, the actual Proposal Form will have to be filled out via Ionwave.

**HUMBLE HIGH SCHOOL ADDITIONS AND RENOVATIONS PHASE TWO
HUMBLE DISTRICT INDEPENDENT SCHOOL DISTRICT**

Submitted by: _____

Date: _____ Phone No.: _____

To: Board of Trustees
Humble Independent School District
1703 Wilson Rd. Building B
Humble, Texas 77396

Having examined Proposal and Contract Documents prepared by PBK, Inc., dated **December 18, 2024**, and having examined site conditions, the undersigned proposes to furnish all labor, equipment and materials and perform all work for the completion of the above-named project for the sum indicated below.

In submitting his Proposal, the undersigned agrees to the following:

1. Base Proposal to be submitted via Ionwave by January 23, 2025, and this signed document to be submitted post-bid.
2. Hold proposal open for acceptance 90 days.
3. Accept right of Owner to reject any or all proposals, to waive formalities and to accept proposal which Owner considers most advantageous.
4. Enter into and execute the contract, if awarded, for the Base Proposal and accepted Alternate Proposals.
5. Complete work in accordance with the Contract Documents within the stipulated contract time.
6. By signing, the undersigned affirms that, to the best of his knowledge, the Proposals have been arrived at independently and is submitted without collusion with anyone to obtain information or gain any favoritism that would in any way limit competition or give an unfair advantage over respondents in the award of this proposal.

I. BASE PROPOSAL

Undersigned agrees to complete the Work for the lump sum amount of:

1.1 Humble High School Additions and Renovations Phase Two

_____ Dollars \$ _____

(Amount written in words governs)

(Amount in figures)

II. ALLOWANCES

Undersigned certifies that the specified allowances are included in the Base Proposal and agrees that any unexpended balance of allowance sums will revert to Owner in the final settlement of the contract.

- | | |
|-----------------------------------|----------------|
| 1. Owner's Contingency | \$1,500,000.00 |
| 2. First Responder Antenna System | \$1,143,112.00 |

3. Super Graphics \$80,000.00

III. UNIT PRICES

1. Unit Price 1: Removal of unsatisfactory soil and replacement with satisfactory soil material

ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

2. Unit Price 2: Rock excavation and replacement with satisfactory soil material

ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

3. Unit Price 3: Cutting and patching of concrete floor slabs

ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

4. Unit Price 4: Concrete

ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

5. Unit Price 5: Select fill

ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

6. Unit Price 6: Spread Footing (Add)

ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

7. Unit Price 7: Spread Footing (Deduct)

ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

8. Unit Price 8: Existing Pier Demo Condition 1 (Overlap with New Pier)

ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

9. Unit Price 9: Existing Pier Demo Condition 2 (No Conflict with New Piers)

ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

10. Unit Price 10: Grade Beam (Add)
ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

11. Unit Price 11: Grade Beam (Deduct)
ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

12. Unit Price 12: Miscellaneous and Structural Steel
ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

IV. CONTRACT TIME

Undersigned agrees to begin Work upon Notice to Proceed, and be Substantially Complete by July 15, 2026. A schedule is to be uploaded on IonWave that must include the following milestone dates.

In addition, the undersigned will agree to meet Milestone completion dates for completion of the Foundation, Structural Steel, Building Envelope and Roof, and HVAC Start Up to be submitted at Bid Time and Date via Ionwave.

IV. ADDENDA

Undersigned acknowledges receipt of Addenda Nos. _____
dated _____, 20__.

V. ALTERNATES

If the Owner accepts any or all of the Alternates, the undersigned agrees to modify the Base Proposal as stipulated below:

A. Alternate No. 1: Synthetic Turf Outdoor Work Area at Athletics Courtyard
ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

B. Alternate No. 2: Existing Ceilings and Lights Replacement
ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

C. Alternate No. 3: Science Labs Renovation
ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

- D. Alternate No. 4: Existing Flooring Replacement
ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)
- E. Alternate No. 5: Existing Doors Replacement
ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)
- F. Alternate No. 6: Irrigation and Sod
ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)
- G. Alternate No. 7: Area H Corridor Renovation
ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)
- H. Alternate No. 8A: Direct Digital Controls – Reliable Controls (Basis of Design)
ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)
- I. Alternate No. 8B: Direct Digital Controls - Alerton
ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)
- J. Alternate No. 9: High Capacity Packaged, Outdoor, Central Station Air Handling Units –
Trane – Horizon Model
ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)
- K. Alternate No. 10: Base Bid Adjustment (if any) – This alternate shall establish the amount to
be added to/ deducted from the Base Proposal in the event the Contractor has discovered
an error in their Base Proposal amount.
ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

VI. CHANGES IN THE WORK

Undersigned understands that changes in the work shall be performed in accordance with the
Supplementary Conditions.

VII. LIQUIDATED DAMAGES

Undersigned understands that liquidated damages as defined in the Supplementary Conditions will be included in the form of Agreement between Owner and Contractor and that the contractor will be bound thereto.

It is understood that the right is reserved by the Owner to reject any or all proposals, or waive any informalities in the proposal process.

(Seal, if a Corporation)
State whether Corporation,
Partnership or Individual

Authorized Signature

Title

Name of Contracting Firm

Address

Telephone

Date

END OF DOCUMENT 00 40 00

DOCUMENT 00 40 01 - PROPOSAL BOND

KNOW ALL MEN BY THESE PRESENTS, that we _____,
as Principal, and _____, as Surety, are held
and firmly bound unto Humble Independent School District, hereinafter called the Owner, in the penal sum of
_____ Dollars (\$_____)
lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves,
our heirs, executors, administrators and successors jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the Principal has submitted the
accompanying Proposal, dated _____, 20__, for Humble High School Additions and Renovations
Phase Two the kind and extent of work involved being set forth in detail in the proposed Contract Documents
cited herein.

THEREFORE, if the Principal shall not withdraw the accompanying proposal within 90 days after the date set
for opening thereof, and shall within ten days after the prescribed forms are presented for signature, enter into
a written contract with the Owner in accordance with the Proposal as accepted; and give Bond and good and
sufficient surety for the faithful performance and proper fulfillment of the contract including payment of persons
supplying labor or materials therefor, or in the event of the withdrawal of the proposal within the period
specified, or the failure to enter into a contract and give the bond within the time specified, if the Principal shall
pay to the Owner the difference between the aggregate amount for which the Owner may enter into a contract
for the same work with another Respondent; if the latter amount be in excess of the former, then the above
obligation shall be void and of no effect, otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above bonded parties have executed this instrument under their respective
seals this _____ day of _____, 20__, the name and Corporate Seal of each
corporate party being hereto affixed and these presents duly signed by its undersigned representatives,
pursuant to authority of its governing body.

Business Address Individual Principal

Business Address Individual Principal

ATTEST:

Secretary President BY: _____

Business Address Corporate Surety

ATTEST: _____ BY: _____

END OF DOCUMENT 00 40 01

DOCUMENT 00 40 12 - LIST OF SUBCONTRACTORS

PROJECT:
Humble High School Additions and Renovations
Phase Two
1700 Wilson Road
Humble, Texas 77338

ARCHITECT:
PBK
11 Greenway Plaza, 22nd Floor
Houston, Texas 77046

ARCHITECT'S PROJECT NO. 220537

TO: [Contractor Name]
[Street]
[City, State Zip]

DATE: _____

List Subcontractors and others proposed to be employed on the above Project as required by the proposal documents.

(To be filled out by the Contractor and returned to the Architect.)

Work/ Division	Firm	Address	Phone	Fax	e-mail	Representative	HUBs Y or N
_____	_____	_____	_____	_____	_____	_____	<input type="checkbox"/> <input type="checkbox"/>
_____	_____	_____	_____	_____	_____	_____	<input type="checkbox"/> <input type="checkbox"/>
_____	_____	_____	_____	_____	_____	_____	<input type="checkbox"/> <input type="checkbox"/>
_____	_____	_____	_____	_____	_____	_____	<input type="checkbox"/> <input type="checkbox"/>
_____	_____	_____	_____	_____	_____	_____	<input type="checkbox"/> <input type="checkbox"/>
_____	_____	_____	_____	_____	_____	_____	<input type="checkbox"/> <input type="checkbox"/>
_____	_____	_____	_____	_____	_____	_____	<input type="checkbox"/> <input type="checkbox"/>
_____	_____	_____	_____	_____	_____	_____	<input type="checkbox"/> <input type="checkbox"/>
_____	_____	_____	_____	_____	_____	_____	<input type="checkbox"/> <input type="checkbox"/>

(Provide additional sheets as required.)

END OF DOCUMENT 00 40 12

NOTE: THIS DOCUMENT MUST BE SUBMITTED VIA IONWAVE WITH PROPOSAL

DOCUMENT 00 50 00 - TEXAS STATUTORY PERFORMANCE BOND
(Penalty of this bond must be 100% of contract amount)

Bond No.: _____

KNOW ALL MEN BY THESE PRESENTS, that: _____
(hereinafter called the Principal), as principal, and _____
a corporation organized and existing under the laws of the State of _____
authorized and admitted to do business in the State of Texas and licensed by the State of Texas to
execute bonds as Surety (hereinafter called the Surety), as Surety, are held and firmly bound unto

(hereinafter called the Obligee) in the amount of _____

Dollars(\$_____) for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated the _____ day of _____, 20__, for

**HUMBLE HIGH SCHOOL ADDITIONS AND RENOVATIONS PHASE TWO
HUMBLE INDEPENDENT SCHOOL DISTRICT**

which contract is hereby referred to and made a part hereof as fully and the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall faithfully perform the work in accordance with the plans, specifications and contract documents, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Chapter 2253 of the Texas Government Code and all liabilities on this bond shall be determined in accordance with the provisions of said Chapter to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this Instrument this _____ day of _____, 20__.

(Seal) _____

Principal

Surety Address _____

By: _____

(Seal) _____

Surety

Surety Telephone Number _____

By: _____
Attorney-in-Fact

END OF DOCUMENT 00 50 00

DOCUMENT 00 50 01 - TEXAS STATUTORY PAYMENT BOND **Bond No.:** _____
(Penalty of this bond must be 100% of contract amount)

KNOW ALL MEN BY THESE PRESENTS, that: _____
(hereinafter called the Principal), as principal, _____
a corporation organized and existing under the laws of the State of _____
authorized and admitted to do business in the State of Texas and licensed by the State of Texas to
execute bonds as Surety (hereinafter called the Surety), as Surety, are held and firmly bound unto

_____ (hereinafter called the Obligee) in the amount of _____

Dollars (\$ _____) for the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated the _____ day of _____, 20__, for

**HUMBLE HIGH SCHOOL ADDITIONS AND RENOVATIONS PHASE TWO
HUMBLE INDEPENDENT SCHOOL DISTRICT**

which contract is hereby referred to and made a part hereof as fully and the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall pay all claimants supplying labor and material to him or a Subcontractor in the prosecution of the work provided for in said contract, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Chapter 22.53 of the Texas Government Code and all liabilities on this bond to all such claimants shall be determined in accordance with the provisions of said Chapter to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this Instrument this _____ day of _____, 20__.

Witness: _____ (Seal)
Principal

By: _____

Witness: _____ (Seal)
Surety

By: _____
Attorney-in-Fact

Surety Address

Surety Telephone Number

END OF DOCUMENT 00 50 01



AIA[®] Document A101[®] – 2017

Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum

AGREEMENT made as of the Fifth day of December in the year Two Thousand Twenty-Four

(In words, indicate day, month and year.)

BETWEEN the Owner:

(Name, legal status, address and other information)

Humble Independent School District
10203 Birchridge Drive
Humble, TX 77338
(B2236)

and the Contractor:

(Name, legal status, address and other information)

for the following Project:

(Name, location and detailed description)

Humble High School Phase 2
1700 Wilson Road
Humble, TX 77338

The Architect:

(Name, legal status, address and other information)

PBK Architects
11 E Greenway Plaza, 22nd Floor
Houston, TX 77046

The Owner and Contractor agree as follows.

ADDITIONS AND DELETIONS:

The author of this document may have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

The parties should complete A101®–2017, Exhibit A, Insurance and Bonds, contemporaneously with this Agreement. AIA Document A201®–2017, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

TABLE OF ARTICLES

- 1 THE CONTRACT DOCUMENTS
- 2 THE WORK OF THIS CONTRACT
- 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION
- 4 CONTRACT SUM
- 5 PAYMENTS
- 6 DISPUTE RESOLUTION
- 7 TERMINATION OR SUSPENSION
- 8 MISCELLANEOUS PROVISIONS
- 9 ENUMERATION OF CONTRACT DOCUMENTS

EXHIBIT A INSURANCE AND BONDS

ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement, and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9.

ARTICLE 2 THE WORK OF THIS CONTRACT

The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be:

(Check one of the following boxes.)

- The date of this Agreement.
- A date set forth in a notice to proceed issued by the Owner.
- Established as follows:
(Insert a date or a means to determine the date of commencement of the Work.)

The date of commencement shall be the day that the Contractor receives a Notice to Proceed from the Owner. If a permit, or other approvals, are not available for the entire Project, the Contractor must commence work on those portions of the Project that do not require a permit or other approvals on receipt of a Notice to Proceed. Work at the Project site shall not begin until Owner has received all required payment and performance bonds and insurance.

If a date of commencement of the Work is not selected, then the date of commencement shall be the date of this Agreement.

§ 3.2 The Contract Time shall be measured from the date of commencement of the Work.

§ 3.3 Substantial and Final Completion

§ 3.3.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the Contractor shall achieve Substantial Completion of the entire Work:

AIA Document A101 – 2017. Copyright © 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1967, 1974, 1977, 1987, 1991, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This document was produced at 09:23:06 CST on 12/06/2024 under Subscription No.20240043200 which expires on 07/12/2025, is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.

User Notes:

(6751d9bfc16f037041cca94b)

(Check one of the following boxes and complete the necessary information.)

Not later than () calendar days from the date of commencement of the Work.

By the following date: July 15, 2026

§ 3.3.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work are to be completed prior to Substantial Completion of the entire Work, the Contractor shall achieve Substantial Completion of such portions by the following dates:

Portion of Work	Substantial Completion Date
-----------------	-----------------------------

§ 3.3.3 If the Contractor fails to achieve Substantial Completion or Final Completion as provided in this Section 3.3, liquidated damages, if any, shall be assessed as set forth in Section 4.5.

§ 3.3.4 Subject to adjustments of the Contract Time as provided in the Contract Documents, Final Completion shall be 45 calendar days after the date of Substantial Completion.

ARTICLE 4 CONTRACT SUM

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor’s performance of the Contract. The Contract Sum shall be (\$), subject to additions and deductions as provided in the Contract Documents.

§ 4.2 Alternates

§ 4.2.1 Alternates, if any, included in the Contract Sum:

Item	Price
------	-------

§ 4.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement.

(Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)

Item	Price	Conditions for Acceptance
------	-------	---------------------------

§ 4.3 Allowances, if any, included in the Contract Sum:
(Identify each allowance.)

Item	Price
------	-------

§ 4.4 Unit prices, if any:

(Identify the item and state the unit price and quantity limitations, if any, to which the unit price will be applicable.)

Item	Units and Limitations	Price per Unit (\$0.00)
------	-----------------------	-------------------------

§ 4.5 Liquidated damages, if any:

(Insert terms and conditions for liquidated damages, if any.)

\$1,500.00 per day as set forth in Paragraphs 8.3.4 and 8.3.5 of the Supplementary Conditions to the A201-2017.

§ 4.6 Other:

(Insert provisions for bonus or other incentives, if any, that might result in a change to the Contract Sum.)

N/A

ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

§ 5.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

N/A

§ 5.1.3 Provided that an Application for Payment is properly executed by the Architect, the Owner shall make payment of the amount certified to the Contractor no later than forty-five days. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner no later than Forty-Five (45) days after the Architect properly executes the Application for Payment, except that no payment shall be considered not paid when due or past due except in accordance with Section 2251.021 of the Texas Government Code. *(Federal, state or local laws may require payment within a certain period of time.)*

§ 5.1.4 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form, and supported by such data to substantiate its accuracy, as the Architect may require. This schedule of values shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 5.1.5 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

§ 5.1.6 In accordance with AIA Document A201™–2017, as amended by the Owner, General Conditions of the Contract for Construction, and subject to other provisions of the Contract Documents, the amount of each progress payment shall be provided using the A702 and G703 format and computed as follows:

§ 5.1.6.1 The amount of each progress payment shall first include:

- .1 That portion of the Contract Sum properly allocable to completed Work;
- .2 That portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction, or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing; and
- .3 That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified.

§ 5.1.6.2 The amount of each progress payment shall then be reduced by:

- .1 The aggregate of any amounts previously paid by the Owner;
- .2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A201–2017, as amended by the Owner;
- .3 Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;
- .4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A201–2017; and
- .5 Retainage withheld pursuant to Section 5.1.7.

§ 5.1.6.3 The progress payment amount determined in accordance with Section 5.1.6 shall be further modified under the following circumstances:

- .1 If Owner is entitled to deduct liquidated damages, or any other damages or amounts provided in the Contract Documents, including clean-up fees, then Owner shall be entitled to deduct such liquidated damages, amounts and fees due to Contractor at any time.
- .2 If Contractor fails or refuses to complete the Project or portions of the Work pursuant to Section 3.3.2 and Section 3.3.3, any final payment to Contractor shall be subject to deduction for such amounts as the Architect and Owner, if applicable, shall determine as the cost for completing incomplete Work.

§ 5.1.7 Retainage

§ 5.1.7.1 For each progress payment made prior to Final Completion of the Work, the Owner may withhold the following amount, as retainage, from the payment otherwise due:

(Insert a percentage or amount to be withheld as retainage from each Application for Payment. The amount of retainage may be limited by governing law.)

10% if contract valued at < \$5,000,000; 5% if contract is valued at \$5,000,000+

§ 5.1.7.1.1 The following items are not subject to retainage:

(Insert any items not subject to the withholding of retainage, such as general conditions, insurance, etc.)

None.

§ 5.1.7.2 Reduction or limitation of retainage, if any, shall be as follows:

(If the retainage established in Section 5.1.7.1 is to be modified prior to Substantial Completion of the entire Work, including modifications for Substantial Completion of portions of the Work as provided in Section 3.3.2, insert provisions for such modifications.)

Unless authorized in writing by the Owner in writing, retainage is not due and owing until Final Payment.

§ 5.1.7.3 Except as set forth in this Section 5.1.7.3, upon Final Completion of the Work, the Contractor may submit an Application for Payment that includes the retainage withheld from prior Applications for Payment pursuant to this Section 5.1.7. The Application for Payment submitted at Final Completion shall not include retainage as follows:

(Insert any other conditions for release of retainage upon Final Completion.)

N/A

§ 5.1.8 If Final Completion of the Work is materially delayed through no fault of the Contractor, the Owner shall pay the Contractor amounts due and owing in accordance with Article 9 of AIA Document A201–2017, as amended by the Owner.

§ 5.1.9 Except with the Owner’s prior written approval or as otherwise provided in Section 9.3.2 of AIA Document A201-2017, as amended by the Owner, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

§ 5.2 Final Payment

§ 5.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, minus disputed sums, authorized deductions and liquidated damages, shall be made by the Owner to the Contractor when

- .1 the Contractor has provided all close-out documents required by the Contract documents, and fully performed the Contract except for the Contractor’s responsibility to correct nonconforming Work as provided in Article 12 of AIA Document A201–2017, as amended by the Owner, and to satisfy other requirements, if any, which extend beyond final payment;
- .2 Contractor has submitted a final Application for Payment to the Architect, and has provided all documents required by Section 3.5 and Section 9.10.2 of the AIA Document A201-2017 as amended by the Owner; and
- .3 a final Certificate for Payment has been properly executed by the Architect.

§ 5.2.2 The Owner’s final payment to the Contractor shall be made no later than 45 days after the issuance of the Architect’s final Certificate for Payment, except that no payment shall be considered not paid when due or past due except in accordance with Section 2251.021 of the Texas Government Code.

§ 5.3 Interest

Undisputed payments due and unpaid under the Contract shall bear interest at a rate set forth by Texas Government Code 2251, or similarly applicable law from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

(Insert rate of interest agreed upon, if any.)

0.00 %

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Initial Decision Maker

The Architect will serve as the Initial Decision Maker pursuant to Article 15 of AIA Document A201–2017, as amended by the Owner, unless the parties appoint below another individual, not a party to this Agreement, to serve as the Initial Decision Maker.

(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

§ 6.2 Binding Dispute Resolution

For any Claim subject to, but not resolved by, mediation pursuant to Article 15 of AIA Document A201–2017, as amended by the Owner, the method of binding dispute resolution shall be as follows:

(Check the appropriate box.)

- Arbitration pursuant to Section 15.4 of AIA Document A201–2017
- Litigation in a court of competent jurisdiction
- Other *(Specify)*

If the Owner and Contractor do not select a method of binding dispute resolution, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.

ARTICLE 7 TERMINATION OR SUSPENSION

§ 7.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2017, as amended by the Owner.

§ 7.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2017.

ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201–2017 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 The Owner's representative:

(Name, address, email address, and other information)

Dr. Jason Seybert
Associate Superintendent of Operational Support Services
1703 Wilson Rd., Bldg. B
Humble, TX 77396
281-641-8712
jason.seybert@humbleisd.net

§ 8.3 The Contractor's representative:

(Name, address, email address, and other information)

§ 8.4 The Contractor's representative shall be changed without ten days' prior notice to the other party.

§ 8.5 Insurance and Bonds

§ 8.5.1 The Contractor shall purchase and maintain insurance as set forth in Exhibit A, Insurance and Bonds, and elsewhere in the Contract Documents.

§ 8.5.2 The Contractor shall provide bonds as set forth in AIA Document A101™–2017 Exhibit A, and elsewhere in the Contract Documents.

§ 8.6

INTENTIONALLY DELETED

§ 8.7 Other provisions:

As designated by the Owner, Contractor will be responsible for inputting project documentation related to the services provided under this Agreement into the Owner's project management software. Owner will be responsible for providing all necessary licenses

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents, in the event of any inconsistency or conflict between or amount the documents that comprise this Agreement, the order of precedence shall be:

- .1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor, as amended by the Owner
- .2 Exhibit A, Insurance and Bonds
- .3 AIA Document A201™–2017, General Conditions of the Contract for Construction
- .4 Supplementary Conditions to the AIA Document A201-2017, as amended by the Owner

.5 Drawings

Number

Title

Date

.6 Specifications

Section

Title

Date

Pages

.7 Addenda, if any:

Number

Date

Pages

Portions of Addenda relating to bidding or competitive purchasing requirements are not part of the Contract Documents unless the bidding or competitive purchasing requirements are also enumerated in this Article 9.

.8 Other Exhibits:

(Check all boxes that apply and include appropriate information identifying the exhibit where required.)

AIA Document E204™–2017, Sustainable Projects Exhibit, dated as indicated below:
(Insert the date of the E204-2017 incorporated into this Agreement.)

The Sustainability Plan:

Title

Date

Pages

[X] Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages
	Supplementary Conditions to AIA A201-2017 as amended by the Owner		

.9 Other documents, if any, listed below:

(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201™-2017 provides that the advertisement or invitation to bid, Instructions to Bidders, sample forms, the Contractor's bid or proposal, portions of Addenda relating to bidding or proposal requirements, and other information furnished by the Owner in anticipation of receiving bids or proposals, are not part of the Contract Documents unless enumerated in this Agreement. Any such documents should be listed here only if intended to be part of the Contract Documents.)

- .1 EDGAR Certifications (executed; on file in Purchasing Dept.)
- .2 FEMA Certifications (if applicable)
- .3 The Project Manual for the Project, including all sections to same, whether issued or created prior to or after the execution of this Agreement.
- .4 Statutory Payment and Performance Bonds.
- .5 Certificates of Insurance required of the Contractor.
- .6 Scale/Schedule of Prevailing Wages.
- .7 Modifications to any Contract Documents executed by duly authorized representatives of both the Parties.
- .8 Any documents stated in this Agreement as being a part of or incorporated into this Agreement or the Contract.

This Agreement entered into as of the day and year first written above.

OWNER *(Signature)*

BY: Dr. Roger Brown, Interim Superintendent

(Printed name and title)

CONTRACTOR *(Signature)*

BY: TBD

(Printed name and title)

Additions and Deletions Report for AIA® Document A101® – 2017

This Additions and Deletions Report, as defined on page 1 of the associated document, reproduces below all text the author has added to the standard form AIA document in order to complete it, as well as any text the author may have added to or deleted from the original AIA text. Added text is shown underlined. Deleted text is indicated with a horizontal line through the original AIA text.

Note: This Additions and Deletions Report is provided for information purposes only and is not incorporated into or constitute any part of the associated AIA document. This Additions and Deletions Report and its associated document were generated simultaneously by AIA software at 09:23:06 CST on 12/06/2024.

Changes to original AIA text

PAGE 2

§ 3.3 Substantial and Final Completion

PAGE 3

§ 3.3.3 If the Contractor fails to achieve Substantial Completion or Final Completion as provided in this Section 3.3, liquidated damages, if any, shall be assessed as set forth in Section 4.5.

§ 3.3.4 Subject to adjustments of the Contract Time as provided in the Contract Documents, Final Completion shall be 45 calendar days after the date of Substantial Completion.

PAGE 4

§ 5.1.3 Provided that an Application for Payment is ~~received properly executed~~ by the Architect ~~not later than the day of a month~~, the Owner shall make payment of the amount certified to the Contractor ~~not later than the forty-five days of the month~~. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner ~~not later than Forty-Five (45) days after the Architect receives properly executes~~ the Application for Payment, except that no payment shall be considered not paid when due or past due except in accordance with Section 2251.021 of the Texas Government Code. *(Federal, state or local laws may require payment within a certain period of time.)*

§ 5.1.6 In accordance with AIA Document A201™–2017, as amended by the Owner, General Conditions of the Contract for Construction, and subject to other provisions of the Contract Documents, the amount of each progress payment shall be provided using the A702 and G703 format and computed as follows:

- .2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A201–2017, as amended by the Owner;
- .5 Retainage withheld pursuant to Section 5.1.7.

§ 5.1.6.3 The progress payment amount determined in accordance with Section 5.1.6 shall be further modified under the following circumstances:

- .1 If Owner is entitled to deduct liquidated damages, or any other damages or amounts provided in the Contract Documents, including clean-up fees, then Owner shall be entitled to deduct such liquidated damages, amounts and fees due to Contractor at any time.
- .2 If Contractor fails or refuses to complete the Project or portions of the Work pursuant to Section 3.3.2 and Section 3.3.3, any final payment to Contractor shall be subject to deduction for such amounts as the Architect and Owner, if applicable, shall determine as the cost for completing

incomplete Work.

PAGE 5

§ 5.1.7.1 For each progress payment made prior to ~~Substantial-Final~~ Completion of the Work, the Owner may withhold the following amount, as retainage, from the payment otherwise due:
(Insert a percentage or amount to be withheld as retainage from each Application for Payment. The amount of retainage may be limited by governing law.)

§ 5.1.7.3 Except as set forth in this Section 5.1.7.3, upon ~~Substantial-Final~~ Completion of the Work, the Contractor may submit an Application for Payment that includes the retainage withheld from prior Applications for Payment pursuant to this Section 5.1.7. The Application for Payment submitted at ~~Substantial-Final~~ Completion shall not include retainage as follows:
(Insert any other conditions for release of retainage upon ~~Substantial-Final~~ Completion.)

§ 5.1.8 If ~~F~~final Completion of the Work is materially delayed through no fault of the Contractor, the Owner shall pay the Contractor ~~any additional~~ amounts due and owing in accordance with Article 9 of AIA Document A201–2017, as amended by the Owner.

§ 5.1.9 Except with the Owner’s prior written approval or as otherwise provided in Section 9.3.2 of AIA Document A201-2017, as amended by the Owner, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

§ 5.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, minus disputed sums, authorized deductions and liquidated damages, shall be made by the Owner to the Contractor when

- .1 the Contractor has provided all close-out documents required by the Contract documents, and fully performed the Contract except for the Contractor’s responsibility to correct nonconforming Work as provided in Article 12 of AIA Document A201–2017, as amended by the Owner, and to satisfy other requirements, if any, which extend beyond final payment; ~~and~~
- .2 Contractor has submitted a final Application for Payment to the Architect, and has provided all documents required by Section 3.5 and Section 9.10.2 of the AIA Document A201-2017 as amended by the Owner; and
- .3 a final Certificate for Payment has been properly executed ~~issued~~ by the Architect.

§ 5.2.2 The Owner’s final payment to the Contractor shall be made no later than ~~4530~~ days after the issuance of the Architect’s final Certificate for Payment, except that no payment shall be considered not paid when due or past due except in accordance with Section 2251.021 of the Texas Government Code. ~~or as follows:~~

Undisputed pPayments due and unpaid under the Contract shall bear interest at a rate set forth by Texas Government Code 2251, or similarly applicable law from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.
(Insert rate of interest agreed upon, if any.)

PAGE 6

The Architect will serve as the Initial Decision Maker pursuant to Article 15 of AIA Document A201–2017, as amended by the Owner, unless the parties appoint below another individual, not a party to this Agreement, to serve as the Initial Decision Maker.
(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

For any Claim subject to, but not resolved by, mediation pursuant to Article 15 of AIA Document A201–2017, as amended by the Owner, the method of binding dispute resolution shall be as follows:
(Check the appropriate box.)

§ 7.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2017, as amended by the Owner.

§ 7.1.1 If the Contract is terminated for the Owner’s convenience in accordance with Article 14 of AIA Document A201–2017, then the Owner shall pay the Contractor a termination fee as follows:
(Insert the amount of, or method for determining, the fee, if any, payable to the Contractor following a termination for the Owner’s convenience.)

§ 8.4 ~~Neither the Owner’s nor the Contractor’s representative shall be changed without ten days’ prior notice to the other party.~~

PAGE 7

§ 8.5.1 ~~The Owner and the Contractor shall purchase and maintain insurance as set forth in AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, Exhibit A, Insurance and Bonds, and elsewhere in the Contract Documents.~~

§ 8.6 ~~Notice in electronic format, pursuant to Article 1 of AIA Document A201–2017, may be given in accordance with a building information modeling exhibit, if completed, or as otherwise set forth below:
(If other than in accordance with a building information modeling exhibit, insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)~~ INTENTIONALLY DELETED

§ 9.1 This Agreement is comprised of the following documents, in the event of any inconsistency or conflict between or amount the documents that comprise this Agreement, the order of precedence shall be:

- .1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor, as amended by the Owner
- .2 AIA Document A101™–2017, Exhibit A, Insurance and Bonds
- .4 Supplementary Conditions to the AIA Document A201-2017, as amended by the Owner ~~Building information modeling exhibit, dated as indicated below:
(Insert the date of the building information modeling exhibit incorporated into this Agreement.)~~

Portions of Addenda relating to bidding or competitive purchasing proposal requirements are not part of the Contract Documents unless the bidding or ~~proposal~~ competitive purchasing requirements are also enumerated in this Article 9.

PAGE 8

Document	Title	Date	Pages
	<u>Supplementary Conditions to AIA A201-2017 as amended by the Owner</u>		

Variable Information

PAGE 1

AGREEMENT made as of the Fifth day of December in the year Two Thousand Twenty-Four
(In words, indicate day, month and year.)

Humble Independent School District

10203 Birchridge Drive

Humble, TX 77338

(B2236)

Humble High School Phase 2

1700 Wilson Road

Humble, TX 77338

PBK Architects

11 E Greenway Plaza, 22nd Floor

Houston, TX 77046

PAGE 2

- The date of this Agreement.
- A date set forth in a notice to proceed issued by the Owner.
- Established as follows:
(Insert a date or a means to determine the date of commencement of the Work.)

The date of commencement shall be the day that the Contractor receives a Notice to Proceed from the Owner. If a permit, or other approvals, are not available for the entire Project, the Contractor must commence work on those portions of the Project that do not require a permit or other approvals on receipt of a Notice to Proceed. Work at the Project site shall not begin until Owner has received all required payment and performance bonds and insurance.

PAGE 3

- Not later than () calendar days from the date of commencement of the Work.
- By the following date: July 15, 2026

\$1,500.00 per day as set forth in Paragraphs 8.3.4 and 8.3.5 of the Supplementary Conditions to the A201-2017.

N/A

PAGE 4

N/A

§ 5.1.3 Provided that an Application for Payment is properly executed by the Architect, the Owner shall make payment of the amount certified to the Contractor no later than forty-five days. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner no later than Forty-Five (45) days after the Architect properly executes the Application for Payment, except that no payment shall be considered not paid when due or past due except in accordance with Section 2251.021 of the Texas Government Code.

(Federal, state or local laws may require payment within a certain period of time.)

PAGE 5

10% if contract valued at < \$5,000,000; 5% if contract is valued at \$5,000,000+

None.

Unless authorized in writing by the Owner in writing, retainage is not due and owing until Final Payment.

N/A

PAGE 6

0.00 % per annum monthly

- Arbitration pursuant to Section 15.4 of AIA Document A201–2017
- Litigation in a court of competent jurisdiction
- Other (*Specify*)

Dr. Jason Seybert

Associate Superintendent of Operational Support Services

1703 Wilson Rd., Bldg. B

Humble, TX 77396

281-641-8712

jason.seybert@humbleisd.net

PAGE 7

As designated by the Owner, Contractor will be responsible for inputting project documentation related to the services provided under this Agreement into the Owner's project management software. Owner will be responsible for providing all necessary licenses

PAGE 8

Supplementary and other Conditions of the Contract:

- .1 EDGAR Certifications (executed; on file in Purchasing Dept.)
- .2 FEMA Certifications (if applicable)
- .3 The Project Manual for the Project, including all sections to same, whether issued or created prior to or after the execution of this Agreement.
- .4 Statutory Payment and Performance Bonds.
- .5 Certificates of Insurance required of the Contractor.
- .6 Scale/Schedule of Prevailing Wages.
- .7 Modifications to any Contract Documents executed by duly authorized representatives of both the Parties.
- .8 Any documents stated in this Agreement as being a part of or incorporated into this Agreement or the Contract.

Certification of Document's Authenticity

AIA® Document D401™ – 2003

I, , hereby certify, to the best of my knowledge, information and belief, that I created the attached final document simultaneously with its associated Additions and Deletions Report and this certification at 09:23:06 CST on 12/06/2024 under Order No. 20240043200 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document A101™ - 2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, other than those additions and deletions shown in the associated Additions and Deletions Report.

(Signed)

(Title)

(Dated)



AIA® Document A201® – 2017

General Conditions of the Contract for Construction

for the following PROJECT:

(Name and location or address)

Humble High School Phase 2
1700 Wilson Road
Humble, TX 77338

THE OWNER:

(Name, legal status and address)

Humble Independent School District
10203 Birchridge Drive
Humble, TX 77338

THE ARCHITECT:

(Name, legal status and address)

PBK Architects, Inc.
11 Greenway Plaza, 22nd Floor
Houston, TX 77046

TABLE OF ARTICLES

- 1 GENERAL PROVISIONS
- 2 OWNER
- 3 CONTRACTOR
- 4 ARCHITECT
- 5 SUBCONTRACTORS
- 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS
- 7 CHANGES IN THE WORK
- 8 TIME
- 9 PAYMENTS AND COMPLETION
- 10 PROTECTION OF PERSONS AND PROPERTY
- 11 INSURANCE AND BONDS
- 12 UNCOVERING AND CORRECTION OF WORK
- 13 MISCELLANEOUS PROVISIONS

ADDITIONS AND DELETIONS:

The author of this document may have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

For guidance in modifying this document to include supplementary conditions, see AIA Document A503™–2017, Guide for Supplementary Conditions.

14 TERMINATION OR SUSPENSION OF THE CONTRACT

15 CLAIMS AND DISPUTES



INDEX

(Topics and numbers in bold are Section headings.)

Acceptance of Nonconforming Work

9.6.6, 9.9.3, **12.3**

Acceptance of Work

9.6.6, 9.8.2, 9.9.3, 9.10.1, 9.10.3, **12.3**

Access to Work

3.16, 6.2.1, 12.1

Accident Prevention

10

Acts and Omissions

3.2, 3.3.2, 3.12.8, 3.18, 4.2.3, 8.3.1, 9.5.1, 10.2.5,
10.2.8, 13.3.2, 14.1, 15.1.2, 15.2

Addenda

1.1.1

Additional Costs, Claims for

3.7.4, 3.7.5, 10.3.2, 15.1.5

Additional Inspections and Testing

9.4.2, 9.8.3, 12.2.1, **13.4**

Additional Time, Claims for

3.2.4, 3.7.4, 3.7.5, 3.10.2, 8.3.2, **15.1.6**

Administration of the Contract

3.1.3, **4.2**, 9.4, 9.5

Advertisement or Invitation to Bid

1.1.1

Aesthetic Effect

4.2.13

Allowances

3.8

Applications for Payment

4.2.5, 7.3.9, 9.2, **9.3**, 9.4, 9.5.1, 9.5.4, 9.6.3, 9.7, 9.10

Approvals

2.1.1, 2.3.1, 2.5, 3.1.3, 3.10.2, 3.12.8, 3.12.9,

3.12.10.1, 4.2.7, 9.3.2, 13.4.1

Arbitration

8.3.1, 15.3.2, **15.4**

ARCHITECT

4

Architect, Definition of

4.1.1

Architect, Extent of Authority

2.5, 3.12.7, 4.1.2, 4.2, 5.2, 6.3, 7.1.2, 7.3.4, 7.4, 9.2,
9.3.1, 9.4, 9.5, 9.6.3, 9.8, 9.10.1, 9.10.3, 12.1, 12.2.1,
13.4.1, 13.4.2, 14.2.2, 14.2.4, 15.1.4, 15.2.1

Architect, Limitations of Authority and
Responsibility

2.1.1, 3.12.4, 3.12.8, 3.12.10, 4.1.2, 4.2.1, 4.2.2,
4.2.3, 4.2.6, 4.2.7, 4.2.10, 4.2.12, 4.2.13, 5.2.1, 7.4,
9.4.2, 9.5.4, 9.6.4, 15.1.4, 15.2

Architect's Additional Services and Expenses

2.5, 12.2.1, 13.4.2, 13.4.3, 14.2.4

Architect's Administration of the Contract

3.1.3, 3.7.4, 15.2, 9.4.1, 9.5

Architect's Approvals

2.5, 3.1.3, 3.5, 3.10.2, 4.2.7

Architect's Authority to Reject Work

3.5, 4.2.6, 12.1.2, 12.2.1

Architect's Copyright

1.1.7, 1.5

Architect's Decisions

3.7.4, 4.2.6, 4.2.7, 4.2.11, 4.2.12, 4.2.13, 4.2.14, 6.3,
7.3.4, 7.3.9, 8.1.3, 8.3.1, 9.2, 9.4.1, 9.5, 9.8.4, 9.9.1,
13.4.2, 15.2

Architect's Inspections

3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.8.3, 9.9.2, 9.10.1, 13.4

Architect's Instructions

3.2.4, 3.3.1, 4.2.6, 4.2.7, 13.4.2

Architect's Interpretations

4.2.11, 4.2.12

Architect's Project Representative

4.2.10

Architect's Relationship with Contractor

1.1.2, 1.5, 2.3.3, 3.1.3, 3.2.2, 3.2.3, 3.2.4, 3.3.1, 3.4.2,
3.5, 3.7.4, 3.7.5, 3.9.2, 3.9.3, 3.10, 3.11, 3.12, 3.16,
3.18, 4.1.2, 4.2, 5.2, 6.2.2, 7, 8.3.1, 9.2, 9.3, 9.4, 9.5,
9.7, 9.8, 9.9, 10.2.6, 10.3, 11.3, 12, 13.3.2, 13.4, 15.2

Architect's Relationship with Subcontractors

1.1.2, 4.2.3, 4.2.4, 4.2.6, 9.6.3, 9.6.4, 11.3

Architect's Representations

9.4.2, 9.5.1, 9.10.1

Architect's Site Visits

3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.5.1, 9.9.2, 9.10.1, 13.4

Asbestos

10.3.1

Attorneys' Fees

3.18.1, 9.6.8, 9.10.2, 10.3.3

Award of Separate Contracts

6.1.1, 6.1.2

Award of Subcontracts and Other Contracts for Portions of the Work

5.2

Basic Definitions

1.1

Bidding Requirements

1.1.1

Binding Dispute Resolution

8.3.1, 9.7, 11.5, 13.1, 15.1.2, 15.1.3, 15.2.1, 15.2.5,
15.2.6.1, 15.3.1, 15.3.2, 15.3.3, 15.4.1

Bonds, Lien

7.3.4.4, 9.6.8, 9.10.2, 9.10.3

Bonds, Performance, and Payment

7.3.4.4, 9.6.7, 9.10.3, **11.1.2**, 11.1.3, **11.5**

Building Information Models Use and Reliance

1.8

Building Permit

3.7.1

Capitalization

1.3

Certificate of Substantial Completion

9.8.3, 9.8.4, 9.8.5

Certificates for Payment

4.2.1, 4.2.5, 4.2.9, 9.3.3, **9.4**, 9.5, 9.6.1, 9.6.6, 9.7,
9.10.1, 9.10.3, 14.1.1.3, 14.2.4, 15.1.4

Certificates of Inspection, Testing or Approval
13.4.4

Certificates of Insurance

9.10.2

Change Orders

1.1.1, 3.4.2, 3.7.4, 3.8.2.3, 3.11, 3.12.8, 4.2.8, 5.2.3, 7.1.2, 7.1.3, **7.2**, 7.3.2, 7.3.7, 7.3.9, 7.3.10, 8.3.1, 9.3.1.1, 9.10.3, 10.3.2, 11.2, 11.5, 12.1.2

Change Orders, Definition of
7.2.1

CHANGES IN THE WORK

2.2.2, 3.11, 4.2.8, **7**, 7.2.1, 7.3.1, 7.4, 8.3.1, 9.3.1.1, 11.5

Claims, Definition of
15.1.1

Claims, Notice of
1.6.2, 15.1.3

CLAIMS AND DISPUTES

3.2.4, 6.1.1, 6.3, 7.3.9, 9.3.3, 9.10.4, 10.3.3, **15**, 15.4
Claims and Timely Assertion of Claims
15.4.1

Claims for Additional Cost

3.2.4, 3.3.1, 3.7.4, 7.3.9, 9.5.2, 10.2.5, 10.3.2, **15.1.5**

Claims for Additional Time

3.2.4, 3.3.1, 3.7.4, 6.1.1, 8.3.2, 9.5.2, 10.3.2, **15.1.6**

Concealed or Unknown Conditions, Claims for **3.7.4**

Claims for Damages

3.2.4, 3.18, 8.3.3, 9.5.1, 9.6.7, 10.2.5, 10.3.3, 11.3, 11.3.2, 14.2.4, 15.1.7

Claims Subject to Arbitration
15.4.1

Cleaning Up

3.15, 6.3

Commencement of the Work, Conditions Relating to
2.2.1, 3.2.2, 3.4.1, 3.7.1, 3.10.1, 3.12.6, 5.2.1, 5.2.3, 6.2.2, 8.1.2, 8.2.2, 8.3.1, 11.1, 11.2, **15.1.5**

Commencement of the Work, Definition of
8.1.2

Communications

3.9.1, **4.2.4**

Completion, Conditions Relating to

3.4.1, 3.11, 3.15, 4.2.2, 4.2.9, 8.2, 9.4.2, 9.8, 9.9.1, 9.10, 12.2, 14.1.2, 15.1.2

COMPLETION, PAYMENTS AND **9**

Completion, Substantial

3.10.1, 4.2.9, 8.1.1, 8.1.3, 8.2.3, 9.4.2, 9.8, 9.9.1, 9.10.3, 12.2, 15.1.2

Compliance with Laws

2.3.2, 3.2.3, 3.6, 3.7, 3.12.10, 3.13, 9.6.4, 10.2.2, 13.1, 13.3, 13.4.1, 13.4.2, 13.5, 14.1.1, 14.2.1.3, 15.2.8, 15.4.2, 15.4.3

Concealed or Unknown Conditions

3.7.4, 4.2.8, 8.3.1, 10.3

Conditions of the Contract

1.1.1, 6.1.1, 6.1.4

Consent, Written

3.4.2, 3.14.2, 4.1.2, 9.8.5, 9.9.1, 9.10.2, 9.10.3, 13.2, 15.4.4.2

Consolidation or Joinder

15.4.4

CONSTRUCTION BY OWNER OR BY **SEPARATE CONTRACTORS**

1.1.4, **6**

Construction Change Directive, Definition of
7.3.1

Construction Change Directives

1.1.1, 3.4.2, 3.11, 3.12.8, 4.2.8, 7.1.1, 7.1.2, 7.1.3, **7.3**, 9.3.1.1

Construction Schedules, Contractor's

3.10, 3.11, 3.12.1, 3.12.2, 6.1.3, 15.1.6.2

Contingent Assignment of Subcontracts

5.4, 14.2.2.2

Continuing Contract Performance

15.1.4

Contract, Definition of

1.1.2

CONTRACT, TERMINATION OR **SUSPENSION OF THE**

5.4.1.1, 5.4.2, 11.5, **14**

Contract Administration

3.1.3, 4, 9.4, 9.5

Contract Award and Execution, Conditions Relating to

3.7.1, 3.10, 5.2, 6.1

Contract Documents, Copies Furnished and Use of
1.5.2, 2.3.6, 5.3

Contract Documents, Definition of

1.1.1

Contract Sum

2.2.2, 2.2.4, 3.7.4, 3.7.5, 3.8, 3.10.2, 5.2.3, 7.3, 7.4, **9.1**, 9.2, 9.4.2, 9.5.1.4, 9.6.7, 9.7, 10.3.2, 11.5, 12.1.2, 12.3, 14.2.4, 14.3.2, 15.1.4.2, **15.1.5**, **15.2.5**

Contract Sum, Definition of

9.1

Contract Time

1.1.4, 2.2.1, 2.2.2, 3.7.4, 3.7.5, 3.10.2, 5.2.3, 6.1.5, 7.2.1.3, 7.3.1, 7.3.5, 7.3.6, 7, 7, 7.3.10, 7.4, 8.1.1, 8.2.1, 8.2.3, 8.3.1, 9.5.1, 9.7, 10.3.2, 12.1.1, 12.1.2, 14.3.2, 15.1.4.2, 15.1.6.1, 15.2.5

Contract Time, Definition of

8.1.1

CONTRACTOR

3

Contractor, Definition of

3.1, **6.1.2**

Contractor's Construction and Submittal **Schedules**

3.10, 3.12.1, 3.12.2, 4.2.3, 6.1.3, 15.1.6.2

Contractor's Employees

2.2.4, 3.3.2, 3.4.3, 3.8.1, 3.9, 3.18.2, 4.2.3, 4.2.6, 10.2, 10.3, 11.3, 14.1, 14.2.1.1

Contractor's Liability Insurance

11.1

Contractor's Relationship with Separate Contractors and Owner's Forces

3.12.5, 3.14.2, 4.2.4, 6, 11.3, 12.2.4

Contractor's Relationship with Subcontractors

1.2.2, 2.2.4, 3.3.2, 3.18.1, 3.18.2, 4.2.4, 5, 9.6.2, 9.6.7, 9.10.2, 11.2, 11.3, 11.4

Contractor's Relationship with the Architect

1.1.2, 1.5, 2.3.3, 3.1.3, 3.2.2, 3.2.3, 3.2.4, 3.3.1, 3.4.2, 3.5.1, 3.7.4, 3.10, 3.11, 3.12, 3.16, 3.18, 4.2, 5.2, 6.2.2, 7, 8.3.1, 9.2, 9.3, 9.4, 9.5, 9.7, 9.8, 9.9, 10.2.6,

10.3, 11.3, 12, 13.4, 15.1.3, 15.2.1
Contractor's Representations
3.2.1, 3.2.2, 3.5, 3.12.6, 6.2.2, 8.2.1, 9.3.3, 9.8.2
Contractor's Responsibility for Those Performing the Work
3.3.2, 3.18, 5.3, 6.1.3, 6.2, 9.5.1, 10.2.8
Contractor's Review of Contract Documents
3.2
Contractor's Right to Stop the Work
2.2.2, 9.7
Contractor's Right to Terminate the Contract
14.1
Contractor's Submittals
3.10, 3.11, 3.12, 4.2.7, 5.2.1, 5.2.3, 9.2, 9.3, 9.8.2, 9.8.3, 9.9.1, 9.10.2, 9.10.3
Contractor's Superintendent
3.9, 10.2.6
Contractor's Supervision and Construction Procedures
1.2.2, 3.3, 3.4, 3.12.10, 4.2.2, 4.2.7, 6.1.3, 6.2.4, 7.1.3, 7.3.4, 7.3.6, 8.2, 10, 12, 14, 15.1.4
Coordination and Correlation
1.2, 3.2.1, 3.3.1, 3.10, 3.12.6, 6.1.3, 6.2.1
Copies Furnished of Drawings and Specifications
1.5, 2.3.6, 3.11
Copyrights
1.5, **3.17**
Correction of Work
2.5, 3.7.3, 9.4.2, 9.8.2, 9.8.3, 9.9.1, 12.1.2, **12.2**, 12.3, 15.1.3.1, 15.1.3.2, 15.2.1
Correlation and Intent of the Contract Documents
1.2
Cost, Definition of
7.3.4
Costs
2.5, 3.2.4, 3.7.3, 3.8.2, 3.15.2, 5.4.2, 6.1.1, 6.2.3, 7.3.3.3, 7.3.4, 7.3.8, 7.3.9, 9.10.2, 10.3.2, 10.3.6, 11.2, 12.1.2, 12.2.1, 12.2.4, 13.4, 14
Cutting and Patching
3.14, 6.2.5
Damage to Construction of Owner or Separate Contractors
3.14.2, 6.2.4, 10.2.1.2, 10.2.5, 10.4, 12.2.4
Damage to the Work
3.14.2, 9.9.1, 10.2.1.2, 10.2.5, 10.4, 12.2.4
Damages, Claims for
3.2.4, 3.18, 6.1.1, 8.3.3, 9.5.1, 9.6.7, 10.3.3, 11.3.2, 11.3, 14.2.4, 15.1.7
Damages for Delay
6.2.3, 8.3.3, 9.5.1.6, 9.7, 10.3.2, 14.3.2
Date of Commencement of the Work, Definition of
8.1.2
Date of Substantial Completion, Definition of
8.1.3
Day, Definition of
8.1.4
Decisions of the Architect
3.7.4, 4.2.6, 4.2.7, 4.2.11, 4.2.12, 4.2.13, 6.3, 7.3.4, 7.3.9, 8.1.3, 8.3.1, 9.2, 9.4, 9.5.1, 9.8.4, 9.9.1, 13.4.2, 14.2.2, 14.2.4, 15.1, 15.2

Decisions to Withhold Certification

9.4.1, **9.5**, 9.7, 14.1.1.3
Defective or Nonconforming Work, Acceptance, Rejection and Correction of
2.5, 3.5, 4.2.6, 6.2.3, 9.5.1, 9.5.3, 9.6.6, 9.8.2, 9.9.3, 9.10.4, 12.2.1
Definitions
1.1, 2.1.1, 3.1.1, 3.5, 3.12.1, 3.12.2, 3.12.3, 4.1.1, 5.1, 6.1.2, 7.2.1, 7.3.1, 8.1, 9.1, 9.8.1, 15.1.1

Delays and Extensions of Time

3.2, **3.7.4**, 5.2.3, 7.2.1, 7.3.1, **7.4**, **8.3**, 9.5.1, **9.7**, 10.3.2, **10.4**, 14.3.2, **15.1.6**, 15.2.5

Digital Data Use and Transmission

1.7

Disputes
6.3, 7.3.9, 15.1, 15.2

Documents and Samples at the Site

3.11

Drawings, Definition of

1.1.5

Drawings and Specifications, Use and Ownership of
3.11

Effective Date of Insurance

8.2.2

Emergencies

10.4, 14.1.1.2, **15.1.5**

Employees, Contractor's

3.3.2, 3.4.3, 3.8.1, 3.9, 3.18.2, 4.2.3, 4.2.6, 10.2, 10.3.3, 11.3, 14.1, 14.2.1.1

Equipment, Labor, or Materials

1.1.3, 1.1.6, 3.4, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1, 4.2.6, 4.2.7, 5.2.1, 6.2.1, 7.3.4, 9.3.2, 9.3.3, 9.5.1.3, 9.10.2, 10.2.1, 10.2.4, 14.2.1.1, 14.2.1.2

Execution and Progress of the Work

1.1.3, 1.2.1, 1.2.2, 2.3.4, 2.3.6, 3.1, 3.3.1, 3.4.1, 3.7.1, 3.10.1, 3.12, 3.14, 4.2, 6.2.2, 7.1.3, 7.3.6, 8.2, 9.5.1, 9.9.1, 10.2, 10.3, 12.1, 12.2, 14.2, 14.3.1, 15.1.4

Extensions of Time

3.2.4, 3.7.4, 5.2.3, 7.2.1, 7.3, 7.4, 9.5.1, 9.7, 10.3.2, 10.4, 14.3, 15.1.6, **15.2.5**

Failure of Payment

9.5.1.3, **9.7**, 9.10.2, 13.5, 14.1.1.3, 14.2.1.2

Faulty Work

(See Defective or Nonconforming Work)

Final Completion and Final Payment

4.2.1, 4.2.9, 9.8.2, **9.10**, 12.3, 14.2.4, 14.4.3

Financial Arrangements, Owner's

2.2.1, 13.2.2, 14.1.1.4

GENERAL PROVISIONS

1

Governing Law

13.1

Guarantees (See Warranty)

Hazardous Materials and Substances

10.2.4, **10.3**

Identification of Subcontractors and Suppliers

5.2.1

Indemnification

3.17, **3.18**, 9.6.8, 9.10.2, 10.3.3, 11.3

Information and Services Required of the Owner

2.1.2, **2.2**, 2.3, 3.2.2, 3.12.10.1, 6.1.3, 6.1.4, 6.2.5, 9.6.1, 9.9.2, 9.10.3, 10.3.3, 11.2, 13.4.1, 13.4.2, 14.1.1.4, 14.1.4, 15.1.4

Initial Decision

15.2

Initial Decision Maker, Definition of

1.1.8

Initial Decision Maker, Decisions

14.2.4, 15.1.4.2, 15.2.1, 15.2.2, 15.2.3, 15.2.4, 15.2.5

Initial Decision Maker, Extent of Authority

14.2.4, 15.1.4.2, 15.2.1, 15.2.2, 15.2.3, 15.2.4, 15.2.5

Injury or Damage to Person or Property

10.2.8, 10.4

Inspections

3.1.3, 3.3.3, 3.7.1, 4.2.2, 4.2.6, 4.2.9, 9.4.2, 9.8.3,

9.9.2, 9.10.1, 12.2.1, 13.4

Instructions to Bidders

1.1.1

Instructions to the Contractor

3.2.4, 3.3.1, 3.8.1, 5.2.1, 7, 8.2.2, 12, 13.4.2

Instruments of Service, Definition of

1.1.7

Insurance

6.1.1, 7.3.4, 8.2.2, 9.3.2, 9.8.4, 9.9.1, 9.10.2, 10.2.5,

11

Insurance, Notice of Cancellation or Expiration

11.1.4, 11.2.3

Insurance, Contractor's Liability

11.1

Insurance, Effective Date of

8.2.2, 14.4.2

Insurance, Owner's Liability

11.2

Insurance, Property

10.2.5, 11.2, 11.4, 11.5

Insurance, Stored Materials

9.3.2

INSURANCE AND BONDS

11

Insurance Companies, Consent to Partial Occupancy

9.9.1

Insured loss, Adjustment and Settlement of

11.5

Intent of the Contract Documents

1.2.1, 4.2.7, 4.2.12, 4.2.13

Interest

13.5

Interpretation

1.1.8, 1.2.3, **1.4**, 4.1.1, 5.1, 6.1.2, 15.1.1

Interpretations, Written

4.2.11, 4.2.12

Judgment on Final Award

15.4.2

Labor and Materials, Equipment

1.1.3, 1.1.6, **3.4**, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1,

5.2.1, 6.2.1, 7.3.4, 9.3.2, 9.3.3, 9.5.1.3, 9.10.2, 10.2.1,

10.2.4, 14.2.1.1, 14.2.1.2

Labor Disputes

8.3.1

Laws and Regulations

1.5, 2.3.2, 3.2.3, 3.2.4, 3.6, 3.7, 3.12.10, 3.13, 9.6.4, 9.9.1, 10.2.2, 13.1, 13.3.1, 13.4.2, 13.5, 14, 15.2.8, 15.4

Liens

2.1.2, 9.3.1, 9.3.3, 9.6.8, 9.10.2, 9.10.4, 15.2.8

Limitations, Statutes of

12.2.5, 15.1.2, 15.4.1.1

Limitations of Liability

3.2.2, 3.5, 3.12.10, 3.12.10.1, 3.17, 3.18.1, 4.2.6,

4.2.7, 6.2.2, 9.4.2, 9.6.4, 9.6.7, 9.6.8, 10.2.5, 10.3.3,

11.3, 12.2.5, 13.3.1

Limitations of Time

2.1.2, 2.2, 2.5, 3.2.2, 3.10, 3.11, 3.12.5, 3.15.1, 4.2.7,

5.2, 5.3, 5.4.1, 6.2.4, 7.3, 7.4, 8.2, 9.2, 9.3.1, 9.3.3,

9.4.1, 9.5, 9.6, 9.7, 9.8, 9.9, 9.10, 12.2, 13.4, 14, 15,

15.1.2, 15.1.3, 15.1.5

Materials, Hazardous

10.2.4, 10.3

Materials, Labor, Equipment and

1.1.3, 1.1.6, 3.4.1, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1,

5.2.1, 6.2.1, 7.3.4, 9.3.2, 9.3.3, 9.5.1.3, 9.10.2,

10.2.1.2, 10.2.4, 14.2.1.1, 14.2.1.2

Means, Methods, Techniques, Sequences and

Procedures of Construction

3.3.1, 3.12.10, 4.2.2, 4.2.7, 9.4.2

Mechanic's Lien

2.1.2, 9.3.1, 9.3.3, 9.6.8, 9.10.2, 9.10.4, 15.2.8

Mediation

8.3.1, 15.1.3.2, 15.2.1, 15.2.5, 15.2.6, **15.3**, 15.4.1,

15.4.1.1

Minor Changes in the Work

1.1.1, 3.4.2, 3.12.8, 4.2.8, 7.1, 7.4

MISCELLANEOUS PROVISIONS

13

Modifications, Definition of

1.1.1

Modifications to the Contract

1.1.1, 1.1.2, 2.5, 3.11, 4.1.2, 4.2.1, 5.2.3, 7, 8.3.1, 9.7,

10.3.2

Mutual Responsibility

6.2

Nonconforming Work, Acceptance of

9.6.6, 9.9.3, **12.3**

Nonconforming Work, Rejection and Correction of

2.4, 2.5, 3.5, 4.2.6, 6.2.4, 9.5.1, 9.8.2, 9.9.3, 9.10.4,

12.2

Notice

1.6, 1.6.1, 1.6.2, 2.1.2, 2.2.2., 2.2.3, 2.2.4, 2.5, 3.2.4,

3.3.1, 3.7.4, 3.7.5, 3.9.2, 3.12.9, 3.12.10, 5.2.1, 7.4,

8.2.2, 9.6.8, 9.7, 9.10.1, 10.2.8, 10.3.2, 11.5, 12.2.2.1,

13.4.1, 13.4.2, 14.1, 14.2.2, 14.4.2, 15.1.3, 15.1.5,

15.1.6, 15.4.1

Notice of Cancellation or Expiration of Insurance

11.1.4, 11.2.3

Notice of Claims

1.6.2, 2.1.2, 3.7.4, 9.6.8, 10.2.8, **15.1.3**, 15.1.5,

15.1.6, 15.2.8, 15.3.2, 15.4.1

Notice of Testing and Inspections

13.4.1, 13.4.2

Observations, Contractor's

3.2, 3.7.4
Occupancy
2.3.1, 9.6.6, 9.8
Orders, Written
1.1.1, 2.4, 3.9.2, 7, 8.2.2, 11.5, 12.1, 12.2.2.1, 13.4.2,
14.3.1

OWNER

2

Owner, Definition of

2.1.1

Owner, Evidence of Financial Arrangements

2.2, 13.2.2, 14.1.1.4

Owner, Information and Services Required of the

2.1.2, **2.2**, 2.3, 3.2.2, 3.12.10, 6.1.3, 6.1.4, 6.2.5,
9.3.2, 9.6.1, 9.6.4, 9.9.2, 9.10.3, 10.3.3, 11.2, 13.4.1,
13.4.2, 14.1.1.4, 14.1.4, 15.1.4

Owner's Authority

1.5, 2.1.1, 2.3.32.4, 2.5, 3.4.2, 3.8.1, 3.12.10, 3.14.2,
4.1.2, 4.2.4, 4.2.9, 5.2.1, 5.2.4, 5.4.1, 6.1, 6.3, 7.2.1,
7.3.1, 8.2.2, 8.3.1, 9.3.2, 9.5.1, 9.6.4, 9.9.1, 9.10.2,
10.3.2, 11.4, 11.5, 12.2.2, 12.3, 13.2.2, 14.3, 14.4,
15.2.7

Owner's Insurance

11.2

Owner's Relationship with Subcontractors

1.1.2, 5.2, 5.3, 5.4, 9.6.4, 9.10.2, 14.2.2

Owner's Right to Carry Out the Work

2.5, 14.2.2

Owner's Right to Clean Up

6.3

**Owner's Right to Perform Construction and to
Award Separate Contracts**

6.1

Owner's Right to Stop the Work

2.4

Owner's Right to Suspend the Work

14.3

Owner's Right to Terminate the Contract

14.2, 14.4

**Ownership and Use of Drawings, Specifications
and Other Instruments of Service**

1.1.1, 1.1.6, 1.1.7, **1.5**, 2.3.6, 3.2.2, 3.11, 3.17, 4.2.12,
5.3

Partial Occupancy or Use

9.6.6, **9.9**

Patching, Cutting and

3.14, 6.2.5

Patents

3.17

Payment, Applications for

4.2.5, 7.3.9, 9.2, **9.3**, 9.4, 9.5, 9.6.3, 9.7, 9.8.5, 9.10.1,
14.2.3, 14.2.4, 14.4.3

Payment, Certificates for

4.2.5, 4.2.9, 9.3.3, **9.4**, 9.5, 9.6.1, 9.6.6, 9.7, 9.10.1,
9.10.3, 14.1.1.3, 14.2.4

Payment, Failure of

9.5.1.3, **9.7**, 9.10.2, 13.5, 14.1.1.3, 14.2.1.2

Payment, Final

4.2.1, 4.2.9, **9.10**, 12.3, 14.2.4, 14.4.3

Payment Bond, Performance Bond and

7.3.4.4, 9.6.7, 9.10.3, **11.1.2**

Payments, Progress

9.3, **9.6**, 9.8.5, 9.10.3, 14.2.3, 15.1.4

PAYMENTS AND COMPLETION

9

Payments to Subcontractors

5.4.2, 9.5.1.3, 9.6.2, 9.6.3, 9.6.4, 9.6.7, 14.2.1.2

PCB

10.3.1

Performance Bond and Payment Bond

7.3.4.4, 9.6.7, 9.10.3, **11.1.2**

Permits, Fees, Notices and Compliance with Laws

2.3.1, **3.7**, 3.13, 7.3.4.4, 10.2.2

**PERSONS AND PROPERTY, PROTECTION
OF**

10

Polychlorinated Biphenyl

10.3.1

Product Data, Definition of

3.12.2

Product Data and Samples, Shop Drawings

3.11, **3.12**, 4.2.7

Progress and Completion

4.2.2, **8.2**, 9.8, 9.9.1, 14.1.4, 15.1.4

Progress Payments

9.3, **9.6**, 9.8.5, 9.10.3, 14.2.3, 15.1.4

Project, Definition of

1.1.4

Project Representatives

4.2.10

Property Insurance

10.2.5, **11.2**

Proposal Requirements

1.1.1

**PROTECTION OF PERSONS AND PROPERTY
10**

Regulations and Laws

1.5, 2.3.2, 3.2.3, 3.6, 3.7, 3.12.10, 3.13, 9.6.4, 9.9.1,
10.2.2, 13.1, 13.3, 13.4.1, 13.4.2, 13.5, 14, 15.2.8,
15.4

Rejection of Work

4.2.6, 12.2.1

Releases and Waivers of Liens

9.3.1, 9.10.2

Representations

3.2.1, 3.5, 3.12.6, 8.2.1, 9.3.3, 9.4.2, 9.5.1, 9.10.1

Representatives

2.1.1, 3.1.1, 3.9, 4.1.1, 4.2.10, 13.2.1

Responsibility for Those Performing the Work

3.3.2, 3.18, 4.2.2, 4.2.3, 5.3, 6.1.3, 6.2, 6.3, 9.5.1, 10

Retainage

9.3.1, 9.6.2, 9.8.5, 9.9.1, 9.10.2, 9.10.3

**Review of Contract Documents and Field
Conditions by Contractor**

3.2, 3.12.7, 6.1.3

**Review of Contractor's Submittals by Owner and
Architect**

3.10.1, 3.10.2, 3.11, 3.12, 4.2, 5.2, 6.1.3, 9.2, 9.8.2

Review of Shop Drawings, Product Data and

Samples by Contractor

3.12
Rights and Remedies
 1.1.2, 2.4, 2.5, 3.5, 3.7.4, 3.15.2, 4.2.6, 5.3, 5.4, 6.1, 6.3, 7.3.1, 8.3, 9.5.1, 9.7, 10.2.5, 10.3, 12.2.1, 12.2.2, 12.2.4, **13.3**, 14, 15.4
Royalties, Patents and Copyrights
3.17
 Rules and Notices for Arbitration
 15.4.1
Safety of Persons and Property
10.2, 10.4
Safety Precautions and Programs
 3.3.1, 4.2.2, 4.2.7, 5.3, **10.1**, 10.2, 10.4
Samples, Definition of
3.12.3
Samples, Shop Drawings, Product Data and
 3.11, **3.12**, 4.2.7
Samples at the Site, Documents and
3.11
Schedule of Values
9.2, 9.3.1
 Schedules, Construction
 3.10, 3.12.1, 3.12.2, 6.1.3, 15.1.6.2
 Separate Contracts and Contractors
 1.1.4, 3.12.5, 3.14.2, 4.2.4, 4.2.7, 6, 8.3.1, 12.1.2
Separate Contractors, Definition of
6.1.1
Shop Drawings, Definition of
3.12.1
Shop Drawings, Product Data and Samples
 3.11, **3.12**, 4.2.7
Site, Use of
3.13, 6.1.1, 6.2.1
 Site Inspections
 3.2.2, 3.3.3, 3.7.1, 3.7.4, 4.2, 9.9.2, 9.4.2, 9.10.1, 13.4
 Site Visits, Architect's
 3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.5.1, 9.9.2, 9.10.1, 13.4
 Special Inspections and Testing
 4.2.6, 12.2.1, 13.4
Specifications, Definition of
1.1.6
Specifications
 1.1.1, **1.1.6**, 1.2.2, 1.5, 3.12.10, 3.17, 4.2.14
 Statute of Limitations
 15.1.2, 15.4.1.1
 Stopping the Work
 2.2.2, 2.4, 9.7, 10.3, 14.1
 Stored Materials
 6.2.1, 9.3.2, 10.2.1.2, 10.2.4
Subcontractor, Definition of
5.1.1
SUBCONTRACTORS
5
 Subcontractors, Work by
 1.2.2, 3.3.2, 3.12.1, 3.18, 4.2.3, 5.2.3, 5.3, 5.4, 9.3.1.2, 9.6.7
Subcontractual Relations
5.3, 5.4, 9.3.1.2, 9.6, 9.10, 10.2.1, 14.1, 14.2.1
 Submittals
 3.10, 3.11, 3.12, 4.2.7, 5.2.1, 5.2.3, 7.3.4, 9.2, 9.3, 9.8, 9.9.1, 9.10.2, 9.10.3
 Submittal Schedule
 3.10.2, 3.12.5, 4.2.7
Subrogation, Waivers of
 6.1.1, **11.3**
Substances, Hazardous
10.3
Substantial Completion
 4.2.9, 8.1.1, 8.1.3, 8.2.3, 9.4.2, **9.8**, 9.9.1, 9.10.3, 12.2, 15.1.2
Substantial Completion, Definition of
9.8.1
 Substitution of Subcontractors
 5.2.3, 5.2.4
 Substitution of Architect
 2.3.3
 Substitutions of Materials
 3.4.2, 3.5, 7.3.8
Sub-subcontractor, Definition of
5.1.2
 Subsurface Conditions
 3.7.4
Successors and Assigns
13.2
Superintendent
3.9, 10.2.6
Supervision and Construction Procedures
 1.2.2, **3.3**, 3.4, 3.12.10, 4.2.2, 4.2.7, 6.1.3, 6.2.4, 7.1.3, 7.3.4, 8.2, 8.3.1, 9.4.2, 10, 12, 14, 15.1.4
 Suppliers
 1.5, 3.12.1, 4.2.4, 4.2.6, 5.2.1, 9.3, 9.4.2, 9.5.4, 9.6, 9.10.5, 14.2.1
 Surety
 5.4.1.2, 9.6.8, 9.8.5, 9.10.2, 9.10.3, 11.1.2, 14.2.2, 15.2.7
 Surety, Consent of
 9.8.5, 9.10.2, 9.10.3
 Surveys
 1.1.7, 2.3.4
Suspension by the Owner for Convenience
14.3
 Suspension of the Work
 3.7.5, 5.4.2, 14.3
 Suspension or Termination of the Contract
 5.4.1.1, 14
Taxes
 3.6, 3.8.2.1, 7.3.4.4
Termination by the Contractor
14.1, 15.1.7
Termination by the Owner for Cause
 5.4.1.1, **14.2**, 15.1.7
Termination by the Owner for Convenience
14.4
 Termination of the Architect
 2.3.3
 Termination of the Contractor Employment
 14.2.2

TERMINATION OR SUSPENSION OF THE CONTRACT

14

Tests and Inspections

3.1.3, 3.3.3, 3.7.1, 4.2.2, 4.2.6, 4.2.9, 9.4.2, 9.8.3, 9.9.2, 9.10.1, 10.3.2, 12.2.1, **13.4**

TIME

8

Time, Delays and Extensions of

3.2.4, 3.7.4, 5.2.3, 7.2.1, 7.3.1, 7.4, **8.3**, 9.5.1, 9.7, 10.3.2, 10.4, 14.3.2, 15.1.6, 15.2.5

Time Limits

2.1.2, 2.2, 2.5, 3.2.2, 3.10, 3.11, 3.12.5, 3.15.1, 4.2, 5.2, 5.3, 5.4, 6.2.4, 7.3, 7.4, 8.2, 9.2, 9.3.1, 9.3.3, 9.4.1, 9.5, 9.6, 9.7, 9.8, 9.9, 9.10, 12.2, 13.4, 14, 15.1.2, 15.1.3, 15.4

Time Limits on Claims

3.7.4, 10.2.8, 15.1.2, 15.1.3

Title to Work

9.3.2, 9.3.3

UNCOVERING AND CORRECTION OF WORK

12

Uncovering of Work

12.1

Unforeseen Conditions, Concealed or Unknown

3.7.4, 8.3.1, 10.3

Unit Prices

7.3.3.2, 9.1.2

Use of Documents

1.1.1, 1.5, 2.3.6, 3.12.6, 5.3

Use of Site

3.13, 6.1.1, 6.2.1

Values, Schedule of

9.2, 9.3.1

Waiver of Claims by the Architect

13.3.2

Waiver of Claims by the Contractor

9.10.5, 13.3.2, **15.1.7**

Waiver of Claims by the Owner

9.9.3, 9.10.3, 9.10.4, 12.2.2.1, 13.3.2, 14.2.4, **15.1.7**

Waiver of Consequential Damages

14.2.4, 15.1.7

Waiver of Liens

9.3, 9.10.2, 9.10.4

Waivers of Subrogation

6.1.1, **11.3**

Warranty

3.5, 4.2.9, 9.3.3, 9.8.4, 9.9.1, 9.10.2, 9.10.4, 12.2.2, 15.1.2

Weather Delays

8.3, 15.1.6.2

Work, Definition of

1.1.3

Written Consent

1.5.2, 3.4.2, 3.7.4, 3.12.8, 3.14.2, 4.1.2, 9.3.2, 9.10.3, 13.2, 13.3.2, 15.4.4.2

Written Interpretations

4.2.11, 4.2.12

Written Orders

1.1.1, 2.4, 3.9, 7, 8.2.2, 12.1, 12.2, 13.4.2, 14.3.1

ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement, and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding or proposal requirements.

§ 1.1.2 The Contract

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants, or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

§ 1.1.3 The Work

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

§ 1.1.4 The Project

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by Separate Contractors.

§ 1.1.5 The Drawings

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

§ 1.1.6 The Specifications

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 Instruments of Service

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 Initial Decision Maker

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

§ 1.2 Correlation and Intent of the Contract Documents

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

§ 1.2.1.1 The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.3 Capitalization

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 Interpretation

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service

§ 1.5.1 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

§ 1.6 Notice

§ 1.6.1 Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

§ 1.6.2 Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

§ 1.7 Digital Data Use and Transmission

The parties shall agree upon written protocols governing the transmission and use of, and reliance on, Instruments of Service or any other information or documentation in digital form.

§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to written protocols governing the use of, and reliance on, the information contained in the model shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

ARTICLE 2 OWNER

§ 2.1 General

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

§ 2.1.2 The Owner shall furnish to the Contractor, within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of, or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

§ 2.2 Evidence of the Owner's Financial Arrangements

§ 2.2.1 Prior to commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 2.2.1, the Contract Time shall be extended appropriately.

§ 2.2.2 Following commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract only if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due; or (3) a change in the Work materially changes the Contract Sum. If the Owner fails to provide such evidence, as required, within fourteen days of the Contractor's request, the Contractor may immediately stop the Work and, in that event, shall notify the Owner that the Work has stopped. However, if the request is made because a change in the Work materially changes the Contract Sum under (3) above, the Contractor may immediately stop only that portion of the Work affected by the change until reasonable evidence is provided. If the Work is stopped under this Section 2.2.2, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided in the Contract Documents.

§ 2.2.3 After the Owner furnishes evidence of financial arrangements under this Section 2.2, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.4 Where the Owner has designated information furnished under this Section 2.2 as "confidential," the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. The Contractor may also disclose "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

§ 2.3 Information and Services Required of the Owner

§ 2.3.1 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 2.3.2 The Owner shall retain an architect lawfully licensed to practice architecture, or an entity lawfully practicing architecture, in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 2.3.3 If the employment of the Architect terminates, the Owner shall employ a successor to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.

§ 2.3.4 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 2.3.5 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.3.6 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

§ 2.4 Owner's Right to Stop the Work

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

§ 2.5 Owner's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect and the Architect may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15.

ARTICLE 3 CONTRACTOR

§ 3.1 General

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.3 The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the

purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner, subject to Section 15.1.7, as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.3 Supervision and Construction Procedures

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner and Architect, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. Unless the Architect objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences, or procedures.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.4 Labor and Materials

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 3.4.2 Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

§ 3.5 Warranty

§ 3.5.1 The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.5.2 All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4.

§ 3.6 Taxes

The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.7 Permits, Fees, Notices and Compliance with Laws

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 Concealed or Unknown Conditions

If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 3.8 Allowances

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct,

but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

- .1 allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- .2 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and
- .3 whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 Superintendent

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Architect may notify the Contractor, stating whether the Owner or the Architect (1) has reasonable objection to the proposed superintendent or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

§ 3.10 Contractor's Construction and Submittal Schedules

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project.

§ 3.10.2 The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Architect's approval. The Architect's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

§ 3.11 Documents and Samples at the Site

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner, and delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as

constructed.

§ 3.12 Shop Drawings, Product Data and Samples

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment, or workmanship, and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of Separate Contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall be entitled to rely upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The

Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Shop Drawings, and other submittals related to the Work, designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review and approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

§ 3.12.10.2 If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Architect at the time and in the form specified by the Architect.

§ 3.13 Use of Site

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.14 Cutting and Patching

§ 3.14.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting, or patching shall be restored to the condition existing prior to the cutting, fitting, or patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or Separate Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Owner or a Separate Contractor, its consent to cutting or otherwise altering the Work.

§ 3.15 Cleaning Up

§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials and rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 Access to Work

The Contractor shall provide the Owner and Architect with access to the Work in preparation and progress wherever located.

§ 3.17 Royalties, Patents and Copyrights

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications, or other documents prepared by the Owner or Architect. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect.

§ 3.18 Indemnification

§ 3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the

Work, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

ARTICLE 4 ARCHITECT

§ 4.1 General

§ 4.1.1 The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

§ 4.1.2 Duties, responsibilities, and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the Owner, Contractor, and Architect. Consent shall not be unreasonably withheld.

§ 4.2 Administration of the Contract

§ 4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 Communications

The Owner and Contractor shall include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

§ 4.2.5 Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may order minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. The Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives.

§ 4.2.11 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions rendered in good faith.

§ 4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a Separate Contractor or the subcontractors of a Separate Contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term “Sub-subcontractor” is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

§ 5.2.1 Unless otherwise stated in the Contract Documents, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor’s Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person, or entity for one previously selected if the Owner or Architect makes reasonable objection to such substitution.

§ 5.3 Subcontractual Relations

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor’s Work that the Contractor, by these Contract Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 Contingent Assignment of Subcontracts

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

- .1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and
- .2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor’s rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 Owner's Right to Perform Construction and to Award Separate Contracts

§ 6.1.1 The term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each Separate Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

§ 6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces or with Separate Contractors, the Owner or its Separate Contractors shall have the same obligations and rights that the Contractor has under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6, and Articles 10, 11, and 12.

§ 6.2 Mutual Responsibility

§ 6.2.1 The Contractor shall afford the Owner and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a Separate Contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a Separate Contractor's delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or Separate Contractor as provided in Section 10.2.5.

§ 6.2.5 The Owner and each Separate Contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, Separate Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor, and Architect. A Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor. An order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

§ 7.2 Change Orders

§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor, and Architect stating their agreement upon all of the following:

- .1 The change in the Work;
- .2 The amount of the adjustment, if any, in the Contract Sum; and
- .3 The extent of the adjustment, if any, in the Contract Time.

§ 7.3 Construction Change Directives

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

- .1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- .2 Unit prices stated in the Contract Documents or subsequently agreed upon;
- .3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
- .4 As provided in Section 7.3.4.

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

- .1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;
- .2 Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;

- .3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
- .4 Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and
- .5 Costs of supervision and field office personnel directly attributable to the change.

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

§ 7.3.6 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.7 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

ARTICLE 8 TIME

§ 8.1 Definitions

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 8.2 Progress and Completion

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.3 Delays and Extensions of Time

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by labor disputes, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending mediation and binding dispute resolution; or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may determine.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

§ 9.1.1 The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.1.2 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 9.2 Schedule of Values

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Architect. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the schedule of values shall be submitted to the Architect and supported by such data to substantiate its accuracy as the Architect may require, and unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

§ 9.3 Applications for Payment

§ 9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage if provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or supplier, unless such Work has been performed by others

whom the Contractor intends to pay.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage, and transportation to the site, for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information, and belief, be free and clear of liens, claims, security interests, or encumbrances, in favor of the Contractor, Subcontractors, suppliers, or other persons or entities that provided labor, materials, and equipment relating to the Work.

§ 9.4 Certificates for Payment

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the Architect. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 Decisions to Withhold Certification

§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

- .1 defective Work not remedied;
- .2 third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
- .3 failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;
- .4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- .5 damage to the Owner or a Separate Contractor;
- .6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay;

or
.7 repeated failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 When either party disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, that party may submit a Claim in accordance with Article 15.

§ 9.5.3 When the reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.4 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or supplier to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Contractor shall reflect such payment on its next Application for Payment.

§ 9.6 Progress Payments

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

§ 9.6.5 The Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.6.8 Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

§ 9.7 Failure of Payment

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents, the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.9 Partial Occupancy or Use

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 Final Completion and Final Payment

§ 9.10.1 Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and reasonable attorneys' fees.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

- .1 liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
- .2 failure of the Work to comply with the requirements of the Contract Documents;
- .3 terms of special warranties required by the Contract Documents; or
- .4 audits performed by the Owner, if permitted by the Contract Documents, after final payment.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.2 Safety of Persons and Property

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

- .1 employees on the Work and other persons who may be affected thereby;

- .2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and
- .3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

§ 10.2.2 The Contractor shall comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing on safety of persons or property or their protection from damage, injury, or loss.

§ 10.2.3 The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment, or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 Injury or Damage to Person or Property

If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.3 Hazardous Materials and Substances

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner and Architect of the condition.

§ 10.3.2 Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed

by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred.

§ 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.

§ 11.1.2 The Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 11.1.3 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

§ 11.1.4 Notice of Cancellation or Expiration of Contractor's Required Insurance. Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve

the Contractor of any contractual obligation to provide any required coverage.

§ 11.2 Owner's Insurance

§ 11.2.1 The Owner shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located.

§ 11.2.2 Failure to Purchase Required Property Insurance. If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform the Contractor in writing prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto.

§ 11.2.3 Notice of Cancellation or Expiration of Owner's Required Property Insurance. Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.

§ 11.3 Waivers of Subrogation

§ 11.3.1 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Architect and Architect's consultants; and (3) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, Architect's consultants, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.

§ 11.3.2 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

§ 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance

The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss. The Owner waives all rights of action against the Contractor and Architect for loss of use of the Owner's property, due to

fire or other hazards however caused.

§11.5 Adjustment and Settlement of Insured Loss

§ 11.5.1 A loss insured under the property insurance required by the Agreement shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.5.2. The Owner shall pay the Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements the Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner.

§ 11.5.2 Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

§ 12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

§ 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.5.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner or Separate Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

§ 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

The Contract shall be governed by the law of the place where the Project is located, excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

§ 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate the assignment.

§ 13.3 Rights and Remedies

§ 13.3.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

§ 13.3.2 No action or failure to act by the Owner, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or

approvals where building codes or applicable laws or regulations so require.

§ 13.4.2 If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Architect's services and expenses, shall be at the Contractor's expense.

§ 13.4.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

§ 13.4.5 If the Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.4.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.5 Interest

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, for any of the following reasons:

- .1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- .2 An act of government, such as a declaration of national emergency, that requires all Work to be stopped;
- .3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or
- .4 The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other persons or entities performing portions of the Work because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

- .1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
- .2 fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;
- .3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
- .4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the reasons described in Section 14.2.1 exist, and upon certification by the Architect that sufficient cause exists to justify such action, the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

- .1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- .2 Accept assignment of subcontracts pursuant to Section 5.4; and
- .3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 Suspension by the Owner for Convenience

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work, in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

- .1 that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or
- .2 that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 Termination by the Owner for Convenience

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall

- .1 cease operations as directed by the Owner in the notice;
- .2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and
- .3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed; costs incurred by reason of the termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

§ 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2.

§ 15.1.3 Notice of Claims

§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

§ 15.1.3.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

§ 15.1.4 Continuing Contract Performance

§ 15.1.4.1 Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

§ 15.1.4.2 The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

§ 15.1.5 Claims for Additional Cost

If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.6 Claims for Additional Time

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

§ 15.1.6.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction.

§ 15.1.7 Waiver of Claims for Consequential Damages

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

- .1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and
- .2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 Initial Decision

§ 15.2.1 Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without a decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days after receipt thereof, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner

may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 Mediation

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.7, shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.3.3 Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.

§ 15.3.4 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

§ 15.4 Arbitration

§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. The Arbitration shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

§ 15.4.2 The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 15.4.4 Consolidation or Joinder

§ 15.4.4.1 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially

similar procedural rules and methods for selecting arbitrator(s).

§ 15.4.4.2 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

§ 15.4.4.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as those of the Owner and Contractor under this Agreement.

Additions and Deletions Report for AIA[®] Document A201[®] – 2017

This Additions and Deletions Report, as defined on page 1 of the associated document, reproduces below all text the author has added to the standard form AIA document in order to complete it, as well as any text the author may have added to or deleted from the original AIA text. Added text is shown underlined. Deleted text is indicated with a horizontal line through the original AIA text.

Note: This Additions and Deletions Report is provided for information purposes only and is not incorporated into or constitute any part of the associated AIA document. This Additions and Deletions Report and its associated document were generated simultaneously by AIA software at 10:43:51 CST on 12/05/2024.

Changes to original AIA text

There are no edits to the original text

Variable Information

PAGE 1

Humble High School Phase 2

1700 Wilson Road
Humble, TX 77338

Humble Independent School District

10203 Birchridge Drive
Humble, TX 77338

PBK Architects, Inc.

11 Greenway Plaza, 22nd Floor
Houston, TX 77046

Certification of Document's Authenticity

AIA® Document D401™ – 2003

I, , hereby certify, to the best of my knowledge, information and belief, that I created the attached final document simultaneously with its associated Additions and Deletions Report and this certification at 10:43:51 CST on 12/05/2024 under Order No. 20240043200 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document A201™ - 2017, General Conditions of the Contract for Construction, other than those additions and deletions shown in the associated Additions and Deletions Report.

(Signed)

(Title)

(Dated)

SUPPLEMENTARY CONDITIONS TO THE AIA DOCUMENT A201-2017 GENERAL CONDITIONS

Owner: Humble Independent School District

Contractor: _____

Project: Humble High School Phase 2

The following supplements modify the “General Conditions of the Contract for Construction”, AIA Document A201, Sixteenth Edition, 2017. Where a portion of the General Conditions is modified or deleted by these Supplementary Conditions, the unaltered portions of the General Conditions shall remain in effect. As appropriate, for purposes of this Request for Proposal, the term “Bid” shall mean “Proposal” and the term “Bidder” shall mean “Offeror”, wherever they appear in the Construction Documents.

ARTICLE 1 -- GENERAL PROVISIONS

1.1 BASIC DEFINITIONS

1.1.1 THE CONTRACT DOCUMENT

Delete Section 1.1.1 in its entirety and substitute the following:

1.1.1 The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Performance Bond, Labor and Material Payment Bond, Drawings, Specifications, Addenda issued prior to execution of the Contract, executed EDGAR or FEMA certifications if applicable, and other documents listed in the Agreement and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract executed by both Parties, (2) a Change Order, (3) a Construction Change Directive or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to propose, instructions to Proposers, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor’s Proposal or portions of Addenda relating to proposal requirements).

To the extent any provision in the Supplementary Conditions to these AIA Document A201-2017 General Conditions, issued by Owner, conflicts with any provision in the Supplementary Conditions issued by the Architect; the Supplementary Conditions to these AIA Document A201-2017 General Conditions issued by Owner shall control.

1.1.3 THE WORK

Add the following sentence at the end of this section:

It also includes all supplies, skill, supervision, transportation services and other facilities and things necessary, proper or incidental to the carrying out and completion of the terms of the contract and all other items of cost or value needed to produce, construct and fully complete the public work identified by the Contract Documents.

1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

Add the following Sections:

1.2.1.2 Precedence of the Contract Documents: The most recently issued Document takes precedence over previous issues of the same Document. The order of precedence is as follows with the highest authority listed as “1”.

- .1 Contract Modifications (such as Change Orders) signed by the Contractor and Owner.
- .2 The Agreement. (AIA Document A101-2017 or AIA Document A133-2019)
- .3 The Supplementary Conditions to the AIA A201-2017 as amended by Owner
- .4 The General Conditions of the Contract for Construction (AIA Document A201-2017)
- .5 Addenda, with those of later date having precedence over those of earlier date
- .6 Drawings and Specifications

Should these Documents disagree in themselves, the Architect and Owner will select the appropriate method for performing the Work, to facilitating avoiding increase in the Contract cost.

1.2.1.3 Relation of Specifications and Drawings: To be equivalent in authority and priority. Should they disagree in themselves, or with each other, prices shall be based on the most expensive combination of quality and quantity of Work indicated. In the event of the above mentioned disagreements, the resolution shall be determined by the Architect and Owner.

1.6 NOTICE

Delete the text of Section **1.6.1** in its entirety and substitute the following:

1.6.1 Written notice shall be deemed to have been duly served if delivered in person to the individual or a member of the firm or entity or to an officer at the corporation for which is was intended, or if delivered at or sent by certified mail, or by registered or certified mail, or by courier service providing proof of delivery, to the last business address known to the party giving notice, or if delivered by facsimile or other electronic communications to the offices of the person or corporation for which it was intended. For facsimiles or other electronic communications received after 5:00 p.m. on a business day, or on a weekend or legal holiday on which the recipient's offices are closed, notice shall be deemed to have been duly served on the next business day. Either Party may change its address for notice by giving notice of the change of address in accordance with this provision. The Architect must be copied on notices sent to the Owner.

Delete the text of Section **1.6.2** in its entirety.

Add Section **1.9** as follows:

1.9 MISCELLANEOUS OTHER DEFINITIONS

1.9.1 ADDENDA, ADDENDUM

Documents issued by the Architect prior to execution of the Owner Contractor Agreement for this Project that modify or clarify the Proposal Documents. All addenda become a part of the Contract Documents.

1.9.2 ALTERNATE PROPOSAL(S)

A separate amount stated on a separate Proposal Form which, if accepted by the Owner, will be added to or deducted from the Base Proposal. If accepted, the work that corresponds to the alternate proposal will become part of the agreement between Owner and Contractor. Alternate proposals shall remain valid for the same period of time as the Base Proposal after receipt of proposals, regardless if an Owner Contractor Agreement has been executed, unless indicated otherwise herein.

1.9.3 APPROVED, APPROVED EQUIVALENT, APPROVED EQUAL, OR EQUAL

The terms Approved, Approved Equivalent, Approved Equal, and Or Equal, relate to the substitution of products or systems approved in writing by the Architect. Refer to Paragraph 3.4.2, Substitution of Products and Systems, for procedures which must be followed after award of contract. The substitution procedure process to be followed prior to receipt of proposals is described in the Instructions to Bidders.

1.9.4 BASE PROPOSAL

The Contractor's proposal for the Work, not including any Alternates.

1.9.5 CONTRACT TIME

The period of time which is established in the Contract Documents for Substantial Completion of the Work.

1.9.6 DATE OF AGREEMENT

The date of the Agreement is upon the execution by all Parties. See also Date of Commencement of Work.

1.9.7 DATE OF COMMENCEMENT OF THE WORK

The date of a written Notice to Proceed to the Contractor for a given portion of the Work. This date constitutes day zero (0) of the stated Contract Time. The Notice to Proceed will be issued after the District has received and validated the Contractor's Payment Bond, Performance Bond and Insurance.

1.9.8 DATE OF FINAL COMPLETION

The end of construction. See AIA Document A201, Section 9.10.

1.9.9 DAY

The following days are referenced in the documents:

- .1 For the purpose of this agreement, “days” shall be defined as calendar days unless otherwise specified.
- .2 Calendar Days. Extensions of time granted for Regular Work Days lost, if any, will be converted to Calendar Days.
- .3 Holidays: The days officially recognized by the construction industry in this area as a holiday; normally limited to the observance days of New Year’s Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day and the day after and Christmas Day.
- .4 Regular Work Days: All calendar days except holidays, Saturdays, and Sundays. Requests for extensions of time shall be requested on the basis of Regular Work Days, and those days, if approved, will be converted to calendar days by multiplying by a factor of one and four-tenths (1.4).
- .5 No time extensions will be allowed due to inclement or adverse weather days.

1.9.10 NOTICE TO PROCEED

A notice that may be given by the Owner to the Contractor that directs the Contractor to start the Work. It may also establish the Date of Commencement of the Work.

1.9.11 PROVIDE

Whenever the word “provide” is used in these documents, it shall mean the same as “furnish and install”.

1.9.12 PUNCH LIST

A comprehensive list prepared by the Contractor prior to Substantial Completion to establish all items to be completed or corrected; this list may be supplemented by the Architect or Owner. See AIA Document A201, Section 9.8.

1.9.13 UNIT PRICES

A cost for a unit of work as described in the Contract Documents. The Owner may add or deduct Unit Price work at the amounts stated on the Proposal Form and such amounts shall not be subject to additional mark up by the Contractor or his subcontractors.

ARTICLE 2 – OWNER

2.1 GENERAL

Delete the text of Section 2.1.1 in its entirety and substitute the following:

2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. All parties understand that only the Board of Trustees for the Owner acting as a body corporate has the authority to bind the Owner with respect to all matters requiring the Board’s approval under current policy of the Board of Trustees for the Owner, including, but not limited to, Change Orders. Except as otherwise provided in Section 4.2.1, the Architect does not have authority to bind the Owner with respect to matters requiring the Owner’s approval or authorization. The term “Owner” means the Owner or the Owner’s authorized representative.

Delete the text of Section 2.1.2 in its entirety.

2.2 EVIDENCE OF THE OWNER’S FINANCIAL ARRANGEMENTS

After the first sentence of Section 2.2.1, delete the remainder of Section 2.2.1 in its entirety.

Delete Sections 2.2.2 and 2.2.3 in their entirety.

2.3 INFORMATION AND SERVICES REQUIRED OF THE OWNER

Delete Section 2.3.6 in its entirety and replace it with the following:

2.3.6 The Contractor will be furnished free of charge 25 copies of the Drawings and 25 copies of the Project Manual. These copies may have been used during the Bid/Proposal process and it is the Contractor’s responsibility to determine their completeness and to request replacement of any missing portions. Additional new copies will be furnished at the cost of reproduction, postage, and handling.

2.5 OWNER’S RIGHT TO CARRY OUT THE WORK

Delete the text of Section 2.5. in its entirety and substitute the following:

If the Contractor defaults or neglects to carry out the work in accordance with the Contract Documents and fails, after receipt of written notice from the Owner, to commence and continue correction of such

default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such deficiencies. In such case, an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the actual cost of correcting such deficiencies, including the Owner's expenses and compensation for the Architect's additional services and expenses made necessary by such default, neglect or failure. Such action by the Owner and amounts charged to the Contractor are both subject to the prior approval of the Architect. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner within thirty (30) days of receipt of written notice from the Owner therefor.

Add Section **2.6** as follows:

2.6 OWNER'S LACK OF LIABILITY TO THIRD PARTY

2.6.1 The Owner is not responsible for the acts and/or omissions of, or contractually involved with, any subcontractors, suppliers of labor or materials, and/or their respective employees or agents or any other third-party claimants. Such claimants shall not constitute third party beneficiaries under this contract. The Contractor and/or his Surety solely shall deal with, take responsibility for, and be liable to such parties under this Contract. Contractor will indemnify and defend the Owner from any legal actions against Owner for unpaid bills of subcontractors.

Add Section **2.7** as follows:

2.7 OWNER'S RIGHT TO OCCUPY THE PROJECT

2.7.1 The Owner shall have the right to occupy or use without prejudice to the right of either party, any completed or largely completed portions of the project, notwithstanding the time for completing the entire work or such portions may not yet have expired. Such occupancy and use shall not constitute acceptance of any work not in accordance with the Contract Documents. If the Contractor determines that said occupancy may cause a delay to the completion of the project, the Contractor shall notify the Owner in writing immediately.

2.7.2 Refer to Article 11 Insurance and Bonds regarding property insurance requirements in the event of such occupancy.

2.7.3 If Contractor has not completed the obligations of the Contract Documents by the dates established by subsequent Amendments to the Agreement Between Owner and Contractor or Construction Manager, the Owner shall have the right to occupy or use the entire project.

ARTICLE 3 -- CONTRACTOR

3.1 GENERAL

Add Section **3.1.4** as follows:

3.1.4 The Contractor must be fully qualified under any state or local licensing laws for Contractors in effect at the time and at the location of the work. The Contractor is responsible for determining that all of his subcontractors and prospective subcontractors are duly licensed in accordance with the law. As used herein, the term "Contractor" means the Construction Manager-at-Risk under a Construction Manager-at-Risk project.

3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

Delete the last sentence of Section **3.2.4** in its entirety and substitute the following:

If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities provided such errors, inconsistencies, omissions, differences, or nonconformities could not have been ascertained from a careful study of the Contract Documents.

Add Sections **3.2.5**, **3.2.6** and **3.2.7** as follows:

3.2.5 The Contractor shall make a reasonable attempt to interpret the Contract Documents before asking the Architect for assistance in interpretation. The Contractor shall not ask the Architect for observation of work prior to the Contractor's field superintendent's personal inspection of the work and his determination that the work of all major subcontractors, to allow the subcontractor to demonstrate his understanding of the documents to the Architect and to allow the subcontractor to ask for any interpretation he may require.

3.2.6 If, in the opinion of the Architect, the Contractor does not make a reasonable effort to comply with the above requirements of the Contract Documents and this causes the Architect or his Consultants to expend an unreasonable amount of time in the discharge of the duties imposed on him by the Contract Documents, then the Contractor shall bear the cost of compensation for the Architect's additional services made necessary by such failure. The Architect will give the Contractor prior notice of intent to bill for additional services related to Sections 3.2.5, 3.2.6 and 3.7 before additional services are performed.

3.2.7 If the Contractor has knowledge that any of the products or systems specified will perform in a manner that will limit the Contractor's ability to satisfactorily perform the work or to honor his Warranty, he shall promptly notify the Architect in writing, providing substantiation for his position. Any necessary changes, including substitutions of materials, shall be accomplished by appropriate Modification.

3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

Delete the last sentence of Section **3.3.1** in its entirety and substitute the following:

If the Contractor is then instructed to proceed with the required means, methods, techniques, sequences or procedures without acceptance of changes proposed by the Contractor, the Owner shall be solely responsible for any resulting loss or damage arising solely from those Owner-required means, methods, techniques, sequences or procedures, but only to the extent the Owner would be responsible for any such losses or damages under state and/or federal law.

Add Sections **3.3.4** and **3.3.5** as follows:

3.3.4 The Contractor is especially cautioned to coordinate the routing of mechanical and electrical items prior to commencing these operations.

3.3.5 Contractor shall bear sole responsibilities for design and execution of acceptable trenching and shoring procedures, in accordance with Texas Government Code, Section 2166.303 and Texas Health and Safety Code, Subchapter C, Sections 756.021, et seq. On trench excavations in excess of 5 feet in depth, Contractor shall pay a qualified engineer, experienced in the engineering design and preparation of drawings and specifications for compliance with state requirements for trenching and shoring, to prepare and professionally seal detailed drawings and specifications directing Contractor in the safe execution of trenching and shoring.

3.3.6 Any time that the Contractors' employees, subcontractors and their agents and employees, and other persons or entities performing portions of the work for or on behalf of the Contractor or any of its subcontractors are on site, the work shall be supervised by a qualified employee of the Contractor.

3.4 LABOR AND MATERIALS

Delete Section **3.4.2** in its entirety and replace it with the following:

3.4.2 The materials, products, and the systems covered by these specifications have been selected as a standard because of quality, particular suitability, or record of satisfactory performance. It is not intended to preclude the use of equivalent or better materials, products, or systems provided that same meets the requirements of the particular project and have been approved in an addendum as a substitution prior to the submission of bids. If prior written approval in an addendum has not been obtained, it will be assumed that the Bid is based upon the materials, products, and systems described in the Bidding Documents and no substitutions will be permitted, except as provided hereinafter.

.1 If, after award of contract, the Contractor of one of his Subcontractors, or Suppliers determines that any of the products or systems specified will perform in a manner that will limit the Contractor's ability to satisfactorily perform the work or to honor the Warranty, the Contractor shall promptly notify the Architect, in writing, providing detailed substantiation for his position. Any changes deemed necessary by the Owner and Architect, including

substitution of materials and change in Contract Sum, either upward or downward, if any, shall be accompanied by appropriate Modification.

.2 After the Contract has been executed, the Owner and Architect will consider a formal request for the substitution of products on the Work in place of those specified only under the conditions set forth in specification referring to Product Options and Substitutions.

.3 Requests for substitution, received by the Architect later than forty five (45) days after "Notice to Proceed" or "Date of Commencement of the Work" (whichever occurs first), may result in additional costs to the Owner. Contractor agrees to reimburse the Owner through deductive Change Order to the Contract, for all costs associated with such requests.

.4 By making request for substitutions based on Subparagraph 3.4.2 above, the Contractor

.1 represents that the Contractor has personally investigated the proposed substitute product and determined that it is equivalent or superior in all respects to that specified, and is suitable for the intended purpose;

.2 represents that the Contractor will provide the same warranty for the substitution that the Contractor would for that specified;

.3 certifies that the cost data presented is complete and includes all related costs under this Contract except the Architect's redesign costs, and waives all claims for additional costs related to the substitution which subsequently become apparent; and

.4 will coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects.

.5 Substitution requests shall be submitted on the forms included herein and in accordance with the process established in specification referring to Product Options and Substitutions.

Add the following Sections after Section 3.4.3

3.4.3 .1 State law prohibits possession and/or use of alcohol and tobacco products on school property at all times.

.2 State law prohibits weapons or firearms on school property.

.3 There shall be zero tolerance for fraternization with students, teachers and any other school district personnel, Contractor will immediately remove any employee that violates this provision from the project.

.4 No glass bottles shall be brought on the construction site or Owner's property by any construction personnel.

3.5 WARRANTY

Delete the text of Section 3.5.1 in its entirety and substitute the following:

3.5.1 The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new, unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect cause by abuse, material alteration to the Work not executed by the Contractor, insufficient maintenance or maintenance not in compliance with written instructions therefor, operation not in compliance with written instructions therefor, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

Add Sections 3.5.3, 3.5.4 and 3.5.5 as follows:

3.5.3 In the event of failure in the Work, including a specified product, whether during construction, or the correction period (which shall be one (1) year from the Date of Substantial Completion, except where a longer period is specified), the Contractor shall take prompt and appropriate measures to assure correction or replacement of the defective Work or any portion thereof, including manufactured products, whether notified by the Owner or the Architect. Upon correction of warranty items, the Contractor shall provide the Owner and Architect with written notification of said correction (including a brief description of

the defect and corrective measures taken). This obligation shall survive acceptance of the Work under the Construction Contract.

3.5.4 The Contractual Correction Period for this Project is one (1) year from the date of Substantial Completion, except for any extended warranties as specified within the Contract Documents. Items of Work not completed until after the deadline for Substantial Completions shall have their warranties (general and any extended warranty periods) extended by the period of time between the deadline for Substantial Completion and the actual completion of the Work. Such warranties shall be submitted to the Owner in writing, documenting such time extensions. This correction period shall not restrict or modify extended warranties called for or provided on systems, equipment or other specific portions of the Work.

3.5.5 The Contractor shall accompany the Owner and Architect for a complete reinspection of the Project approximately eleven (11) months after the Date of Substantial Completion and shall promptly complete any observed or reported deficiencies in the Work, including any uncompleted Punch List items or outstanding and incomplete warranty items. The contractor shall provide written notification to the Owner and Architect when said Punch List items and/or additional deficiencies observed have been corrected. This obligation shall survive acceptance of the Work under the Construction Contract.

3.6 TAXES

Delete Section **3.6** in its entirety and substitute the following:

The Owner qualifies for exemption from State and Local Sales and Use Taxes pursuant to the provision of Article 20.04(f) of the Texas Limited Sales, Excise and Use Tax Act. Taxes normally levied on the purchase, rental and lease of materials, supplies and equipment used or consumed in performance of the Contract may be exempted by issuing to suppliers an exemption certificate in lieu of tax. Exemption certificates comply with State Comptroller of Public Accounts Ruling No. 95-0.07. Any such exemption certificate issued in lieu of tax shall be subject to State Comptroller of Public Accounts Ruling No. 95-0.09, as amended. Failure by the Contractor or Subcontractors to take advantage of the Owner's exemption and to obtain such exemption certificate shall make him responsible for paying taxes incurred on materials furnished on the Project without additional cost to or reimbursement by the Owner.

3.7 PERMITS, FEES, NOTICES AND COMPLIANCES WITH LAWS

After Section **3.7.1**, add the following Sections:

- 3.7.1**
- .1 The Owner shall pay directly to the governing authority the cost of all permanent property utility assessments and similar utility connection charges.
 - .2 The Contractor shall pay directly all utility charges through Substantial Completion, utility district/company inspection fees, temporary tap charges, and temporary water meter charges and any other similar fees assessed by jurisdictional authority having control over this Project. The Contractor shall secure and pay for all governing authorities' permit fees.
 - .3 Fees payable to the Texas Department of Licensing and Regulation (TDLR) for document review relative to the Elimination of Architectural Barriers Act shall be paid by the Owner and the Architect will submit the documents to the TDLR for review and approval.
 - .4 The Contractor shall pay for all measures required for the SWPPP.
 - .5 The Contractor shall be responsible for contacting the governing utility authority and/or independent line locating contractor prior to the commencement of any underground digging and shall be responsible for all fees associated. Contractor shall adhere to utility line restrictions identified by the governing utility authority and/or independent line locating contractor. In the event Contractor fails to notify the proper governing utility authority and/or independent line locating contractor or abide by utility line restrictions, Contractor shall be responsible for any and all fees associated with costs to repair damages.

3.8 ALLOWANCES

Delete Section **3.8** in its entirety and substitute the following:

3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct and approve in writing.

3.9 SUPERINTENDENT

Delete Section 3.9.1 in its entirety and substitute the following:

3.9.1 The Contractor shall employ a competent superintendent, project manager and necessary assistants who shall be in attendance at the Project site during performance of the Work, including Punch List work. The superintendent and project manager shall represent the Contractor, and unless provided otherwise in Section 3.1.1, communications given to the superintendent or project manager shall be binding as if given to the Contractor.

3.10 CONTRACTOR'S CONSTRUCTION AND SUBMITTAL SCHEDULES

Delete Section **3.10.1** and substitute the following:

3.10.1 Within 30 days of being awarded a Contract, the Contractor shall prepare and submit for the Owner and Architect's review, a construction schedule for the Work, with critical path clearly defined. The schedule shall not exceed time limits current under the Contract Documents. For further schedule requirements refer to specification section regarding project schedules in the Project Manual.

Add the following clause to Section **3.10.2**:

3.10.2 Requirements for the submittal schedule are outlined in specification section 01 32 00, Construction Progress Schedules. If the Contractor fails to submit a submittal schedule or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in the Contract Sum or extension of the Contract Time based on the time required for review of submittals.

Add Section **3.10.4** as follows:

3.10.4 The Contractor shall submit to the Architect, with each monthly Application for Payment; a copy of the progress schedule updated to reflect the current status of the project. The Contractor shall take whatever action necessary to assure that the project completion schedule is met.

3.11 DOCUMENTS AND SAMPLES AT THE SITE

Add Section **3.11.1** as follows:

3.11.1 The Contractor shall post all Addenda on Construction Documents prior to commencing work in the site.

3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

At Section **3.12.5**, add the following Sections:

3.12.5 .1 If, in the opinion of the Architect, the Shop Drawings, Product Data, Samples and similar submittals are incomplete, indicate an inadequate understanding of the work covered by the submittals, or indicate a lack of study and review by the Contractor prior to submittal to the Architect, the submittals will be returned, unchecked, to the Contractor for correction of these three deficiencies and subsequent resubmittal. Additional service charges as outlined in 3.2.6 may be charged by the Architect in this event.

.2 The Architect will take no action on Shop Drawings, Product Data, and Samples that have not first been certified, by stamped and signed as having been checked and approved by the Contractor for use in the Work, or that are not specifically required by the Contract Documents.

.3 Any increases to the Contract Sum based on IFC drawings must be submitted to the Owner for review and approval within thirty (30) days of receipt of IFC drawings from the Architect.

At Section **3.12.7**, correct the word "approved" in the last line to read "accepted".

At Section **3.12.8**, correct "Architect's approval" in the last line to read "Architect's acceptance".

At Section **3.12.9**, correct "Architect's approval" in the last line to read "Architect's acceptance" and add the following Section:

3.12.9.1 Deviation from the requirements of the Contract Documents indicated on shop Drawings, Product Data, and Samples, does not constitute the required notification "in writing."

Add Sections **3.12.11** and **3.12.12** as follows:

3.12.11 The Contractor shall submit complete Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents to the Architect at least thirty (30) days prior to the date the Contractor needs the reviewed submittals returned. Where colors are to be selected by the Owner, submit all Samples within sixty (60) days of the Notice to Proceed to allow the Architect to prepare a complete selection schedule. In general, all submittals requiring color selection shall be submitted to the Architect within four weeks of the date of the contract for construction.

3.12.12 The Contractor shall submit digital PDF's of Shop Drawings, Product Data, and similar submittals in the proper format according to the procedures stipulated within the Contract Documents. Digitally submitted Shop Drawings will be reviewed and marked by the Architect and/or his consultants and returned to the Contractor for his use, distribution, correction or resubmittal as required. Contractor corrections or revisions shall be resubmitted to the Architect in accordance with same procedures. The digitally marked up prints will be retained by the Architect and his consultants. Samples shall be submitted directly to the Architect for review.

Add Section **3.12.13** as follows:

3.12.13 The Contractor shall provide MEP coordination drawings within a schedule mutually agreed upon by the Owner, Architect and MEP Engineer and prior to installing the Work, showing how all piping, ductwork, lights, conduit, equipment, etc. will fit into the ceiling space allotted, including clearances required by the manufacturer, by code, or in keeping with good construction practice. Space for all trade elements must be considered on the same drawing. Drawings shall be at ¼ inch per foot minimum scale and shall include invert elevations and sections required to meeting intended purpose. The Contractor may propose an alternate method of accomplishing MEP coordination. If the alternate method is approved by the Team, it may be utilized.

3.14 CUTTING AND PATCHING

Add Section **3.14.3** as follows:

3.14.3 Leave all chases, holes and openings, straight and true, of proper size, and cut them into existing work as may be necessary for the proper installation of the work. Consult with all Subcontractors concerned, regarding proper locations and size. In case of conflict between requirement for cutting and patching and any other requirement of the Work, submit request for direction before proceeding with the Work. In case of failure to leave or cut them in the proper place, openings shall be cut afterward at no expense to the Owner. No excessive cutting will be permitted, nor shall any piers or other structural members be cut without prior approval. After such work has been installed, satisfactorily and carefully fit around, close up, repair, patch, and point up all cuts. Work shall be done with proper tools by workmen of the particular trade to which work belongs and shall be done without extra expense to the Owner. No description of specific cutting, patching, digging, etc., required for the work under a Specification Section that may be required for the proper accommodation of that work to the work of other trades shall relieve the Contractor from responsibility described above.

3.15 CLEANING UP

Add Section **3.15.3** as follows:

3.15.3 Prior to the Architect's inspection for Substantial Completion the Contractor shall clean exterior and interior surfaces exposed to view; remove temporary labels, stains, and foreign substances; polish transparent and glossy surfaces; clean equipment and fixtures to a sanitary condition; replace air filters in mechanical equipment; camera the underground plumbing lines to detect and resolve any potential issues and include video in close-out documentation, clean roof, gutters, and downspouts; remove obstructions and flush debris from drainage systems; clean site; sweep paved areas and rake clean other surfaces; remove trash and surplus materials from the site.

3.18 INDEMNIFICATION

Delete Sections **3.18.1** and **3.18.2** in their entirety and replace them with the following:

3.18.1 TO THE FULLEST EXTENT PERMITTED BY LAW, CONTRACTOR SHALL INDEMNIFY DEFEND AND HOLD HARMLESS THE OWNER AND ITS TRUSTEES, OFFICERS, AGENTS, AND EMPLOYEES (COLLECTIVELY, THE "INDEMNIFIED

PARTIES”) FROM AND AGAINST ALL CLAIMS, LOSSES, EXPENSES, COSTS, DEMANDS, SUITS, CAUSES OF ACTION, AND DAMAGES, INCLUDING WITHOUT LIMITATION, ATTORNEYS’ FEES AND EXPENSES, ATTRIBUTABLE TO BODILY INJURY, SICKNESS, DISEASE OR DEATH OF ANY EMPLOYEE OF CONTRACTOR, ITS AGENTS, OR ITS SUBCONTRACTORS OF EVERY TIER, EVEN IF THE BODILY INJURY, SICKNESS, DISEASE OR DEATH IS CAUSED BY OR ALLEGED TO HAVE BEEN CAUSED BY THE NEGLIGENCE, FAULT OR STRICT LIABILITY OF ANY OF THE INDEMNIFIED PARTIES.

FOR ALL CLAIMS NOT ADDRESSED IN THE ABOVE PARAGRAPH, CONTRACTOR SHALL INDEMNIFY, DEFEND AND HOLD HARMLESS THE OWNER AND ITS TRUSTEES, OFFICERS, AGENTS, AND EMPLOYEES AND (COLLECTIVELY, THE “INDEMNIFIED PARTIES”), FROM AND AGAINST ALL CLAIMS, LOSSES, EXPENSES, COSTS, DEMANDS, SUITS, CAUSES OF ACTION, AND DAMAGES, INCLUDING WITHOUT LIMITATION, ATTORNEYS’ FEES AND EXPENSES, OF ANY NATURE WHATSOEVER ARISING OUT OF OR RELATED TO THIS AGREEMENT OR THE WORK TO BE PERFORMED UNDER THIS AGREEMENT, BUT ONLY TO THE EXTENT OF THE NEGLIGENCE OR OTHER FAULT OF THE CONTRACTOR, ITS AGENTS, REPRESENTATIVES, EMPLOYEES OR SUBCONTRACTORS OF ANY TIER.

3.18.2 It is understood and agreed that Subparagraph 3.18 above is subject to, and expressly limited by, the terms and conditions of TEX. CIV. PRACT. & REM. CODE ANN. 130.001-130.005 (Vernon Supp. 1989), as amended or modified, or any successor statute. Contractor shall not be obligated under Subparagraph 3.18 to indemnify or hold harmless Architect or any agent, servant of employee of Architect from liability or damage that is caused by or results from:

- .1 defects in plans, designs or specifications prepared, approved or used by the Architect; or
- .2 negligence of the Architect in the rendition or conduct of professional duties called for or arising out of the Contract Documents and the plans, designs or specifications that are a part of the Contract Documents; and arises from:
 - .1 personal injury or death;
 - .2 property injury; or
 - .3 any other expense that arises from personal injury, death or property injury.

Add Section **3.18.3** as follows:

3.18.3 It is agreed with respect to any legal limitations, now or hereafter in effect and affecting the validity or enforceability of the indemnification obligation under Paragraph 3.18, such legal limitations are made a part of the indemnification obligation and shall operate to amend the indemnification obligation to the minimum extent necessary to bring the provision into conformity with the requirements of such limitations, and as so modified, the indemnification obligation shall continue in full force and effect.

Add Sections **3.19**, **3.20**, and **3.21** as follows:

3.19 RECORD DRAWINGS

Add the following Paragraphs in their entirety:

3.19 REPRODUCIBLE RECORD DRAWINGS

3.19.1 At the completion of the Project, the Contractor shall submit to the Owner one (1) complete set of drawings with all changes made during construction, including concealed mechanical, electrical and plumbing items. Drafting shall be compatible with original drawings and the Contractor shall submit these as hard copies. The record drawings shall exclude the seal of the Architect and/or Engineer and shall have a statement added to indicate the purpose of the drawings (i.e, “RECORD DRAWING”). The Contractor shall also submit to the Owner one (1) mutually agreeable electronic format containing the following:

- .1 Final Record Drawings;
- .2 Final Specifications;

- .3 Copy of final Construction Contract, including all Change Orders.
- .4 CPR;
- .5 AEA;
- .6 Copies of minutes to all Project meetings.

3.19.2 The Contractor shall also provide the Owner with one (1) set of Record Drawings on a mutually agreeable electronic format. The record drawings including specifications shall be 100% complete (including properly dated and executed warranties, complete technical instructions to the Owner, etc.) prior to delivery to the Architect for review. The record documents must be delivered to the Architect thirty (30) days prior to receipt of the Contractor's Final Application for Payment. The record drawings shall exclude the seal of the Architect and/or Engineer and shall have a statement added to indicate the purpose of the drawings (i.e., "RECORD DRAWING").

3.20 PREVAILING WAGE RATES

3.20.1 As required by Chapter 2258 of the Texas Government Code Title 10 Prevailing Wage Rate, no employee used in this construction may be paid less than the minimum prevailing wage rate in effect for the Owner.

3.20.2 The Contractor and each Subcontractor and Sub-subcontractor shall pay to all laborers, workmen, and mechanics employed in execution of this Contract not less than rates set forth by law and as noted in the following Wage Rate Scale (See CB-23 through CB-25), for each craft or type of workman or mechanic needed to execute Contract.

3.20.3 Determination of prevailing wages shall not be construed to prohibit payment of more than the rates identified.

3.21 ANTITRUST VIOLATIONS

3.21.1 Contractor hereby assigns to Owner any and all claims for overcharges associated with this Contract which arise under the antitrust laws of the United States, 15 U.S.C.A. Section 1 et.seq. (1973). The Contractor shall include this provision in his contracts with each Subcontractor and Supplier. Each Subcontractor shall include such provision in contracts with Sub-subcontractors and suppliers.

3.22 THIRD-PARTY BENEFICIARY

3.22.1 No person or entity shall be deemed to be a third-party beneficiary of any provision(s) of this Contract; nor shall any provision(s) hereof be interpreted to create a right of action or otherwise permit anyone not a signatory party to the Contract to maintain an action for personal injury or property damage.

ARTICLE 4 – ARCHITECT

4.2 Administration of the Contract

Delete Section **4.2.2** in its entirety and substitute the following:

4.2.2 The Architect, as a representative of the Owner, will visit the site at intervals appropriate to the stage of the Contractor's operations (1) to become generally familiar with and to keep the Owner informed about the progress and quality of the portion of the Work completed, (2) to endeavor to guard the Owner against defects and deficiencies in the work, and (3) to determine in general if the work is being performed in a manner indicating that the work, when fully completed, will be in accordance with the Contract Documents. The Architect will be required to make on-site inspections as necessary to keep the Owner informed of the progress of the Work and as necessary to guard the Owner against defects and deficiencies in the Work. The Architect will neither have control over or charge of, not be responsible for, the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents, except as provided in Section 3.3.1.

Delete Section **4.2.6** in its entirety and substitute the following:

4.2.6 The Architect or Owner shall have authority to reject Work that does not conform to the Contract Documents. The Architect shall be required to promptly notify the Owner of any non-conforming Work and shall reject such non-conforming Work unless the Owner objects to the rejection in writing within twenty-four (24) hours of such notification. Whenever the Architect considers it necessary or advisable

for implementation of the intent of the Contract documents, the Architect will have authority to require inspection or testing of the Work in accordance with the provisions of the Contract Documents, whether or not such Work is fabricated, installed or completed. Performance of any additional inspection or testing, which would result in additional cost to the Owner, shall require advance notice to and approval of the Owner. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, material and equipment suppliers, their agents or employees, or other persons or entities performing portions of the Work, except when the Contractor's inability to perform the Work is a result of design flaw, error or omission.

Add the following Section **4.2.8.1**:

4.2.8.1 Allowance Expenditure will be authorized using Allowance Expenditure authorizations (AEA) executed by the Owner, the Architect and the Contractor. All Allowance Expenditure Authorizations will be incorporated into the contract by Change Order at the completion of the project. Work authorized by an AEA may be invoiced as it is completed.

Delete Section **4.2.13** in its entirety and substitute the following:

4.2.13 All decisions on matters relating to aesthetic effect shall initially be made by the Architect; however, all such decisions are subject to the Owner's written approval.

ARTICLE 5 – SUBCONTRACTORS

5.1 DEFINITIONS

At the end of Section **5.1.1** add the following sentence:

Wherever relevant, the term "Subcontractor" shall also include a person, or entity who supplies material or equipment for the Project.

At the end of Section **5.2.4**, add the following sentence:

Prior to such change the Contractor shall notify the Architect of his intent and reasons for such proposed changes.

5.4 CONTINGENT ASSIGNMENT OF SUBCONTRACTS

Delete the last sentence of Section **5.4.1** in its entirety and substitute the following:

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract, but only to the extent permitted by law.

Delete the last sentence of Section **5.4.3** in its entirety.

ARTICLE 7 -- CHANGES IN THE WORK

7.1 GENERAL

Delete the text of Section **7.1.2** in its entirety and substitute the following:

7.1.2 A Change Order shall be based on agreement among the Owner, Contractor, and Architect, except when the Contract balance is amended as a result of Owner's Right to Carry out the Work under Section 2.4.1 or the Owner's assessment of liquidated damages as allowed by the Contract Documents. A Construction Change Directive requires agreement by the Owner and Architect, and may or may not be agreed to by the Contractor; an order for a minor change may be issued by the Architect alone.

7.2 CHANGE ORDERS

Add the following Subparagraph 7.2.2:

7.2.2 Methods used in determining adjustments to the Contract Sum shall be determined in one or more of the ways listed below. For deductive change orders, the same amounts used below for markups on additional Work shall also be used for credits on deductions. The first method listed shall be used unless the Architect determines that the method is inappropriate, in which case another method shall be selected:

- .1 By mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation. Where additional Work is involved, any lump sum over the amount of \$100.00 shall be broken down to

represent the estimated cost of labor and materials plus mark-ups to cover overhead and profit.

- .2 To compensate the Contractor, Subcontractor, or Sub-subcontractor actually performing a part of the Work for the combined cost of overhead and profit, the performing party shall be entitled to a single mark-up not to exceed 10% of the estimated cost of that part of the Work.
- .3 To compensate (a) the Contractor for the combined cost of overhead and profit on Work performed by Subcontractors, or (b) Subcontractors for the combined cost of overhead and profit on Work performed by Sub-subcontractors, the Contractor or Subcontractor each shall be entitled to a single mark-up not to exceed 5% of the subcontract amount. On a Construction Manager-at Risk project, the Contractor's markup shall not exceed the CM Fee, and no additional CM Fee shall be permitted on self-performed Work or Work performed by a Related Party.
- .4 When a Sub-subcontractor performs the Work of a change, the maximum mark-up not to exceed 10% for combined overhead and profit shall be used only by the Sub-subcontractor. The Contractor and Subcontractor would each be entitled to a single mark-up not to exceed 5% of the cost to them for the Subcontractor and Sub-subcontractor, respectively.
- .5 By Unit Prices stated in the Contract Documents or subsequently agreed upon. Additional mark-ups for overhead and profit will not be allowed in Unit Price work.
- .6 By cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee.
- .7 Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.2.2 shall be limited to the costs established in Sections 7.3.4.1 through 7.3.4.5.

7.3 CONSTRUCTION CHANGE DIRECTIVES

Delete text of Subparagraph 7.3.3 in its entirety and substitute the following:

- 7.3.3** The cost or credit to the Owner resulting from a change in the Work shall be determined in one or more ways listed below. For deductive change orders, the same amounts used below for markups on additional Work shall also be used for credits on deductions. The first method listed shall be used unless the Architect determines that the method is inappropriate, in which case another method shall be selected.

.1 By mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation. Where additional Work is involved, the lump sum shall represent the estimated cost of labor and materials plus markups to cover overhead and profit:

To compensate the Contractor or Subcontractor actually performing a part of the Work for the combined cost of overhead and profit, the performing party shall be entitled to a single markup not to exceed 10% of the estimated cost of that part of the Work.

To compensate the Contractor for the combined cost of overhead and profit on work performed by Subcontractors, the Contractor shall be entitled to a single markup not to exceed 10% of the subcontract amount. On a Construction Manager-at Risk project, the Contractor's markup shall not exceed the CM Fee, and no additional CM Fee shall be permitted on self-performed Work or Work performed by a Related Party.

When a Sub-subcontract performs the Work of a change, the 10% markup for combined overhead and profit shall be used only by the Sub-subcontractor. The Contractor and Subcontractor would each be entitled to a single markup not to exceed 10% of the cost to

them from the Subcontractor and Sub-subcontractor respectively.

.2 By unit prices stated in the Contract Documents or subsequently agreed upon. Additional markups for overhead and profit will not be allowed in Unit Price Work.

.3 By cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee.

Add Section 7.5 as follows:

7.5 ALLOWABLE MARKUPS FOR CHANGES IN THE WORK

7.5.1 Unless otherwise directed, the procedure and markup of the costs for additional work shall be determined in the following manner:

.1 Upon Change Proposal Request ("CPR"), prior to the commencement of the Work, the Contractor shall quote the cost for changes in the work showing separately, credits and additional costs broken down by headings used in the Schedule of Values. Further breakdown into units of labor and materials may be required if agreement on cost cannot be reached using the breakdown by headings. The final cost shall be the amount of the Total Contract Value Change shown on the Change Proposal signed by the Contractor and Owner.

For general construction work, not subcontracted, the Contractor shall consider as costs the actual invoice amount for additional materials, the sales tax on additional materials when applicable, the wages paid for additional direct labor, plus the Contractor's usual markup of wages to cover additional labor related costs such as insurance, taxes and fringe benefits.

.2 On changes executed within the Owner's Contingency Allowance, prior to the commencement of the Work, Contractor shall have included costs for combined overhead and profit, to the extent permitted by the Contract Documents, and General Conditions costs, including the cost of superintendents, field office expense, temporary facilities and services, small hand tools, construction equipment not specifically provided for the change in hand, home office expense, bond and building insurance premiums, and managing the Subcontractor's work, in his Base Contract amount. Allowed overhead and profit fee on Owner's Contingency Allowance changes to be included in the total cost to the Owner shall be based as follows:

.1 For each Subcontractor or Sub-subcontractor involved, for Work performed by that Subcontractor's or Sub-subcontractor's own forces, ten percent (10%) of the cost.

.2 For each Subcontractor, for Work performed by the Subcontractor's Sub-subcontractors, five percent (5%) of the amount due the Sub-subcontractors.

7.5.2 If any additional Work is authorized outside of or in excess of the Owner's Contingency Allowance, the combined overhead and profit for this work shall be based as follows:

.1 For the Contractor, for Work performed by the Contractor's own forces, a maximum total markup of ten percent (10%) of the actual cost. On a Construction Manager-at Risk project, the Contractor's markup shall not exceed the CM Fee, and no additional CM Fee shall be permitted on self-performed Work or Work performed by a Related Party.

.2 For Work performed by the Contractor's Subcontractor(s), five percent (5%) of the amount due the Subcontractor(s). On a Construction Manager-at Risk project, the Contractor's markup shall not exceed the CM Fee, and no additional CM Fee shall be permitted on self-performed Work or Work performed by a Related Party.

.3 For each Subcontractor or Sub-subcontractor involved, for work performed by that Subcontractor's or Sub-subcontractor's own forces, a maximum markup of ten percent (10%) of the actual cost.

.4 For each Subcontractor, for work performed by the Subcontractor's Sub-subcontractors, five percent (5%) of the amount due the Sub-subcontractor.

.5 The combined total markup from all categories and tiers above shall not exceed fifteen percent (15%).

.6 Cost to which overhead and profit is to be applied shall be determined in accordance with Section 7.3.7.

7.5.3 In order to facilitate checking of quotations for extras or credits, all proposals, (except those so minor that their propriety can be seen by inspection), shall be accompanied by a complete and detailed itemization of costs including labor, materials, and Subcontracts. Labor and materials shall be itemized in the manner prescribed above. Where major cost items are Subcontracts, they shall be itemized also. In no case will a change be approved without such itemization.

7.5.4 Change orders, as they are accepted by the Owner, shall be entered under heading "Change Orders" in the next current Request for Payment.

7.5.5 All credits to or deductions from the Contract Sum, a Contingency or an Allowance shall be calculated using the same methodology set forth in this Section 7.5, including a credit of ten percent (10%) for the Contractor's overhead and profit included in the Contract Sum.

ARTICLE 8 -- TIME

8.1 DEFINITIONS

At Section **8.1.4**, add the following sentence:

See further definition of "Day" in Section **1.9.10**.

8.3 DELAYS AND EXTENSIONS OF TIME

Delete Section **8.3.1** in its entirety and substitute the following:

8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by an act or neglect of the Owner or Architect, or of an employee of either, or of a separate contractor employed by the Owner, or by changes ordered in the Work, or by labor disputes, fire, unusual delay in deliveries, unavoidable casualties or other unforeseeable causes beyond the Contractor's control, or by other causes which the Owner determines may justify delay, then the Contract Time shall be extended by Change Order for such reasonable time as the Owner may determine. **There shall be no extension of the Contract Time for inclement or adverse weather.** For any excusable delays, Contractor will be solely responsible for its own costs arising in connection with any such delay, and no adjustment will be made to the Contract Sum (including extended general conditions) to account for damages to the Contractor.

Add Sections **8.3.4** and **8.3.5** as follows:

8.3.4 The parties hereto agree that time is of the essence of this Contract and that pecuniary damages would be suffered by the Owner if the Contractor does not substantially complete the Work called for in the Contract Document by the specified dates, which damages are, by their very nature, difficult of ascertainment. It is therefore expressly agreed, as a part of the consideration inducing the Owner to execute this Contract that the Owner may deduct from the final payment made to the Contractor a sum equal to the amount stated in the Contract Documents, per phase for each and every Calendar Day beyond the agreed date which the Contractor has agreed to for Substantial Completion of the Work included in the Contract Documents. In the event that Substantial Completion of each portion of the Work as defined in the Contract Documents is not achieved by the date specified for that portion of the Work, liquidated damages as specified in Section 4.5 of the AIA Document A101-2017, Standard Form of Agreement Between Owner and Contractor, as modified by Owner for the Project, shall be deducted from the current and future pay applications for each calendar day beyond that portion's Substantial Completion date until the missed portion of Work is completed. In the event that the Contractor completes the missed portion of Work on or before the next Substantial Completion date, in addition to completing the portion of Work specified for that next Substantial Completion date, the liquidated damages accrued for that specific missed portion of Work may be included in the next pay application for Owner's review and payment pursuant to the terms of this Agreement. Liquidated damages for missed portions of the Work as specified in this subsection shall be in addition to any liquidated damages which may accrue for the failure to reach Substantial Completion of the entire Work. It is expressly understood that said sums per day are agreed upon as a fair estimate of the pecuniary damages which will be sustained by the Owner in the event that the Work is not substantially completed within the agreed time, or with the legally extended time, if any, otherwise provided for herein. Said sums shall be considered as

liquidated damages only, and in no sense shall be considered a penalty or forfeiture; said damage being caused by additional compensation to personnel, and other miscellaneous increased costs, all of which are difficult of exact ascertainment. Except as otherwise provided in the Contract Documents, the liquidated damages assessed herein shall be Owner's sole remedy for time delays between the deadlines for substantial completion for all or a portion of the Work and Contractor's achievement of substantial completion.

8.3.5 Failure to complete and close-out the Project, and complete all Punch List items, within sixty (60) days after the scheduled Substantial Completion date will additionally entitle the Owner to deduct from the final payment made to the Contractor a sum equal to the amount stated in the Contract Documents, per phase, for each and every Calendar Day beyond the 60-day close-out period for each phase. It is expressly understood that said sum per day is agreed upon as a fair estimate of the pecuniary damages which will be sustained by the Owner in the event that the Project close-out does not occur on a timely basis. Said sum shall be considered as liquidated damages only and in no sense shall be considered a penalty or forfeiture; said damage being caused by additional compensation to personnel, and other miscellaneous increased costs, all of which are difficult of exact ascertainment. If the Contractor is delayed through no fault of the Owner, the Substantial Completion is not achieved by the agreed contract completion date, the Project close-out period of sixty (60) days will not be extended by the number of days of delay past the actual Substantial completion date and will remain based upon the agreed contract completion date.

Add Sections **8.3.6**, **8.3.7**, **8.3.8** and **8.3.9** as follows:

8.3.6 Extensions of time granted for causes described herein will be granted on the basis of 1.4 Calendar Days extension for each Regular Working Day lost.

8.3.7 Each Bidder shall include in his proposed Contract Time an adequate allowance of inclement or adverse weather days. **Contractor shall not be entitled to any extension of the Contract Time adjustment to the Contract Sum due to inclement or adverse weather.**

ARTICLE 9 -- PAYMENTS AND COMPLETION

9.1 CONTRACT SUM

Add Section **9.1.1.1** as follows:

9.1.1.1 The Owner is exempt from payment of Texas State Sales Tax on materials required for the Work. Therefore, to comply with the law, the Contract Sum shall be broken down into the amount of cost for labor and the amount of cost for materials. This breakdown shall be provided by the Contractor within ten (10) days of award of Contract.

9.2 SCHEDULE OF VALUES

Add the following Sections:

9.2.1 General Contractor's cost for Contractor's fee, bonds and insurance, General Conditions, etc., shall be listed as individual line items.

9.2.2 Schedule of Values shall break each line into materials and labor. Once approved by the Owner and Architect, it shall be used as basis for reviewing Application for Payment but not be taken as evidence of market or other value.

9.2.3 Contractor's cost for various construction items shall be detailed. For example, concrete work shall be subdivided into footings, grade beams, floor slabs, paving, etc. These subdivisions shall appear as individual line items.

9.2.4 On major subcontracts, such as mechanical, electrical, and plumbing, the Schedule shall indicated line items and amounts in detail, (for example; underground, major equipment, fixtures, installation of fixtures, start up, etc.)

9.2.5 Costs for subcontract work shall be listed without any addition of General Contractor's costs for overhead, profit or supervision.

9.2.6 The Contractor shall include a value for the coordination documents/drawings on the schedule of values.

9.2.7 The Contractor shall include a value for the correction of deficiencies noted by the Commissioning Agent and the Test, Adjust and Balance consultant on the schedule of values for each sub-contractor subject to commissioning and test, adjust and balance requirements.

9.3 APPLICATIONS FOR PAYMENT

Delete Sections **9.3.1** and **9.3.2** in their entirety and replace them with the following:

9.3.1 No later than 3 working days prior to the first Wednesday of each month, submit an itemized Application for Payment, supported by such data sustaining the Contractor's right to payment as the Owner or Architect may require, and reflecting retainage, as provided elsewhere in the Construction Documents. Information on the form shall be divided into the same last day of the month preceding, which shall also be the basis of payment or as agreed by the Owner, Contractor and Architect by verification at the site, prior to submittal.

9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work which have been properly authorized by Construction Change Directives but not yet included in Change Orders.

9.3.2 Payments will be made on account of materials or equipment 1) incorporated in the Work; 2) suitably stored at the site; or 3) suitably stored at some off-site location, provided the following conditions are met for off-site storage:

- .1 The location must be agreed to, in writing, by the Owner and Surety.
- .2 Surety must agree, in writing, to each request for payment.
- .3 The Contractor must bear the cost of the Owner's and Architect's expenses related to visiting the offsite storage area for confirmation.
- .4 The Contractor must provide evidence of purchase and delivery in good order without damage, and a certificate of insurance listing Humble ISD as an additional insured, specifically covering the materials or equipment identified by way of serial numbers, bill of lading, and copy of signature of receipt of materials and photography showing materials or equipment.

Payments for materials or equipment stored on or off the site shall be conditioned upon submission by the Contractor of bills of sale or such other procedures satisfactory to the Owner to establish the Owner's ownership and title to such materials or equipment or otherwise protect the Owner's interest, including applicable insurance (naming the Owner as insured) and transportation to the site for those materials and equipment stored off the site. Under no circumstances will the Owner reimburse the Contractor for down payments, deposits, or other advance payments for materials or equipment. Security and protection from theft and damage remains on the Contractor as the first line of accountability and financial responsibility. Delays due to issues arising from stored materials shall be not considered as reasonable justification to release the Contractor from meeting the schedule unless the Owner agrees to such delay in writing in advance of any delay. The Contractor acknowledges that the review of materials and/or equipment stored off the side is an additional service of the Architect, and the Contractor shall be charged for that service. The cost for such service will be established by the Architect and is not subject to appeal.

Add Section **9.3.4** as follows:

9.3.4 The Contractor shall submit requests for payment in quadruplicate, using AIA Document G702, Application and Certificate of Payment, as the cover sheet. Continuation sheets showing in detail the amounts requested, etc., shall be submitted using AIA Document G703, Continuation Sheet, or a computerized version of these documents previously approved for use. The information provided on the continuation sheets in the Description of the Work and Scheduled Values columns shall match the corresponding information shown on the approved Schedule of Values. All blank spaces on AIA Document G702, Application and Certificate of Payment, must be completed and the signatures of the Contractor and Notary Public shall be original on each form. By submitting his application for payment, the Contractor certifies that the individual signing the application is authorized to do so.

9.7 FAILURE OF PAYMENT

Delete the phrase "or awarded by binding dispute resolution." Replace all references to "seven days" to "ten days."

9.8 SUBSTANTIAL COMPLETION

At Section **9.8.2**, add the following sentence at the end:

Should the Architect determine that the Contractor's List of Items to be Completed or Corrected lacks sufficient detail or requires extensive supplementation, the list will be returned to the Contractor for revision, and inspection for determining the Date of Substantial Completion will be delayed until the List submitted is a reasonable representation of the work to be done.

Add Sections **9.8.6** and **9.8.7** as follows:

9.8.6 In order for the project or a major portion thereof to be considered substantially complete, the following conditions must be met:

- .1 All inspections by governmental authorities having jurisdiction over the project must have been finalized, any remedial work required by those authorities must have been completed, and Certificates of Occupancy and similar governmental approval forms must have been issued and copies delivered to the Owner and Architect.
- .2 All work, both interior and exterior, shall have been completed and cleaned except minor items which if completed after occupancy, will not, in the Owner's opinion, cause interference to the Owner's use of the building or any portion thereof. A significantly large number of items to be completed or corrected will preclude the Architect from issuing a Certificate of Substantial Completion. The Owner and Architect will be the sole judge of what constitutes a significantly large number of items.

The following items are a partial specific list of requirements, as applicable to the Project, that must be completed prior to established Substantial Completion of all portions of the work (Including the Substantial Completion of the commissioning phase).

1. All fire alarm system components must be completed and demonstrated to the Owner.
2. Local fire marshal approval certificate, or similar Certificate of Occupancy from the governing agency, must be delivered to the Owner.
3. All exterior clean-up and landscaping must be complete.
4. All final interior clean-up must be complete.
5. All Building Automation Systems must be complete and fully operational and demonstrated to the Owner.
6. All communications equipment, telephone system, and P.A. systems must be complete and demonstrated to the Owner.
7. All final lockset cores must be installed and all final Owner directed keying completed.
8. All room plaques and exterior signage must be completed.
9. All Owner demonstrations must be completed including kitchen equipment, HVAC equipment, plumbing equipment, and electrical equipment.
10. A final certificate of occupancy must be signed by the Contractor and delivered to the Owner.

9.8.7 After the date of Substantial Completion of the Project is evidenced by the Certificate of Substantial Completion, the Contractor will be allowed a period of time within which to correct all deficiencies attached to the Certificate of Substantial Completion as outlined in Section 8.3.4 of these supplementary conditions. Failure of the Contractor to complete such corrections within the stipulated time will be reported to the contractor's surety. In this report, the Contractor and surety will be informed that, should correction remain incomplete for fifteen (15) days, the Owner may initiate action to complete corrective work out of the remaining Contract funds in accordance with Article 14.2.

- .1 Should corrective work following Substantial Completion require more than one reinspection after notification by the Contractor that corrections are complete, the cost of subsequent inspections may also be deducted from the Contract funds remaining unpaid to the Contractor.

9.10 FINAL COMPLETION AND FINAL PAYMENT

Add Section **9.10.6** as follows:

9.10.6 Final Payment, constituting the entire unpaid balance of the Contract Sum, shall be paid by the Owner to the Contractor forty-five (45) days after Substantial Completion of the Work unless otherwise stipulated in the Certificate of Substantial Completion, provided the Work has then been completed, the Contract fully performed, all Contract Close Out Documents have been submitted, reviewed and approved by the Architect and Owner, and the Final Certificate for Payment has been issued by the Architect. The final payment will not be made until all of these conditions have been satisfied.

ARTICLE 10 -- PROTECTION OF PERSONS AND PROPERTY

Add Section 10.2.1 as follows:

If a building will be used or occupied by the Owner or members of the public, the Contractor shall be responsible for maintaining safe routes of travel from sidewalks and parking areas to the building and shall notify the Owner in the event rerouting access is necessary to maintain safe access during construction at no additional cost beyond the agreed contract amount.

Add Sections **10.2.9** and **10.2.10** as follows:

10.2.9 The performance of the foregoing services by the Contractor shall not relieve the Subcontractors of their responsibilities for the safety of persons and property and for compliance with all applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to the conduct of the Work.

10.2.10 The Contractor shall be responsible for taking all precautions necessary to protect the Work in place from any foreseeable weather conditions which could cause any potential damage to portions or all Work in place. The Contractor shall be responsible for performing all repairs and/or replacement of any Work that results from foreseeable weather conditions, with no extension to the Contract Time or Contract Sum.

10.3 HAZARDOUS MATERIALS

Delete the text of Section **10.3.1** in its entirety and substitute the following:

10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and report the condition to the Owner and Architect in writing. The Owner, Contractor and Architect shall then proceed in the same manner described in section 10.3.2.

Delete the text of Sections **10.3.3**, **10.3.4** and **10.3.5** in their entirety.

Delete the text of Section **10.3.6** in its entirety and substitute the following:

10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a governmental agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall indemnify the Contractor for all costs and expenses thereby incurred, but only to the extent provided by law.

Add Section **10.3.7** as follows:

10.3.7 As part of the construction contract close out process, and prior to receiving payment of any of the retainage, the Contractor and his subcontractors shall submit notarized statements pertaining to the above referenced hazardous materials.

ARTICLE 11 -- INSURANCE AND BONDS

Delete the text of Section **11.1.1** its entirety and replace with the following:

11.1.1 The Contractor agrees and acknowledges that will comply with and provide all requirements set forth in Exhibit A to the A101 or A133 Agreement (whichever is used for the Project).

Delete the text of Section **11.3** in its entirety.

Delete the text of Section 11.4 in its entirety and replace with the following:

11.4 PERFORMANCE BOND AND PAYMENT BOND

Add the following Sections:

11.4.1 The Contractor shall provide a Performance Bond, in the penal sum equal to one hundred percent (100%) of the Contract Sum, if the formal Contract is in excess of One Hundred Thousand Dollars (\$100,000.00) and a Labor and Material Payment bond, in the penal sum equal to one hundred percent (100%) of the Contract sum if the formal contract is in excess of Twenty-Five Thousand Dollars (\$25,000.00).

11.4.2 The Work will not be started until the bonds and issuing companies have been accepted as satisfactory by the Owner. The original bonds will be delivered to the Owner with an attached authorized power of attorney. Such Bonds shall be issued by a company authorized to do business in the State of Texas with an A.M. Best Company rating of a least A-X and included on the U.S. Department of the Treasury Listing of Approved Sureties (Dept. Circular 570).

11.4.3 The Performance Bond Form and the Payment Bond Form included herein shall be executed and submitted to the Architect in duplicate prior to commencement of the work. The surety companies must be acceptable to the Owner and licensed admitted carriers in the State of Texas; and the companies must appear in a current Federal Treasury list as Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring companies.

11.4.4 Each bond shall be of penal sum equal to one hundred percent (100%) of the Contract Sum and shall be compatible with the provisions of the governing authority. The Contractor shall file copies of each bond with the county clerk and furnish the Owner with a file receipt. The bonds shall remain in force throughout the warranty period of the contract. The Work will not be started until the bonds and issuing companies have been accepted as satisfactory by the Owner. The original bonds will be delivered to the Owner with an authorized power of attorney attached.

11.4.5 Claims must be sent to the Contractor and his Surety in accordance with Article 5160, Revised Civil Statutes. The Owner will furnish in accordance with such Article, a copy of the Payment Bond as provided therein to claimants upon request. All claimants are cautioned that no lien exists on the funds unpaid to the contractor on such Contract, and that reliance on notices sent to the Owner may result in loss of their rights against the Contractor and/or his Surety. The Owner is not responsible in any manner to a claimant for collection of unpaid bills, and accepts no responsibility because of any representation by any agent or employee.

11.5 WORKER'S COMPENSATION INSURANCE COVERAGE

Delete the text of Section 11.5 in its entirety. Refer to Exhibit A.

11.6 BUILDER'S RISK COVERAGE

11.6.1 Contractor shall be responsible for obtaining Builders Risk Property Insurance which shall be required for all construction contracts when the property of the Owner is at risk or in the care, custody, and control of the Contractor. Builder's Risk insurance shall be required for all construction contracts requiring a bond. All Property insurance shall include coverage against the perils of Flood and Earthquake and Domestic Terrorism. (Installation Floater may be substituted when contract involves installation only). Coverage limits shall be the Contract Limit or Replacement Cost of Value of Scope of Work, whichever is greater. Permission to Occupy granted. Deductible: 1% of contract, \$50,000 maximum, unless otherwise approved by the Owner.

ARTICLE 12—UNCOVERING AND CORRECTION OF WORK

12.2.1 BEFORE SUBSTANTIAL COMPLETION

After Section **12.2.1** add the following Sections:

12.2.1.1 In the event of failure of a specified project, either during construction or the correction period, the Contractor shall take appropriate measures with the manufacturer of the product to assure correction or replacement of the defective products.

12.2.1.2 Refer to 01 78 00, Closeout Procedures in Division One for further terms regarding warranties which will be required prior to final payment.

12.2.2 AFTER SUBSTANTIAL COMPLETION

After Section **12.2.2** add the following Section:

12.2.2.1 Approximately eleven months after Substantial Completion, the Contractor shall accompany the Owner and Architect on an “end of the one year correction period” reinspection of the Project. Additional deficiencies observed or reported shall be corrected by the Contractor.

12.3 ACCEPTANCE OF NONCONFORMING WORK

Number the existing provision as Section **12.3.1**, and add Section **12.3.2** as follows:

12.3.2 The Owner’s use and/or occupancy of any or all of the Project site shall never be construed as an acceptance of Work not in conformance with Contract Documents. The Owner reserves the right to enforce provisions of the Contract unless the Owner’s acceptance is provided to the Contractor in writing.

ARTICLE 13—MISCELLANEOUS PROVISIONS

Add Sections **13.7** and **13.8** as follows:

13.7 EQUAL OPPORTUNITY

13.7.1 The contractor shall maintain policies of employment as follows:

.1 The Contractor and the Contractor’s Subcontractors shall not discriminate against any employee or applicant for employment because of race, religion, color, sex or national origin. The Contractor shall take affirmative action to insure that applicants are employed, and that employees are treated during employment without regard to their race, religion, color, sex or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the policies of non-discrimination.

13.8 CRIMINAL BACKGROUND CHECKS

The Contractor/Subcontractor shall certify the Criminal Background Check, as stated in Board Policy CJA and the form included herein, as required by Texas Education Code Section 22.0834 and Texas Administrative Code Section 153.1101 and 153.1117, and shall comply with all requirements of such laws and policy. If Contractor/Subcontractor does not have access to the results of the Criminal Background Check, Contractor/Subcontractor will ensure all documents necessary for use of the Owner’s LEE Fast Pass are submitted to the Owner for the required Criminal Background Check.

13.9 REQUIRED CERTIFICATIONS AND VERIFICATIONS

Contractor hereby certifies that it is not a company identified on the Texas Comptroller’s list of companies known to have contracts with, or provide supplies or services to, a foreign organization designated as a Foreign Terrorist Organization by the U.S. Secretary of State under federal law. Contractor further verified

that it is not a prohibited foreign-owned company as defined by Texas Government Code Sections 2274.0101; 2274.0102.

Contractor certifies and verifies that, as defined and set forth in Texas Government Code Chapters 2270, 2271 and 2274, Consultant or any affiliate, subsidiary, or parent company of Consultant, if any, does not boycott Israel, does not boycott energy companies, or discriminate against a firearm entity or firearm trade association; and will not boycott Israel, will not boycott energy companies, or discriminate against a firearm entity or firearm trade association during the term of the contract.

The requirements of the Texas Public Information Act, Chapter 552 of the Texas Government Code, Subchapter J, including requirements to preserve “contracting information defined in 552.003) may apply to this contract if it is valued at more than \$1 million.

ARTICLE 14—TERMINATION OR SUSPENSION OF THE CONTRACT

Delete the text of Section 14.1.3 in its entirety and substitute the following:

14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven day’s written notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed as of the date of the notice, plus costs of demobilization.

14.4 TERMINATION BY THE OWNER FOR CONVENIENCE

Delete the text of Section **14.4.3** in its entirety and substitute the following:

14.4.3 In the case of such termination for the Owner’s convenience, the Contractor shall be entitled to receive payment for Work executed up to date of receipt of the notice of termination, plus costs of demobilization.

ARTICLE 15—CLAIMS AND DISPUTES

15.1 CLAIMS

Delete the text of Section **15.1.1** in its entirety and substitute the following:

15.1.1 DEFINITION

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, adjustment or interpretation of contract terms, payment of money, extension of time or other relief with respect to the terms of the Contract. The term “Claim” also includes other disputes and matters in question between the Owner, Architect, and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. Nothing herein shall require the Owner to make or file a Claim in order to assess liquidated damages provided for in the Contract Documents.

15.1.2 TIME LIMITS ON CLAIMS

Delete the last sentence of Section **15.1.2** in its entirety.

15.1.3 NOTICE OF CLAIMS

Delete the second sentence of Section **15.1.3** in its entirety and substitute the following:

Claims by either party must be initiated within ninety (90) days after occurrence of the event giving rise to such Claim or within ninety (90) days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

15.1.6 CLAIMS FOR ADDITIONAL TIME

Delete the text of **Section 15.1.6.2** in its entirety and substitute the following:

15.1.6 .2 Adverse weather conditions shall not be the basis for a Claim for additional time or additions to the Contract Sum.

15.1.7 CLAIMS FOR CONSEQUENTIAL DAMAGES

Delete the text of Section **15.1.7** in its entirety.

15.2 INITIAL DECISION

Delete the text of Section **15.2.1** in its entirety and substitute the following:

15.2.1 Claims, excluding those alleging an error or omission by the Architect or those arising after expiration of the period for correction of the Work, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. If the parties are unable to agree, any claim, dispute or matters arising out of the contract between the Architect, Owner and Contractor or any combination of those parties shall be submitted to a court of appropriate jurisdiction.

Delete the text of Section **15.2.5** in its entirety and substitute the following:

15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefore; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties, but subject to mediation, if both parties so agree, and subject to legal or equitable proceedings in a court having jurisdiction thereof. It is understood and agreed that, in the event that any dispute, controversy, or conflict arises during the design and construction of the Project or following its completion, the parties hereto will cooperate in good faith, if possible, to resolve the issues without resorting to litigation.

Delete the text of Sections **15.2.6** and **15.2.6.1** in their entirety.

Add the following Section **15.2.9**

15.2.9 The prevailing party in any judicial proceeding arising from the Contract Documents shall recover its reasonable and necessary attorneys' fees.

15.3 MEDIATION

15.3.1 Delete the text of **15.3.1** in its entirety.

Delete Section **15.3.2** in its entirety and replace with the following:

15.3.2 The parties may mutually agree to resolve their claims by mediation which, unless the parties mutually agree otherwise, shall be in accordance with the Construction Industry Mediation Rules of the American Arbitration Association currently in effect. Request for mediation shall be filed in writing with the other party to the Contract. Mediation shall proceed in advance of legal or equitable proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing unless stayed for a longer period of agreement of the parties or court order.

15.4 ARBITRATION

Delete the text of Sections **15.4.1** through **15.4.3** and **15.4.4.1** through **15.4.4.3** in their entirety.

These Additional Supplementary Conditions are entered into as of the date indicated on the AIA Standard Form of Agreement.

OWNER:

HUMBLE INDEPENDENT SCHOOL DISTRICT

By: _____

Name: Dr. Roger Brown

Title: Interim Superintendent

Date: _____

CONTRACTOR:

By: _____

Name: _____

Title: _____

Date:

EXHIBIT A to A101-2017

OWNER'S CONSTRUCTION BOND & INSURANCE REQUIREMENTS

It is suggested that this Exhibit be provided to the Contractor's insurance provider.

Contractor shall not commence work until all required bonds and insurance coverages have been obtained and such insurance has been reviewed and accepted by the District. Certificates of Insurance on the current ACORD form shall be issued to the District showing all required insurance coverages.

Bonds Required

Construction, installation and service contracts (including repair and alteration) exceeding \$100,000 requires that a 100% Performance Bond be furnished by the successful bidder (contractor). Contracts exceeding \$25,000 require that a 100% Payment Bond be furnished by the successful bidder (contractor). All such bids must include a 5% Bid Bond.

Bonds shall be issued by a company authorized to do business in the State of Texas with an A.M. Best Company rating of at least A- X and included on the U.S. Department of the Treasury Listing of Approved Sureties (Dept. Circular 570). The contractor shall be responsible for obtaining bonds and shall absorb any and all costs of such Bonds.

<u>Insurance Required</u>	<u>Limit Required</u>
Automobile Liability insurance covering Any Auto	\$1,000,000 Combined Single Limit
Comprehensive (Commercial) General Liability insurance including Products, Completed Operations, Independent Contractors, Broad Form Property Damage, Pollution and Blanket Contractual Liability coverages. Any XCU exclusions to be removed when underground work is performed.	\$1,000,000 Aggregate, Occurrence and Personal Injury \$ 500,000 Fire Damage \$ 5,000 Medical Payments Per Project Aggregate (CG 70 49) Evidence of coverage must be shown on certificates of insurance.
Professional Errors & Omissions Liability insurance is required from all professionals consultants; e.g., architects and engineers.	\$2,000,000 Per Claim Retroactive Date preceding date of contract must be shown Extended Reporting Period three years past completion of contract
Workers Compensation insurance with limits to comply with the requirements of the Texas Workers' Compensation Act Employers Liability insurance	Statutory Limits \$1,000,000
Umbrella or Excess Liability insurance (excess of primary General Liability, Automobile Liability and WC Coverage B)	\$5,000,000

Limits for primary policies may differ from those shown when Umbrella or Excess Liability insurance is provided.

<p>All Risk Builders Risk Property Insurance shall be required for all construction contracts when property of the owner is at risk or in the care, custody and control of the Contractor. Builders Risk insurance shall be required for all construction contracts requiring a bond. All Property insurance shall include coverage against the perils of Flood and Earthquake and Domestic Terrorism. (Installation Floater may be substituted when contract involves installation only.)</p>	<p>Contract Limit or Replacement Cost Value of Scope of Work which ever is greater</p> <p>Permission to Occupy granted</p> <p>Deductible: 1% of contract, \$50,000 maximum, unless otherwise approved by the Owner.</p>
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Insurance Conditions

All insurance coverages shall be issued on an Occurrence basis (except Professional Liability) by companies acceptable to District and licensed to do business in the State of Texas by the Texas Department of Insurance. Such companies shall have a Best's Key rating of at least "A- X".

All certificates must include:

1. The location or description and the bid number, CSP number or Purchase Order number,
2. A 60 day notice of cancellation of any non-renewal, cancellation or material change to any of the policies, and copies of CG 02 05, TE 02 02A and WC 42 06 01 or their equivalents specifically naming the District,
3. "Additional Insured" on the Property, General Liability, Automobile Liability and Umbrella (Excess) Liability policies naming the District.
4. A "Waiver of Subrogation" clause in favor of the District will be attached to the Workers Compensation, General Liability, Automobile Liability, Umbrella Liability and the Property insurance policies.
5. In addition to certificates of insurance, copies of policy endorsements specifically naming the District must be provided (a) listing the District as Additional Insured: CG 20 10, CG 20 37, CA 04 03 and (b) showing waivers of subrogation in favor of the District: CG 24 04, TE 20 46A, WC 42 03 04A, or their equivalents.

All insurance must be maintained for one year following substantial completion with Certificates of Insurance provided.

Contractor shall be responsible for payment of all deductibles; the District shall approve the deductibles selected.

If any policy has aggregate limits, a statement of claims against the aggregate limits is required.

The District reserves the right to review the insurance requirements during the effective period of any contract to make reasonable adjustments to insurance coverages and limits when deemed reasonably prudent by District based upon changes in statutory laws, court decisions or potential increase in exposure to loss.

Prevailing Wage Rate Determination Information

The following information is from Chapter 2258 Texas Government Code:

Sec. 2258.021. Right to be Paid Prevailing Wage Rates.

- (a) A worker employed on a public work by or on behalf of the state or a political subdivision of the state shall be paid:
 - (1) not less than the general prevailing rate of per diem wages for work of a similar character in the locality in which the work is performed; and
 - (2) not less than the general prevailing rate of per diem wages for legal holiday and overtime work.
- (b) Subsection (a) does not apply to maintenance work.
- (c) A worker is employed on a public work for the purposes of this section if the worker is employed by a contractor or subcontractor in the execution of a contract for the public work with the state, a political subdivision of the state, or any officer or public body of the state or a political subdivision of the state.

Sec. 2258.023. Prevailing Wage Rates to be paid by Contractor and Subcontractor; Penalty.

- (a) The contractor who is awarded a contract by a public body or a subcontractor of the contractor shall pay not less than the rates determined under Section [2258.022](#) to a worker employed by it in the execution of the contract.
- (b) A contractor or subcontractor who violates this section shall pay to the state or a political subdivision of the state on whose behalf the contract is made, \$60 for each worker employed for each calendar day or part of the day that the worker is paid less than the wage rates stipulated in the contract. A public body awarding a contract shall specify this penalty in the contract.
- (c) A contractor or subcontractor does not violate this section if a public body awarding a contract does not determine the prevailing wage rates and specify the rates in the contract as provided by Section [2258.022](#).
- (d) The public body shall use any money collected under this section to offset the costs incurred in the administration of this chapter.
- (e) A municipality is entitled to collect a penalty under this section only if the municipality has a population of more than 10,000.

Sec. 2258.051. Duty of Public Body to Hear Complaints and Withhold Payment.

A public body awarding a contract, and an agent or officer of the public body, shall:

- (1) take cognizance of complaints of all violations of this chapter committed in the execution of the contract; and
- (2) withhold money forfeited or required to be withheld under this chapter from the payments to the contractor under the contract, except that the public body may not withhold money from other than the final payment without a determination by the public body that there is good cause to believe that the contractor has violated this chapter.

Prevailing Wage Rates – School Construction Trades

June 1, 2022

Texas Gulf Coast Area

CLASSIFICATION	2022 HOURLY RATE
ASBESTOS WORKER	\$21.13
BRICKLAYER; MASON	\$25.32
CARPENTER; CASEWORKER	\$23.38
CARPET LAYER; FLOOR INSTALLER	\$25.12
CONCRETE FINISHER	\$23.40
DATA COMM/TELE COMM	\$23.50
DRYWALL INSTALLER; CEILING INSTALLER	\$26.65
ELECTRICIAN	\$25.93
ELEVATOR MECHANIC	\$28.80
FIREPROOFING INSTALLER	\$22.25
GLAZIER	\$22.30
HEAVY EQUIPMENT OPERATOR	\$22.40
INSULATOR	\$20.50
IRONWORKER	\$25.50
LABORER, HELPER	\$16.71
LATHERER; PLASTERER	\$23.25
LIGHT EQUIPMENT OPERATOR	\$20.50
METAL BUILDING ASSEMBLER	\$21.10
MILLWRIGHT	\$33.63
PAINTER; WALL COVERING INSTALLER	\$19.60
PIPEFITTER	\$26.97
PLUMBER	\$26.71
ROOFER	\$20.50
SHEET METAL WORKER	\$19.90
SPRINKLER FITTER	\$26.13
STEEL ERECTOR	\$23.25
TERRAZZO WORKER	\$23.50
TILE SETTER	\$19.58
WATERPROOFER; CAULKER	\$19.88

This document was developed by PBK Architects, Inc., in strict accordance with Chapter 2258 of the Texas Government Code.

Prevailing Wage Rates

Worker Classification Definition Sheet

CLASSIFICATION	DEFINITION
ASBESTOS WORKER	Worker who removes and disposes of asbestos materials.
BRICKLAYER; MASON	Craftsman who works with masonry products, stone, brick, block, or any material substituting those materials and accessories.
CARPENTER; CASEWORKER	Worker who build wood structures or structures of any material which has replaces wood. Includes rough and finish carpentry, hardware and trim.
CARPET LAYER; FLOOR INSTALLER	Worker who installs carpets and /or floor coverings, vinyl tile.
CONCRETE FINISHER	Worker who floats, trowels, and finishes concrete.
DATA COMM/TELE COMM	Worker who installs data/telephone and television cable and associate equipment and accessories.
DRYWALL; CEILING INSTALLER	Worker who installs metal framed walls and ceiling, drywall coverings, ceiling grids, and ceilings.
ELECTRICIAN	Skilled craftsman who installs or repairs electrical wiring and devices. Includes fire alarm systems and HVAC electrical controls.
ELEVATOR MECHANIC	Craftsman skilled in the installation and maintenance of elevators.
FIREPROOFING INSTALLER	Worker who sprays or applies fire proofing materials.
GLAZIER	Worker who installs glass, glazing, and glass framing.
HEAVY EQUIPMENT OPERATOR	Includes but not limited to: all CAT tractors, all derrick-powered, all power operated cranes, back-hoes, back-fillers, power operated shovels, winch trucks, and all trenching machines.
INSULATOR	Worker who applies, sprays, or installs insulation.
IRONWORKER	Skilled craftsman who erects structural steel framing, and installs structural concrete Rebar.
LABORER, HELPER	Worker qualified for only unskilled or semi-skilled work. Lifting, carrying materials or tools, hauling, digging, clean up.
LATHERER; PLASTERER	Worker who installs metal framing and lath. Worker who applies plaster to lathing and installs associated accessories.
LIGHT EQUIPMENT OPERATOR	Includes but not limited to , air compressors, truck crane drivers, flex planes, building elevators, form graders, concrete mixers less than 14cf), conveyers.
METAL BUILDING ASSEMBLER	Worker who assembles pre-made metal buildings.
MILLWRIGHT	Mechanic specializing in the installation of heavy machinery, conveyance, wrenches, dock levelers, hydraulic lifts, and align pumps.
PAINTER; WALL COVERING INSTALLER	Worker who prepares wall surfaces and applies paint and/or wall coverings, tape, and bedding.
PIPEFITTER	Trained worker who installs piping systems, chilled water piping and hot water (boiler) piping, pneumatic tubing controls, chillers, boilers, and associated mechanical equipment.
PLUMBER	Skilled craftsman who installs domestic hot and cold water piping, waste piping, storm system piping, water closets, sinks, urinals, and related work.
ROOFER	Worker who installs roofing materials, Bitumen (asphalt and coal tar) felts, flashings, all types of roofing membranes, and associated products.
SHEET METAL WORKER	Worker who installs sheet metal products, Roof metal, flashings and curbs, ductwork, mechanical equipment, and associated metals.
SPRINKLER FITTER	Worker who installs fire sprinklers systems and fire protectant equipment.
STEEL ERECTOR	Worker who erects and dismantles structural steel frames of buildings and other structures.
TERRAZZO WORKER	Craftsman who places and finishes Terrazzo
TILE SETTER	Worker who prepares wall and/or floor surfaces and applies ceramic tiles to these surfaces.
WATERPROOFER; CAULKER	Worker who applies water proofing material to buildings. Products include sealant, caulk, sheet membranes, and liquid membranes, sprayed, rolled or brushed.

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 1. Project information.
 2. Work covered by Contract Documents.
 3. Phased construction.
 4. Work by Owner.
 5. Work under separate contracts.
 6. Purchase contracts.
 7. Owner furnished products.
 8. Owner furnished, Contractor installed products.
 9. Access to site.
 10. Coordination with occupants.
 11. Work restrictions.
 12. Specification and drawing conventions.
 13. Miscellaneous provisions.

1.3 PROJECT INFORMATION

- A. Project Identification: Humble High School Additions and Renovations Phase Two
 1. Project Location: 1700 Wilson Road, Humble, Texas 77338
- B. Owner: Humble Independent School District
 1. Owner's Representative: Thomas Haggerty
- C. Architect: PBK Architects
- D. Consultants: Additional design professionals have been retained who have prepared designated portions of the Contract Documents.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following: Building addition to the existing Humble High School; miscellaneous renovations inside the existing building; and associated site improvements on campus. The building addition is a fully-sprinkled one-story buildings (with spread footings, slab-on-grade, steel frame, and masonry cavity walls) which will include an auxiliary gym, locker rooms, and athletics offices. Renovations inside the existing building consist of select demolition inside the classroom wing to be renovated into new science labs. On-site improvements and site amenities include paved parking areas, driveways, walkways, utilities, and lighting.
- B. Type of Contract: Project will be constructed under a competitive sealed proposal (CSP) contract.

1.5 WORK BY OWNER AND UNDER SEPARATE CONTRACTS

- A. Cooperate fully with Owner so Work may be carried out smoothly, without interfering with or delaying the work or work by Owner. Coordinate the Work with Work performed by Owner.

- B. The Owner reserves the right to let separate contract for Work outside of the scope of this Contract. Cooperate fully with separate contractors so Work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract or other contracts. Coordinate the Work of this Contract with Work performed under separate contracts.
- C. Purchase Contracts: The Owner reserves the right to negotiate purchase contracts with suppliers of material and equipment that may be incorporated into the Work. The Owner will assign these purchase contracts to Contractor. Include costs for purchasing, receiving, handling, storage if required, and installation of material and equipment in the Contract Sum, unless otherwise indicated.
 - 1. Contractor's responsibilities are same as if Contractor had negotiated purchase contracts, including responsibility to renegotiate purchase and to execute final purchasing agreements.
- D. Owner Furnished, Contractor Installed Products (OFCI): The Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner furnished products and making building services connections when applicable.
 - 1. Owner Furnished Products: Coordinate with Owner.

1.6 ACCESS TO SITE

- A. Use of Site: Limit use of Project site to Work in areas and areas within the Contract limits indicated. Do not disturb portions of site beyond areas in which the Work is indicated.
 - 1. Limits: The drawings indicate the limits of the construction operations.
 - 2. Driveways, Walkways, and Entrances: Keep driveways, parking areas, student drop off and pick up points, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, the students, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- B. Condition of Existing Building: Maintain portions of existing building affected by construction operations in weathertight condition throughout construction period. Repair damage caused by construction operations.

1.7 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy site and adjacent building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform Work to prevent interference with Owner's day to day operations. Maintain existing exits unless otherwise indicated.
 - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
 - 2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.
- B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
 - 1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
 - 2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.

3. Before limited Owner occupancy, ensure mechanical and electrical systems are fully operational, and required tests and inspections and start up procedures are successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
4. Upon occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.8 WORK RESTRICTIONS

- A. Work Restrictions: Comply with restrictions on construction operations. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On Site Work Hours: Limit Work in the existing building to normal working hours, Monday through Friday, unless otherwise indicated. Coordinate with Owner when it is necessary to extend working hours or Work on weekends.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and after providing temporary utility services according to requirements indicated:
 1. Notify Owner not less than two weeks in advance of proposed utility interruptions.
 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors: Coordinate operations that result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
 1. Notify Owner not less than two weeks in advance of proposed disruptive operations.
 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Controlled Substances, Firearms, and Explosive Devices: Use of tobacco products, controlled substances, firearms, and explosive devices on the site is not permitted.
- F. Employee Identification: Provide identification tags for Contractor personnel working on site. Require personnel to use identification tags at all times.
- G. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on site.
 1. Maintain list of approved screened personnel with Owner's representative.

1.9 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 1 General Requirements: Requirements of Sections in Division 1 apply to the Work of each specification section.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 2. Abbreviations: Materials and products are identified by abbreviations.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 CONSTRUCTION SCHEDULE

- A. The Owner has a critical need for the Work to begin upon Notice to Proceed and shall be Substantially Complete by **July 15, 2026**. There will be No Extensions of Time due to weather.

END OF SECTION 01 10 00

SECTION 01 21 00 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Administrative and procedural requirements governing allowances.
 - 1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.
- B. Types of allowances include:
 - 1. Lump sum allowances.
 - 2. Unit cost allowances.
 - 3. Quantity allowances.
 - 4. Contingency allowances.
 - 5. Testing and inspecting allowances.

1.3 COORDINATION

- A. Coordinate allowance items with other portions of the Work.

1.4 LUMP SUM, UNIT COST, AND QUANTITY ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.5 CONTINGENCY ALLOWANCES

- A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.
- B. Contractor's related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, taxes, insurance, equipment rental, and similar costs.
- C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit margins.

- D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.6 TESTING AND INSPECTING ALLOWANCES

- A. Testing and inspecting allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results.
- B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure. The cost for incidental labor to assist the testing agency shall be included in the Contract Sum.
- C. Costs of services not required by the Contract Documents are not included in the allowance.
- D. At Project closeout, credit unused amounts remaining in the testing and inspecting allowance to Owner by Change Order.

1.7 ADJUSTMENT OF ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
 - 1. Include installation costs in purchase amount only where indicated as part of the allowance.
 - 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
 - 3. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit cost allowances.
 - 4. Owner reserves the right to establish the quantity of Work in place by independent quantity survey, measure, or count.
- B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
 - 1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of Work has changed from what could have been foreseen from information in the Contract Documents.
 - 2. No change to Contractor's indirect expense is permitted for selection of higher or lower priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related Work.

3.3 SCHEDULE OF ALLOWANCES

- A. Owner's Contingency Allowances: \$1,500,000.00
 - 1. Contractor shall include the amount indicated below in the Base Proposal as a contingency to cover the cost of hidden, concealed or otherwise unforeseen conditions which develop during completion of the work. Contractor shall be allowed to recover all costs associated with the completion of work under this contingency, however, no overhead or profit will be allowed.

- B. First Responder Antenna System Allowance: \$1,143,112.00
 - 1. Contractor shall include the amount indicated above in his Base Proposal for the cost to provide first responder antenna systems.

- C. Super Graphics Allowance: \$80,000.00
 - 1. Contactor shall include the amount indicated above in his Base Proposal for the cost of purchasing, delivering, and installing any super graphics.

END OF SECTION 01 21 00

SECTION 01 22 00 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for unit prices.
- B. Related Requirements:
 - 1. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
 - 2. Section 014000 "Quality Requirements" for general testing and inspecting requirements.

1.3 DEFINITIONS

- A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

- A. Unit Price 1: Removal of unsatisfactory soil and replacement with satisfactory soil material.
 - 1. Description: Unsatisfactory soil excavation and disposal off site and replacement with satisfactory fill material or engineered fill from off site, as required, according to Section 312000 "Earth Moving."
 - 2. Unit of Measurement: Cubic yard of soil excavated, based on survey of volume removed.
 - 3. Quantity Allowance: Coordinate unit price with allowance adjustment requirements in Section 012100 "Allowances."

- B. Unit Price No. 2: Rock excavation and replacement with satisfactory soil material.
1. Description: Classified rock excavation and disposal off site and replacement with satisfactory fill material or engineered fill from off site, as required, according to Section 312000 "Earth Moving."
 2. Unit of Measurement: Cubic yard of rock excavated, based on survey of volume removed.
 3. Quantity Allowance: Coordinate unit price with allowance adjustment requirements in Section 012100 "Allowances."
- C. Unit Price No. 3: Cutting and patching of concrete floor slabs.
1. Description: Cutting of new or existing concrete floor slabs up to 6 inches thick, removal and excavation as required, and subsequent backfill, compaction, and patching of concrete according to Section 017300 "Execution." not otherwise indicated in the Contract Documents.
 2. Unit of Measurement: Square feet of concrete removed.
- D. Unit Price No. 4: Concrete
1. Description: This Unit Price shall be the entire unit cost including overhead and profit for one (1) cubic yard of new cement stabilized sand and lean concrete material delivered, spread, and compacted per plans and specs. Cost shall include all materials and labor for complete installation. Enter unit cost on Proposal form.
- E. Unit Price No. 5: Select Fill
1. Description: This Unit Price shall be the entire unit cost including overhead and profit for one (1) cubic yard of new select fill material, delivered, spread, and compacted per plans and specs. Cost shall include all materials and labor for complete installation. Enter unit cost on Proposal Form.
- F. Unit Price No. 6: Spread Footing (Add)
1. Description: This Unit Price shall be the entire unit cost including overhead and profit for the addition of one (1) spread footing of each size utilized in the project per 1/S-303. Cost shall include all materials and labor for complete installation. Enter unit cost for each drilled pier size on Proposal Form.
- G. Unit Price No. 7: Spread Footing (Deduct)
1. Description: This Unit Price shall be the entire unit cost including overhead and profit for the removal of one (1) spread footing of each size utilized in the project per 1/S-303. Cost shall include all materials and labor for complete installation. Enter unit cost for each drilled pier size on Proposal Form.
- H. Unit Price No. 8: Existing Pier Demo Condition 1 (Overlap With New Pier):
1. Description: At any location where a new pier will overlap an existing footing/pier, the soil currently in the existing footing/pier shall be excavated. The resulting hole shall be backfilled with controlled low-strength material (CLSM) or flowable fill. CLSM / flowable fill shall meet the desired strength at the time of excavation. The testing and inspections laboratory shall be on-site to observe and test the infill of the existing foundations to reasonably ensure that the bearing values recommended in the geotechnical report can be achieved. This unit price shall cover the entire unit cost including overhead for all of the work described in the GC Note in the SD-100 & SD-101 series for each pier size.
- I. Unit Price No. 9: Existing Pier Demo Condition 2 (No Conflict with New Piers):
1. Description: At any location where an existing footing/pier does not overlap with a new pier, the portion of the existing footing/pier within 4.5-ft of the bottom of the future slab shall be demolished. The area between the top of the existing footing/pier and the bottom of the future slab shall be backfilled with select fill. The select fill should be placed in 8" thick max loose lifts, with each lift compacted to at least 95 percent of the maximum dry density determined by standard effort (ASTM D 698). The testing and inspections laboratory shall

be on-site to observe and test the infill of the existing foundations to reasonably ensure that the bearing values recommended in the geotechnical report can be achieved. This unit price shall cover the entire unit cost including overhead for all of the work described in the GC Note on SD-100 & SD-101 series for each pier size.

- J. Unit Price No. 10: Grade Beam (Add)
1. Description: This Unit Price shall be the entire unit cost including overhead and profit for the addition of one (1) linear foot of grade beam of each grade beam size utilized in the project per the grade beam schedule on S-302. Cost shall include all materials and labor for complete installation. Enter unit cost for each grade beam size on Proposal Form.
- K. Unit Price No. 11: Grade Beam (Deduct)
1. Description: This Unit Price shall be the entire unit cost including overhead and profit for the removal of one (1) linear foot of grade beam of each grade beam size utilized in the project per the grade beam schedule on S-302. Cost shall include all materials and labor for complete installation. Enter unit cost for each grade beam size on Proposal Form.
- L. Unit Price No. 12: Miscellaneous and structural steel.
1. Description: Miscellaneous lintels and other supports not otherwise indicated in the Contract Documents, according to Section 051200 "Structural Steel Framing" and Section 055000 "Metal Fabrications."
 2. Unit of Measurement: Cost in place of pounds of fabricated steel as indicated on itemized invoice of steel supplier and verified by Architect.

END OF SECTION 01 22 00

SECTION 01 23 00 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes: Administrative and procedural requirements for alternates.

1.3 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain Work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Alternates described are part of the Work when enumerated in the Agreement.
 - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent Work as necessary to completely integrate Work of the alternate into Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Forty-eight (48) hours following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.
- C. Execute accepted alternates under the same conditions as other Work of the Contract.
- D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the Work described under each alternate.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. Alternate No. 01: Synthetic Turf Outdoor Workout Area at Athletics Courtyard
 - 1. This alternate shall establish the amount to be added to the base proposal for the contractor to install non-infilled turf glued to a concrete pad (along with associated improvements) to provide an outdoor workout area in an athletics courtyard, as shown in the drawings.

- B. Alternate No. 02: Existing Ceilings and Lights Replacement
 - 1. This alternate shall establish the amount to be added to the base proposal for the contractor to remove existing ceilings and light fixtures and to replace with new ceilings and light fixtures, as shown in the drawings.
- C. Alternate No. 03: Science Labs Renovation
 - 1. This alternate shall establish the amount to be added to the base proposal for the contractor to renovate existing classroom spaces to become new science labs, as shown in the drawings.
- D. Alternate No. 04: Existing Flooring Replacement
 - 1. This alternate shall establish the amount to be added to the base proposal for the contractor to remove existing flooring and base and to replace with new flooring and base, as shown in the drawings.
- E. Alternate No. 05: Existing Doors Replacement
 - 1. This alternate shall establish the amount to be added to the base proposal for the contractor to remove and replace the doors and hardware as shown in the drawings and specifications.
- F. Alternate No. 06: Irrigation and Sod
 - 1. This alternate shall establish the amount to be added to the base proposal for the contractor to provide an irrigation system and sod as shown in the drawings and specifications.
- G. Alternate No. 07: Area H Corridor Renovation
 - 1. This alternate shall establish the amount to be added to the base proposal for the contractor to renovate the existing Area H corridor, as shown in the drawings.
- H. Alternate No. 8A: 23 09 23 – Direct Digital Controls – **Reliable Controls (Basis of Design)**
 - 1. This Alternate shall establish the amount to be added to the Base Proposal for the cost of furnishing and installing Direct Digital Controls manufactured by Reliable Controls installed by **Unify Energy Solutions**. As shown and scheduled on the drawings and as specified. This alternate shall include the pricing for all materials and labor for proper completion. Refer to specs and drawings for additional information. There are no Direct Digital Controls included in the base bid.
- I. Alternate No. 8B: 23 09 23 – Direct Digital Controls – **Alerton**
 - 1. This Alternate shall establish the amount to be added to the Base Proposal for the cost of furnishing and installing Direct Digital Controls manufactured by **Climatec - Houston**. As shown and scheduled on the drawings and as specified. This alternate shall include the pricing for all materials and labor for proper completion. Refer to specs and drawings for additional information. There are no Direct Digital Controls included in the base bid.
- J. Alternate No. 9: 23 09 23 – High Capacity Packaged, Outdoor, Central Station Air Handling Units – **Trane – Horizon Model**
 - 1. This Alternate shall establish the amount to be added to the Base Proposal for the cost of furnishing and installing High Capacity Packaged, Outdoor, Central Station Air Handling Units, manufactured by **Trane – Horizon Model**. As shown and scheduled on the drawings and as specified. This alternate shall include the pricing for all materials and labor for proper completion. Refer to specs and drawings for additional information. There are no High Capacity Packaged, Outdoor, Central Station Air Handling Units included in the base bid.
- K. Alternate No. 10: Base Bid Adjustment (if any)

1. This alternate shall establish the amount to be added to/deducted from the Base Proposal in the event the Contractor has discovered an error in their Base Bid Proposal amount. The intent of this alternate is to receive accurate pricing numbers for Alternates 1-9 from all proposers.
2. To add to the bid price, enter a positive number. To deduct from the bid price, use a negative number. If there is no change to the base bid price, enter \$0.00.

END OF SECTION 01 23 00

SECTION 01 25 13 - PRODUCT SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Specified product compliance, and product quality assurance.
- B. Specific administrative and procedural requirements for handling requests for substitutions made prior to award of Contract.
- C. Requirements for product delivery, storage and handling.

1.3 RELATED REQUIREMENTS

- A. Instructions to Offerors: Product options and procedures for submittal of requests for substitutions during the Proposal period.

1.4 DESCRIPTION OF REQUIREMENTS

- A. Definitions: Definitions used in this Section are not intended to negate the meaning of other terms used in the Contract Documents, including such terms as "specialties", "systems", "structure", "finishes", "accessories", "furnishings", "special construction", and similar terms. Such terms are self-explanatory and have recognized meanings in the construction industry.
 - 1. Products: Shall mean items purchased for incorporation in the Work, regardless of whether they were specifically purchased for the project or taken from the Contractor's previously purchased stock. The term "product" as used herein includes the terms "material", "equipment", "system", and other terms of similar intent.
 - a. Named Products: Are those identified by the use of the manufacturer's name for a product, including such items as a make or model designation, as recorded in published product literature, of the latest issue as of the date of the Contract Documents.
 - b. Specified Products: same as Named Products.
 - 2. Materials: Shall mean products that must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, or installed to form units of work.
 - 3. Equipment: Is defined as a product with operational parts, regardless of whether motorized or manually operated, and in particular, a product that requires service connections such as wiring or piping.

1.5 PRODUCT QUALITY ASSURANCE

- A. Source Limitations: To the fullest extent possible, provide products of the same generic kind, from a single source, for each unit of work.
 - 1. When it is discovered that specific products are available only from sources that do not or cannot produce an adequate quantity to complete project requirements in a timely manner, consult with the Architect/Engineer for a determination of what product quantities are most important before proceeding. The Architect/Engineer will designate those qualities, such as visual, structural, durability, or compatibility, that are most important. When the Architect/Engineer's determination has been made, select products from those sources that produce products that possess the most important qualities, to the fullest extent possible.

- B. **Compatibility of Options:** Compatibility of products is a basic requirement of product selection. When the Contractor is given the option of selecting between two (2) or more products for use on the project, the product selected must be compatible with other products previously selected, even if the products previously selected were also Contractor options. The complete compatibility between the various choices available to the Contractor is not assured by the various requirements of the Contract Documents, but must be provided by the Contractor.
- C. **Or Equal:**
 - 1. Where the phrase “or equal”, “or equivalent”, “or Architects approved equal”, or similar phrasing, occurs in the Proposal Documents, do not assume that materials, equipment, or methods of construction will be approved by the Architect unless the item has been specifically approved for this Work by the Architect.
 - 2. The decision of the Architect shall be final.
- D. Where a proposed substitution involves the work of more than one (1) contractor, each contractor involved shall cooperate and coordinate the work with each other contractor involved, so as to provide uniformity and consistency and to assure the compatibility of products.
- E. **Foreign Product Limitations:** “Foreign products” as distinguished from “domestic products” are defined as products that are either manufactured substantially (50 percent or more of value) outside of the United States and its possessions, or produced or supplied by entities known to be substantially owned (more than 50 percent) by persons who are not citizens of nor living within the United States and its possessions.
 - 1. Except under one (1) of the following conditions, select and provide domestic, not foreign, products for inclusion in the Work.
 - a. There is no domestic product available that complies with the requirements of the Contract Documents.
 - b. Available domestic products that comply with the requirements of the Contract Documents are available only at prices or other procurement terms that are substantially higher (25 percent or more) than for available foreign products that comply with the requirements of the Contract Documents.
 - c. At the discretion of the Architect or Owner.
 - 2. Final determination and acceptance will be the responsibility of the Architect.
- F. **Standards:** Refer to Section 01 41 00, Regulatory Requirements for the applicability of industry standards to the products specified for the Project, and for the acronyms used in the text of the Specification Sections.

1.6 SUBSTITUTIONS OF PRODUCTS

- A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability or record of satisfactory performance. It is not intended to preclude the use of equal or better materials or equipment provided that same meets the requirements of the particular project and is approved in an Addendum as a substitution prior to the submission of proposals.
- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect at least seven (7) days prior to the date for receipt of proposals. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance and test data and any other information necessary for an evaluation. The Architect's decision of approval or disapproval of a proposed substitution shall be final.

- C. If the Architect approves any proposed substitution prior to receipt of proposals, such approval will be set forth in an Addendum. Offerors shall not rely upon approvals made in any other manner.
- D. The Architect and Owner reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final
- E. The following are not considered as substitutions:
 - 1. Revisions to the Contract Documents, when requested by the Owner, Architect, or any of their consultants are considered as “changes” not substitutions.
 - 2. Specified Contractor options on products and construction methods included in Contract Documents are choices made available to the Contractor and are not subject to the requirements specified in this Section for substitutions.
 - 3. Except as otherwise provided in the Contract Documents, the Contractor’s determination of and compliance with governing authorities do not constitute “substitutions” and do not constitute a basis for change orders.
- F. The following may be considered as a reason for a request for substitution:
 - 1. The request is directly related to an “or approved equal” clause or similar language in the Contract Documents.
 - 2. The specified product or method of construction cannot be provided within the Contract Time in accordance with paragraph below concerning availability of specified items.
 - 3. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
 - 4. A substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other consideration of merit, after deducting offsetting responsibilities the Owner may be required to bear. These additional responsibilities may include such considerations as additional compensation to the Architect/Engineer for redesign and evaluation services, the increased cost of other work by the Owner or separate contractors, and similar considerations.
 - 5. The specified product or method of construction cannot be provided in a manner that is compatible with other materials, and where the Contractor certifies that the substitution will overcome the incompatibility.
 - 6. The specified product or method of construction cannot be coordinated with other materials, and where the Contractor certifies that the proposed substitution can be coordinated.
 - 7. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provides the required warranty.
- G. Availability of specified items:
 - 1. Verify prior to submittal of Proposal that all specified items will be available in time for installation during orderly and timely progress of the work.
 - 2. In the event specified items will not be so available, notify the Architect prior to receipt of Proposals. Submit Request for Substitutions in accordance with this section.
 - 3. The request will not be considered if the product or method cannot be provided as a result of the Contractor’s failure to pursue the work promptly or coordinate activities properly.
 - 4. Costs of delays because of non-availability of specified items, when such delays could have been avoided by the Contractor, will be back-charged as necessary and shall not be borne by the Owner.
- H. A request constitutes a representation that Offeror:
 - 1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
 - 2. Will provide same warranty for Substitution as for specified product, except when inability to provide specified Warranty is reason for request for substitution as described above.

3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension which may subsequently become apparent.
5. Will reimburse the Owner and pay for all costs, including Architect/Engineer's redesign and evaluation costs resulting from the use of the proposed substitution, or for review or redesign services associated with re-approval by authorities having jurisdiction.

I. **No substitutions will be considered after the Award of Contract.**

1.7 SUBSTITUTION REQUEST SUBMITTAL

- A. Requests for Substitutions: Submit three (3) copies of each request for substitution. In each request identify the product or fabrication or installation method to be replaced by the substitution; include related Specifications Section and Drawing numbers, and complete documentation showing compliance with the requirements for substitutions. Include, as appropriate, with each request, the following information:
1. Product data, drawings and descriptions of products, fabrication and installation procedures.
 2. Samples, where applicable or requested.
 3. A detailed comparison of the significant qualities of the proposed substitution with those of the work originally specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect, where applicable.
 4. Coordination information, including a list of changes or modifications needed by other parts of the work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.
 5. A statement indicating the effect the substitution will have on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
 6. Cost information, including a proposal of the net change, if any in the Contract Sum.
 7. Certification by the Contractor to the effect that, in the Contractor's opinion, after thorough evaluation, the proposed substitution will result in work that in every significant respect is equal-to or better than the work required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
 8. A statement indicating the Contractor will reimburse the Owner and pay for all costs, including Architect/Engineer's re-design and evaluation costs resulting from the use of the proposed substitution.
- B. Work-Related Submittals: The Contractor's submittal of, and the Architect/Engineer's acceptance of, Shop Drawings, Product Data, or Samples which are related to work not complying with the Contract Documents, does not constitute an acceptance or valid request for a substitution, nor approval thereof.

1.8 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. General: Deliver, store, and handle products in accordance with manufacturer's recommendations, using means and methods that will prevent damage, deterioration and loss, including theft. Control to prevent overcrowding of construction spaces or overloading of structure. In particular, coordinate delivery and installation to ensure minimum holding or storage times for items known or recognized to be flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other sources of loss.
1. Deliver products to the site in the manufacturer's sealed containers or other packaging system, complete with labels intact, and instructions for handling, storage, unpacking, installing, cleaning and protecting.

2. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation or potential degradation of product.
3. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
4. Store products at the site or in a bonded and insured off-site storage facility or warehouse in a manner that will facilitate inspection and measurement of quantity or counting of units. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.
5. Store heavy materials away from the project structure or in a manner that will not endanger the supporting construction.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT COMPLIANCE

- A. General: Requirements for individual products are indicated in the Contract Documents; compliance with these requirements is in itself a contract requirement. These requirements may be specified in any one (1) of several different specifying methods, or in any combination of these methods. These methods include the following:
 1. Proprietary.
 2. Descriptive.
 3. Performance.
 4. Compliance with Reference Standards.
- B. Compliance with codes, compliance with graphic details, allowances, and similar provisions of the Contract Documents also have a bearing on the selection process
- C. Procedures for Selecting Products: The Contractor's options in selecting products are limited by requirements of the Contract Documents and governing regulations. They are not controlled by industry traditions or procedures experienced by the Contractor on previous construction projects. Required procedures include, but are not limited to the following for the various indicated methods of specifying:
 1. Proprietary and Semi-Proprietary Specification Requirements:
 - a. Single Product Name: Where only a single product or manufacturer is named, provide the product indicated, unless the specification indicates the possible consideration of other products. Advise the Architect/Engineer before proceeding, when it is discovered that the named product is not a reasonable or feasible solution.
 - b. Two (2) or More Product Names: Where two (2) or more products or manufacturers are named, provide one (1) of the products named, at the Contractor's option. Exclude products that do not comply with specification requirements. Do not provide or offer to provide an unnamed product, unless the specification indicates the possible consideration of other products. Advise the Architect/Engineer before proceeding where none of the named products comply with specification requirements, or are not feasible for use. Where products or manufacturers are specified by name, accompanied by the term "or approved equal" or similar language, comply with this Section regarding "substitutions" to obtain approval from the Architect/Engineer for the use of an unnamed product.
 2. Non-Proprietary Specification Requirements: Where the specifications name products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to the use of these products only, the Contractor may, at his option, use any available product that complies with the Contract requirements.
 3. Descriptive Specification Requirements: Where the specifications describe a product or assembly generically, in detail, listing the exact characteristics required, but without use of a brand name, provide products or assemblies that provide the characteristics indicated and otherwise comply with Contract requirements.

4. Performance Specification Requirements: Where the specifications require compliance with indicated performance requirements, provide products that comply with the specific performance requirements indicated, and that are recommended by the manufacturer for the application indicated. The manufacturer's recommendations may be contained in published product literature, or by the manufacturer's individual certification of performance. General overall performance of a product is implied where the product is specified for specific performances.
 5. Compliance with Standards, Codes, and Regulations: Where the specifications require only compliance with an imposed standard, code or regulation, the Contractor has the option of selecting a product that complies with specification requirements, including standards, codes, and regulations.
 6. Visual Matching: Where matching an established sample is required, the final judgement of whether a product proposed by the Contractor matches the sample satisfactorily will be determined by the Architect. Where there is no product available within the specified product category that matches the sample satisfactorily and also complies with other specified requirements, comply with the provisions of this Section regarding "substitutions" and other Contract Documents for "change orders" for the selection of a matching product in another product category, or for non-compliance with specified requirements.
 7. Visual Selection: Except as otherwise indicated, where specified product requirements include the phrase "...as selected from the manufacturer's standard colors, patterns, textures..." or similar phrases, the Contractor has the option of selecting the product and manufacturer, provided the selection complies with other specified requirements. The Architect is subsequently responsible for selecting the color, pattern and texture from the product line selected by the Contractor.
 8. Allowances: Refer to individual sections of the specifications and Section 01 21 00, Allowances for an indication of product selections that are controlled by established allowances, and for the procedures required for processing such selections.
- D. Producer's Statement of Applicability: Where individual specification sections indicate products that require a "Statement of Applicability" from the manufacturer or other producer, submit a written-certified statement from the producer stating that the producer has reviewed the proposed application of the product on the project. This statement shall state that the producer agrees with or does not object to the Architect/Engineer's specification and the Contractor's selection of the product on the project is suitable and proper.

2.2 SUBSTITUTIONS

- A. Condition: The Contractor's request for substitution will be received and considered when extensive revisions to Contract Documents are not required, when the proposed changes are in keeping with the general intent of the Contract Documents, when the request is timely, fully documented and properly submitted, and when one (1) or more of the above conditions are satisfied, all as judged and determined by the Architect/Engineer; otherwise the requests will be returned without action except to record non-compliance with these requirements.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS

- A. General: Except as otherwise indicated in individual sections of these specifications, comply with the manufacturer's instructions and recommendations for installation of the products in the applications indicated.
- B. Anchor each product securely in place, accurately located and aligned with other work.
- C. Clean exposed surfaces and protect surfaces as necessary to ensure freedom from damage and deterioration at time of acceptance.

- D. Products and assemblies shall be installed complete, in-place, watertight and structurally sound.

3.2 INSTALLATION OF APPROVED SUBSTITUTIONS

- A. Coordinate all approved substitutions with adjacent work.
- B. Comply with the manufacturer's and/or supplier's instructions and recommendations for installation of the products in the applications indicated.
- C. Provide all items required by manufacturer and/or supplier regarding installation, i.e. supplemental supports, anchors, fasteners, painting, etc. whether or not indicated or specified.

END OF SECTION 01 25 13

01 25 13.01 - REQUEST FOR SUBSTITUTION

Contract Award Date: _____

To: _____

Substitution Requested By: _____

Project Name and Number: _____

We submit for consideration the following product in lieu of the specified item for the above project:

Drawing No.	Specification Section	Paragraph	Specified Item
_____	_____	_____	_____

Proposed Substitution: _____

Request is made during ____ bidding ____ construction period.

Submit in accordance with Section 01 33 00.

1. Technical data, cost, and time information relating to changes to Construction Documents required by proposed substitution.
2. Detailed comparison of proposed substitution and specified product including but not limited to warranty, significant variations, qualifications of manufacturers, and maintenance.
3. Complete technical data, detailed shop drawings, samples, installation procedures, warranty, and substantiating data marked to indicate equivalent quality and performance to that specified. Manufacturer sell sheets are not acceptable submittals.

Cause for Request: _____

Cost saving realized by Owner _____

Does substitution affect adjacent Work, Construction Documents, cost, schedule, quality, and related submittals?

Yes ____ No ____ On separate sheet, explain affects to the Work, documents, schedule, and submittals.

The Contractor is responsible for associated costs and additional time of the proposed substitution including costs incurred by the Architect for evaluation of substitution and changes to the documents. Describe costs for changes to design, including engineering and detailing costs caused by the requested substitution.

Warranty: Is the warranty for the requested substitution the same or different? Yes ____ No ____

Explain Differences: _____

Contractor Certification:

In making a request for substitution, the Contractor certifies that:

1. The proposed substitution has been thoroughly researched and evaluated and determined as equivalent or superior to specified product or material, will fit into space provided, and is compatible with adjacent materials.

- 2. It will provide the same or better warranty for the proposed substitution at no additional cost to the Owner.
- 3. Cost data is complete and includes related costs under the Contract. Claims for additional costs related to the proposed substitution that may subsequently become apparent are waived.
- 4. It will assume the responsibility for delays and costs caused by the proposed substitution, if approved, are accepted by the Contractor unless delays are and costs are specifically mentioned and approved in writing by the Owner and the Architect.
- 5. It will assume the liability for the performance of the substitution and its performance.
- 6. The installation of the proposed substitution is coordinated with the Work and with changes required for the Work.
- 7. It will reimburse the Owner and Architect for evaluation and redesign services associated with the substitution request and, when required, by approval by governing authorities.

Submitted by:

Signature of Contractor _____ Title _____

Firm _____ Telephone _____ Date _____

Signature shall be by the individual authorized to legally bind the Contractor's to the above terms. Failure to provide legally binding signature will result in retraction of approval.

FOR USE BY ARCHITECT:

Accepted Accepted as Noted
 Not Accepted Received Too Late

FOR USE BY OWNER:

Accepted Not Accepted

By: _____

By: _____

Date: _____

By: _____

Remarks: _____

Remarks: _____

END OF SECTION 01 25 13.01

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Work:
 - 1. Section 01 25 13 – Product Substitution Procedures.

1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710 *Architect's Supplemental Instructions*.

1.4 PROPOSAL REQUESTS

- A. Owner Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop Work in progress or to execute the proposed change.
 - 2. After receipt of Proposal Request, submit quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
- B. Contractor Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
 - 1. Include statement outlining reasons for the change and the effect of the change on the Work. Provide complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 - 2. Include list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - 4. Include costs of labor and supervision directly attributable to the change.
 - 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times,

and activity relationship. Use available total float before requesting an extension of the Contract Time.

6. Comply with requirements in Section 01 25 00 if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use AIA Document G709.

1.5 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: When an allowance is specified, refer to Section 01 21 00 for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.
 1. Allowance Adjustment: To adjust allowance amounts, base each Change Proposal Request (CPR) on the difference between purchase amount and the allowance, multiplied by final measurement of Work in place. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
 - a. Include installation costs in purchase amount only where indicated as part of the allowance.
 - b. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
 - c. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit cost allowances.
 - d. Owner reserves the right to establish the quantity of Work in place by independent quantity survey, measure, or count.
 2. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the Purchase Order amount or Contractor's handling, labor, installation, overhead, and profit. Submit claims within 7 days of receipt of the Change Order authorizing work to proceed. Owner will reject claims submitted later than 7 days after authorization.

1.6 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Changes Proposal Request, Architect will execute a Change Order also requiring signatures of Owner and Contractor on AIA Document G701.

1.7 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 1. Construction Change Directive contains a complete description of change in the Work and designates the method to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of Work required by the Construction Change Directive. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 26 00

SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Procedures for submitting Applications for Payment.

1.2 GENERAL

- A. Coordinate requirements of this Section with the requirements of the General and Supplementary Conditions of the Contract concerning payment procedures.

1.3 SCHEDULE OF VALUES

- A. Submit printed schedule on AIA Form G703 - Continuation Sheet for G702 in accordance with Section 01 29 73, Schedule of Values. Each G702 and G703 form shall be submitted to the architect in digital format (xls file) at each application interval.
- B. Submit Schedule of Values in duplicate within twenty (20) days after the date of the Notice to Proceed.
- C. Format: Utilize the sample schedule of values breakdown included with this Section.
- D. Include a separate line item for each Allowance. After Allowance Expenditure Authorizations (AEA) are fully executed, add a line item for each AEA.
- E. Include a separate line item for Contractor's overhead.
- F. Include a separate line item for Contractor's profit.
- G. Include separate line items for General Conditions (Mobilization, Temporary Facilities, Supervision, Bonds, Insurance, etc.)
- H. Include separate line items for shop drawings for each specification section.
- I. Include separate line items for close out documents for each sub-contract.

1.4 APPLICATIONS FOR PAYMENT

- A. Payment Period: Submit at intervals stipulated in the Agreement. Refer to the General Conditions of the Contract for Construction, Article 9.3, Applications for Payment, for review and submittal requirements.
- B. Submit four (4) copies of each application on AIA Form G702 - Application and Certificate for Payment and AIA G703 - Continuation Sheet for G702. Contractor's electronic media driven form will be considered.
- C. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.
- D. Submit with each application, a complete and executed copy of the Application for Payment Checklist and Transmittal form included in the Project Manual.

- E. Payment will be made on materials or equipment suitably stored on at the site provided that the following conditions are met:
 - 1. Contractor shall be responsible for presenting stored materials to the Owner and Architect in a manner that allows for expeditious comparison of the materials to the schedule of values and material invoices.
 - 2. Submit a complete and executed Stored Materials Worksheet for each Continuation Sheet line item for stored materials.
 - 3. Invoices for stored materials must be dated, include the name and address of the Project and include an itemized listing of the materials stored consisting of quantities and unit prices. The invoices must total at minimum, the amount applied for in the Application for Payment. Overhead and profit will not be paid on stored materials until the materials are installed.
- F. Refer to the Amended General Conditions of the Contract for Construction for requirements on payment of materials and equipment suitable stored off-site.
- G. Submit a completed and executed General Contractor's Waiver and Release of Lien using the form included in the Project Manual.
- H. Beginning with the second Application for Payment, submit notarized Waivers and Releases of Lien for each Continuation Sheet line item drawn on in the previous Application for Payment, using the form included in the Project Manual. Releases submitted on forms other than the form included in the Project Manual will not be accepted.
- I. Submit updated construction schedule indicating project progress by including percentages of work complete to date along with percentages of work remaining to be complete. Refer to the Amended General Conditions of the Contract for Construction, Paragraph 3.10.3 for additional requirements.
- J. Submit construction progress photographs as described in Section CB, Supplementary Conditions to the Amended General Conditions of the Contract for Construction.
- K. Submit a completed and executed Electronic Record Drawings Status Form with 8 1/2" x 11" copies of the changes made during the previous month.
- L. Refer to Paragraph 9.10, Final Completion and Final Payment in the Supplementary Conditions to the General Conditions of the Contract for Construction for final payment requirements.
 - 1. Submit notarized Waivers and Releases of Lien Upon final Payment from all subcontractors and direct suppliers using the form included in the Project Manual. . Releases submitted on forms other than the form included in the Project Manual will not be accepted.

PART 2 – PRODUCTS Not Used.

PART 3 – EXECUTION Not Used.

**APPLICATION AND CERTIFICATE FOR PAYMENT
CHECK LIST AND TRANSMITTAL**

Date: _____ **Application for Payment No.** _____

Project: _____ **Architect's Project No.** _____

Owner: Humble Independent School District

Architect: PBK Architects, Inc.

Contractor: _____

Transmitted herewith are four (4) complete copies of the above referenced Application and Certificate for Payment. By initialing each item listed below, the undersigned certifies that he has personally checked and determined that each of the items is in compliance with the requirements of the Contract Documents.

Item	Description	Initial to Acknowledge Compliance	Notes, Exceptions
A	Four (4) complete copies of the above referenced Application and Certificate for Payment, signed and notarized, are enclosed.		
B	The grand totals of the Continuation Sheet match the amounts shown on the Application and Certificate for Payment.		
C	Percentage drawn for Supervision and General Conditions matches the Continuation Sheet grand total percentage in Column G		
D	Two (2) copies of Waiver and Release of Lien Forms enclosed for monies drawn in the previous application for payment		
E	Two (2) copies of Stored Materials Worksheet and invoices enclosed for each line item of stored materials		
F	Two (2) Electronic Record Drawings Status Form enclosed		
G	Two (2) Updated Construction Schedule enclosed		
H	Construction Progress Photographs enclosed		

Submitted by (signature): _____

Name (printed or typed): _____

Title: _____

Continuation Sheet Line No. _____

STORED MATERIALS WORKSHEET
PROGRESS PAYMENT NO. _____

Humble Middle School 11

HUMBLE INDEPENDENT SCHOOL DISTRICT

The Contractor shall complete a Stored Materials Worksheet when applying for payment of stored materials.

Column B. Description _____

Column F. Materials Presently Stored \$ _____

Total of Attached Invoices
for Materials Stored \$ _____

The Contractor hereby certifies that the applied for materials have been stored on the project site in accordance with the requirements of the Contract Documents, the attached invoices accurately document the cost for these materials and the invoice totals equal or exceed the amount applied for. (Staple copies of applicable invoices behind each Stored Materials Worksheet submitted)

Contractor's Signature

Printed Name and Title

Date

ELECTRONIC RECORD DRAWINGS STATUS FORM
PROGRESS PAYMENT NO. _____

Humble Middle School 11

HUMBLE INDEPENDENT SCHOOL DISTRICT

By signature of this document, the Contractor certifies that electronic record drawings have been updated with the following changes during the past month.

Field Changes _____

Minor Change No(s). _____

AEA No(s). _____

Contractor's Signature

Printed Name and Title

Date

FORM 1: CONDITIONAL WAIVER FOR PROGRESS PAYMENTS

* * * * *

CONDITIONAL WAIVER AND RELEASE ON PROGRESS PAYMENT

Project: _____

Job No: _____

On receipt by the signer of this document of a check from _____

_____ (maker of check)
in the sum of \$ _____

payable to _____
(payee or payees of check) and when the check has been properly endorsed and has been paid by the bank on which it is drawn, this document becomes effective to release any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position that the signer has on

the property of _____ (owner)

located at _____ (location)

to the following extent: _____

_____ (job description).

This release covers a progress payment for all labor, services, equipment, or materials furnished to the property or to _____

_____ (person with whom signer contracted)
as indicated in the attached statement(s) or progress payment request(s), except for unpaid retention, pending modifications and changes, or other items furnished.

Before any recipient of this document relies on this document, the recipient should verify evidence of payment to the signer.

The signer warrants that the signer has already paid or will use the funds received from this progress payment to promptly pay in full all of the signer's laborers, subcontractors, material men, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project in regard to the attached statement(s) or progress payment request(s)."

Date: _____ (Company name)

By: _____ (Signature) (Title)

This instrument was acknowledged and executed before me this ___ day of _____, 20___,

By: _____ (Public Notary)

_____ (Commission Expires)

FORM 2: UNCONDITIONAL WAIVER FOR PROGRESS PAYMENTS

* * * * *

NOTICE: THIS DOCUMENT WAIVES RIGHTS UNCONDITIONALLY AND STATES THAT YOU HAVE BEEN PAID FOR GIVING UP THOSE RIGHTS. IT IS PROHIBITED FOR A PERSON TO REQUIRE YOU TO SIGN THIS DOCUMENT IF YOU HAVE NOT BEEN PAID THE PAYMENT AMOUNT SET FORTH BELOW. IF YOU HAVE NOT BEEN PAID, USE A CONDITIONAL RELEASE FORM.

UNCONDITIONAL WAIVER AND RELEASE ON PROGRESS PAYMENT

Project: _____

Job No: _____

The signer of this document has been paid and has received a progress payment in the sum of \$ _____ for all labor, services, equipment, or materials furnished to the property or to _____ (person with whom signer contracted) on the property of _____ (owner) located at _____ (location) to the following extent: _____ (job description).

The signer therefore waives and releases any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position that the signer has on the above referenced project to the following extent:

This release covers a progress payment for all labor, services, equipment, or materials furnished to the property or to _____ (person with whom signer contracted) as indicated in the attached statement(s) or progress payment request(s), except for unpaid retention, pending modifications and changes, or other items furnished.

The signer warrants that the signer has already paid or will use the funds received from this progress payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project in regard to the attached statement(s) or progress payment request(s).

Date: _____ (Company name)

By: _____ (Signature) (Title)

This instrument was acknowledged and executed before me this ___ day of _____, 20____.

By: _____ (Public Notary)

_____ (Commission Expires)

FORM 3: CONDITIONAL WAIVER FOR FINAL PAYMENT

* * * * *

CONDITIONAL WAIVER AND RELEASE ON FINAL PAYMENT

Project: _____

Job No: _____

On receipt by the signer of this document of a check from _____

_____ (maker of check)

in the sum of \$ _____

payable to: _____
(payee or payees of check) and when the check has been properly endorsed and has been paid by the bank on which it is drawn, this document becomes effective to release any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position that the signer has on the property of _____

_____ (owner)

located at _____ (location)

to the following extent: _____

_____ (job description)

This release covers the final payment to the signer for all labor, services, equipment, or materials furnished to the property or to _____ (person with whom signer contracted).

Before any recipient of this document relies on this document, the recipient should verify evidence of payment to the signer.

The signer warrants that the signer has already paid or will use the funds received from this final payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project up to the date of this waiver and release.

Date: _____ (Company name)

By: _____ (Signature) (Title)

This instrument was acknowledged and executed before me this ___ day of _____, 20____,

By: _____ (Public Notary)

_____ (Commission Expires)

FORM 4: UNCONDITIONAL WAIVER FOR FINAL PAYMENT

* * * * *

NOTICE: THIS DOCUMENT WAIVES RIGHTS UNCONDITIONALLY AND STATES THAT YOU HAVE BEEN PAID FOR GIVING UP THOSE RIGHTS. IT IS PROHIBITED FOR A PERSON TO REQUIRE YOU TO SIGN THIS DOCUMENT IF YOU HAVE NOT BEEN PAID THE PAYMENT AMOUNT SET FORTH BELOW. IF YOU HAVE NOT BEEN PAID, USE A CONDITIONAL RELEASE FORM.

UNCONDITIONAL WAIVER AND RELEASE ON FINAL PAYMENT

Project: _____

Job No: _____

The signer of this document has been paid in full for all labor, services, equipment, or materials

furnished to the property or to _____

_____ (person with whom signer contracted)

on the property of _____ (owner)

located at _____ (location)

to the following extent _____ (job description).

The signer therefore waives and releases any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position.

The signer warrants that the signer has already paid or will use the funds received from this final payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project up to the date of this waiver and release.

Date: _____ (Company name)

By: _____ (Signature) (Title)

This instrument was acknowledged and executed before me this ___ day of _____, 20___,

By: _____ (Public Notary)

_____ (Commission Expires)

SECTION 01 29 73 - SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

- A. Work Included: Provide a detailed breakdown of the agreed Contract Sum showing values allocated to each of the various parts of the work, as specified herein and in other provisions of the Contract Documents.
- B. Coordinate requirements of this Section with the requirements of the General and Supplementary Conditions of the Contract concerning Schedule of Values.

1.3 QUALITY ASSURANCE

- A. Use required means to assure arithmetical accuracy of the sums described.
- B. When so required by the Owner, provide copies of the subcontracts or other data acceptable to the Owner, substantiating the sums described.

1.4 SUBMITTALS

- A. Prior to the first Application for Payment, submit a proposed schedule of values to the Owner, as outlined below:
 - 1. Meet with the Owner and determine additional data, if any, required to be submitted.
 - 2. Secure the Owner's approval of the schedule of values prior to submitting first Application for Payment.

1.5 SCHEDULE OF VALUES

- A. The Schedule of Values shall be broken down into item costs for each specification section as a minimum. After review by the Owner, the Schedule of Values shall be broken down into further items as required. (See following list and refer to the enclosed sample.). In addition, total each Specification Division separately.
- B. Schedule of Values - Items in addition to Specification Sections.
 - 1. Mobilization
 - 2. Clean Up
 - 3. Building Permit
 - 4. Bonds, Insurance
 - 5. Misc. Mechanical Accessories
 - 6. Demolition
 - 7. Rough-In Labor - (Electrical)
 - 8. Rough-In Material - (Electrical)
 - 9. Finish Labor - (Electrical)
 - 10. Finish Material - (Electrical)
 - 11. Allowances (listed separately)
 - 12. Record drawings and close-out documents
 - 13. Submittals listed separately per mechanical, electrical and plumbing
 - 14. Roof warranty as a line item

15. Donated items individually itemized at \$0.00 (zero dollars).

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 SCHEDULE OF VALUES

- A. Refer to following sample.

END OF SECTION 01 29 73

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Div. 1 - General Reqs. Site Work General Conditions Supervision Mobilization Bonds & Insurance Permits Contractor's Fee Close-Out Documents								
	Div. 1 - Total								
	Div. 2 - Existing Conditions Demolition (As applicable) Erosion Control Div. 2 - Total								
	Div. 3 - Concrete Drill Piers Caps & Beams Slab on Grade Cooling Tower Basin Misc Bldg Conc Floor Sealer Rebar Matl Rebar Labor Lt.Wt.Insul Fill - Materials Lt.Wt.Insul Fill - Labor Submittals/Close-Out Documents Supervision Clean-up								
	Div. 3 - Total Div 4 - Masonry Brickwork - Labor Brickwork - Matls Concrete Masonry - Labor Concrete Masonry - Materials Str. Glazed Tile-Labor Str. Glazed Tile-Materials Submittals/Close-Out Documents Supervision Clean-up								
	Div. 4 - Total								
	Div 5 - Metals Structural Steel - Labor Structural Steel - Materials Alternating Stairs Misc. Steel - Materials Steel Joists - Materials Lt. Gauge Steel Framing-Labor Lt. Gauge Steel Framing-Matls Metal Decking - Labor Expansion Joint Covers Metal Decking - Matls								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Detailing Submittals/Close-Out Documents Supervision Clean-up								
	Div. 5 - Total								
	Div. 6 - Wood & Plastics Rough Carpentry - Labor Rough Carpentry - Materials Millwork - Labor Millwork - Materials Submittals/Close-Out Documents								
	Div. 6 - Total								
	Div. 7 - Thermal and Moisture Protection Waterpfgng / Damppfng-Matls Waterpfgng / Damppfng-Labor Building Insulation - Labor Building Insulation - Materials Fireproofing - Labor Fireproofing - Materials Metal Roof - Labor Metal Roof - Materials Metal Roof Guarantee Built-up Roofing-Labor Built-up Roofing-Materials Built-up Roofing Guarantee Roof Accessories Building Sheet Metal - Labor Building Sheet Metal - Matls Bldg. Sheet Metal Guarantee Roof Curbs Roof Hatches Sealants Submittals/Close-Out Documents Supervision Clean-up								
	Div. 7 - Total								
	Div. 8 - Doors and Frames Finish Carpentry/Door - Labor Finish Hardware - Matls Thresholds & Seals - Matls+B66 Hollow Metal Doors & Frames - Matls Plastic Faced Doors-Matls Overhead Doors & Grilles-Labor Overhead Doors & Grilles - Matls Alum. Entrances & Store-fronts - Labor Alum. Entrances & Store-								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	fronts - Matls Alum. Windows - Labor Alum Windows - Matls Glass & Glazing-Labor Glass & Glazing-Matls Submittals/Close-Out Documents Supervision Clean-up								
	Div. 8 - Total								
	Div. 9 - Finishes Lath & Plaster-Labor Lath & Plaster-Matls Gypsum Wallboard Systems - Labor Gypsum Wallboard Systems - Matls Ceramic Tile - Labor Ceramic Tile - Matls Quarry Tile - Labor Quarry Tile - Matls Terrazzo-Labor Terrazzo-Matls Acoustic Clg. - Labor Acoustic Clg. - Matls Acoustic Wall Panels Resilient Flooring - Labor Resilient Flooring - Matls Carpet - Labor Carpet - Matls Athletic Flooring - Materials Athletic Flooring - Labor Floor Sealer Painting - Labor Painting - Mtls Submittals/Close-Out Documents Supervision Clean-up								
	Div. 9 - Total								
	Div. 10 - Specialties Visual Display Boards & Tackboards - Materials Visual Display Boards & Tackboards - Labor Toilet Partitions - Labor Toilet Partitions - Matls Louvers Aluminum Flag Pole Graphics Lockers Cubicle Curtains & Track Fire Extinguisher Cabinets Demountable Partitions-Labor								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Demountable Partitions-Matls Shelving Toilet Room Accessories-Matls Toilet Room Accessories-Lbr Submittals/Close-Out Documents Supervision Clean-up								
	Div. 10 - Total								
	Div. 11 - Equipment Stage Curtains Misc. Appliances Food Service Eqpt-Labor Food Service Eqpt-Matls Submittals/Close-Out Documents Supervision Clean-up								
	Div. 11 - Total								
	Div. 12 - Furnishings Horizontal Blinds Projection Screens Casework - Labor Casework - Matls Science Casework - Labor Science Casework - Matls Submittals/Close-Out Documents Supervision Clean-up								
	Div. 12 - Total								
	Div. 13 - Specialties Stage Curtains and Draperies Music Instrument Storage Bleachers Press Box Pre-eng. Metal Bldg. Stadium Seating Submittals/Close-Out Documents Supervision Clean-up								
	Div. 13 - Total								
	Div. 14 - Conveying Systems Platform Lifts Elevators Submittals/Close-Out Documents Supervision Clean-up								
	Div. 14 - Total								
	Div. 21, 22 - Plumbing Shop Drawings As-Builts/Close-Out/ O&M Manuals Sanitary Underground -								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Labor Sanitary Underground - Matls Storm Underground - Labor Storm Underground - Matls Domestic Water - Labor Domestic Water - Matls Plumbing Insulation - Matls Plumbing Insulation - Labor Gas Piping - Matls Gas Piping - Labor Grease Trap Plumbing Fixtures - Matls Plumbing Fixtures - Labor Coordination Drawings Submittals/Close-Out Documents Supervision Clean-up								
	Div. 21, 22 Plumbing - Total								
	Div. 23 - Mechanical Shop Drawings As-Builts/Close-Out/ O&M Manuals Chillers - Matls Chillers - Labor Cooling Towers - Matls Cooling Towers - Labor Boilers - Matls Boilers - Labor AHU's - Matls AHU's - Labor Fans - Matls Fans - Labor Grilles - Matls Grilles - Labor Ductwork - Matls Ductwork - Labor Pumps - Mtls Pumps - Labor Water Treatment - Labor Water Treatment - Matls Isolation - Labor Isolation - Matls Pipe Flex - Matls Pipe Flex - Labor Connections Sheet Metal - Matls Sheet Metal - Labor Duct Insulation - Matls Duct Insulation - Labor								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Pipe Insulation - Matls								
	Pipe Insulation - Labor								
	VAV Boxes - Materials								
	VAV Boxes - Labor								
	Refrigerant Monitor - Matls								
	Refrigerant Monitor - Labor								
	Unit Heaters - Materials								
	Unit Heaters - Labor								
	Startup								
	Controls - Matls								
	Control - Labor								
	Engineer / Submittals								
	Modules / End Devices								
	Low Voltage Wiring								
	Startup								
	Close-Out Documents								
	Fire Sprinkler								
	Engineer / Submittals								
	Piping - Materials								
	Piping - Labor								
	Equipment - Materials								
	Equipment - Labor								
	Trimout - Materials								
	Trimout - Labor								
	Pipe, Valves, Fittings - Labor								
	Pipe, Valves, Fittings - Matls								
	Misc. - Matls								
	Insulation - Matls								
	Insulation - Labor								
	Sanitary Above Slab-Labor								
	Sanitary Above Slab-Matls								
	Storm Above Slab - Labor								
	Storm Above Slab - Matls								
	Gas - Labor								
	Gas - Matls								
	Fixtures - Labor								
	Fixtures - Matls								
	Permits								
	Coordination Drawings								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 23 Mechanical - Total								
	Div. 26 - Electrical								
	Mobilization+B220								
	Shop Drawings								
	As-Builts/Close-Out/ O&M Manuals								
	Underground								
	Conduit - Labor								
	Conduit - Matl								
	Wire - Labor								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Wire - Mats								
	Feeder Wire - Labor								
	Feeder Wire - Mats								
	Switches/Recpt.								
	Switchgear - Labor								
	Switchgear - Mats								
	Temporary - Materials								
	Temporary - Labor								
	Gas Generator - Materials								
	Gas Generator - Labor								
	Fixtures - Labor								
	Fixtures - Mats								
	Communications - Labor								
	Communications - Mats								
	Fire Alarm - Labor								
	Fire Alarm - Mats								
	Security - Labor								
	Security - Mats								
	Low Voltage Ltng Sys-Mats								
	Low Voltage Ltng Sys-Labor								
	Voice System - Materials								
	Voice System - Labor								
	Video System - Materials								
	Video System - Labor								
	Data System - Materials								
	Data System - Labor								
	Master Clock - Materials								
	Master Clock - Labor+B277								
	Coordination Drawings								
	Submittals/Close-Out Documents								
	Supervision Clean-up								
	Div. 26 - Total								
	Divs. 31, 32 and 33 - Earthwork, Exterior Improvements and Utilities								
	Site Clearing & Grubbing								
	Building Pad - Materials								
	Building Pad - Labor								
	Paving Subgrade								
	Signage / Striping								
	Bike Racks								
	Landscaping - Materials								
	Landscaping - Labor								
	Hydro Mulch - Materials								
	Hydro Mulch - Labor								
	Irrigation - Materials								
	Irrigation - Labor								
	Earthwork								
	Finish Grading								
	Stabilization - Materials								
	Stabilization - Labor								
	Site Drainage - Materials								
	Site Drainage - Labor								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Chain Link Fence-Materials Chain Link Fence-Labor Paving - Labor Paving - Materials Sidewalks Submittals/Close-Out Documents Supervision Clean-up								
	Div. 31, 32 and 33 - Total								
	General Conditions Mobilization Temp. Facilities Final Cleaning Record Documents/Close-out/ O&M Manuals Supervision Permits Bonds Insurance Allowances Alternates (list) Change Orders A. PR# B. PR# C. PR#								

END OF SECTION

SECTION 01 31 00 – PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. Pre-install meetings.
- B. Each Contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific Contractor.
- C. Contractor shall make a reasonable attempt to interpret the Contract Documents before asking the Architect for assistance in interpretation. Requests for Information (RFI's) will not be allowed from the Contractor. The Contractor shall arrange the necessary meeting in the field with appropriate Architect's field representative(s) to obtain clarification as needed on items that may need interpretation.

1.3 SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and email addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
 - 1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.4 COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.

- B. Coordination: Each Contractor shall coordinate its construction operations with those of other Contractors and entities to ensure efficient and orderly installation of each part of the Work. Each Contractor shall coordinate its operations with operations, included in different Sections, which depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components with other Contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include items as required notices, reports, and list of attendees at meetings.
 - 1. Prepare similar memoranda for Owner and separate Contractors if coordination of the Work is required.
- D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Administrative activities include, but are not limited to, the following:
 - 1. Preparation of Contractor's construction schedule.
 - 2. Preparation of the schedule of values.
 - 3. Installation and removal of temporary facilities and controls.
 - 4. Delivery and processing of submittals.
 - 5. Progress meetings.
 - 6. Preinstallation conferences.
 - 7. Project closeout activities.
 - 8. Startup and adjustment of systems.
 - 9. Coordinating inspections and other jurisdictional requirements.
 - 10. Coordinate OFCI equipment.
 - 11. Action items and issue logs.
- E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to the Specifications Sections for disposition of salvaged materials that are designated as Owner's property.

1.5 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
 - 1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade specific information to the coordination drawings by multiple Contractors in sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.

- d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures, ductwork, piping, and other components.
 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire protection, fire-alarm, and electrical equipment.
 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
 - e. Floor boxes.
 8. Fire Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, sprinkler heads, and inspector test locations.
 9. IDF/MDF Rooms: Communications and low voltage (security, data, phone, etc.) audio
 10. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.

11. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 01 33 00.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
 1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
 2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format.
 3. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Digital Data Software Program: Drawings are available in Revit.
 - c. Contractor shall execute a data licensing agreement in the form of AIA Document C106.

1.6 PROJECT MEETINGS

- A. Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 2. Agenda: Architect to prepare the meeting agenda and distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
 4. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.
 5. Issue logs: Documentation element of software project management and contains a list of ongoing and closed issues of the project.
- B. Kick-off & Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect.
 1. Conduct the conference to review responsibilities and personnel assignments.
 2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that affect progress.
 4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
 5. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.
- C. Preinstallation Conferences: Conduct a preinstallation trade conference at site before each construction activity that requires coordination with other construction trades.
 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect and Engineer of Record of scheduled meeting dates.
 2. Agenda: Contractor to review progress of other construction activities and preparations for the particular activity under consideration.
 3. Contractor to record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Contractor to distribute minutes of the meeting to each party present and to other parties requiring information.

5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
 6. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.
- D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Substantial Completion.
 2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect or delay Project closeout.
 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
 5. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.
- E. Progress Meetings: Conduct progress meetings at weekly intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner and Architect, each Contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
 - b. Six (6) week look-ahead schedules.
 5. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.
- F. Coordination Meetings: Conduct coordination meetings at weekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

- a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each Contractor present.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.
 4. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 31 00

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 1. Startup construction schedule.
 2. Contractor's construction schedule.
 3. Construction schedule updating reports.
 4. Daily construction reports.
 5. Material location reports.
 6. Site condition reports.
 7. Special reports.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 2. Predecessor Activity: An activity that precedes another activity in the network.
 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum unless otherwise approved by Architect.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Float: The measure of leeway in starting and completing an activity.
 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- F. Resource Loading: The allocation of manpower and equipment necessary for completion of an activity as scheduled.
- G. Recovery Schedule: Submittal of a revised critical path method (CPM) schedule and a written plan.
- H. Look-ahead Schedule: Prepare schedule indicating activities scheduled to occur or commence prior to submittal of next schedule update.

- I. Milestones: Measurable and observable and serve as progress markers (flags) but, by definition, are independent of time (have zero durations) therefore no Work or consumption of resources is associated with them.

1.4 SUBMITTALS

- A. Submittal Format: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file, where indicated.
 - 2. PDF electronic file.
- B. Startup Diagram: Of size necessary to display entire network for entire construction period. Show logic relationship ties for all activities.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 - 1. Submit a working electronic copy of schedule, labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.
- D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
 - 1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
 - 2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
 - 3. Total Float Report: List of all activities sorted in ascending order of total float.
 - 4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.
- E. Construction Schedule Updating Reports: Submit with Applications for Payment.
- F. Daily Construction Reports: Submit at monthly intervals.
- G. Material Location Reports: Submit at monthly intervals.
- H. Site Condition Reports: Submit at time of discovery of differing conditions.
- I. Special Reports: Submit at time of unusual event.

1.5 QUALITY ASSURANCE

- A. Prescheduling Conference: Conduct conference at site. Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:
 - 1. Review software limitations and content and format for reports.
 - 2. Verify availability of qualified personnel needed to develop and update schedule.
 - 3. Discuss constraints, including phasing, Work stages, area separations, interim milestones, and partial Owner occupancy.
 - 4. Review delivery dates for Owner furnished products.
 - 5. Review schedule for Work of Owner's separate contracts, if any.
 - 6. Review submittal requirements and procedures.
 - 7. Review time required for review of submittals and resubmittals.
 - 8. Review requirements for tests and inspections by independent testing and inspecting agencies.
 - 9. Review time required for Project closeout and Owner startup procedures.
 - 10. Review and finalize list of construction activities to be included in schedule.
 - 11. Review procedures for updating schedule.

1.6 COORDINATION

- A. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from entities involved.
 - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Time is of the essence to the Owner. Commence Work immediately upon issuance of the Notice to Proceed. There is a critical need for the Work to be substantially complete within the time frame identified in the Agreement.
- B. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial Completion and date of final completion.
 - 1. Contract completion date shall not be changed by submission of schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each separate area or story as a separate numbered activity for each main element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities in terms of number of days anticipated.
 - 2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - 3. Submittal Review Time: Include review and resubmittal times indicated in Section 01 33 00 in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
 - 4. Startup and Testing Time: Include number of days anticipated for startup and testing.
 - 5. Substantial Completion: Indicate completion of all conditions as in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 - 6. Punch List and Final Completion: Include a maximum of 30 days for completion of punch list items and final completion.
 - 7. Inspections required by Authorities Having Jurisdiction (AHJ).
- D. Constraints: Include constraints and Work restrictions indicated in the Contract Documents and show how the sequence of the Work is affected.
 - 1. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use of premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
 - i. Rain days as indicated in Specification Section 01 10 00 Summary.

2. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Submittals.
 - b. Mockups.
 - c. Fabrication.
 - d. Installation.
 - e. Tests and inspections.
 - f. Adjusting.
 - g. Curing.
- E. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
- F. Six (6) week, lookahead schedule: Prepare schedule indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
 1. Unresolved issues.
 2. Unanswered Requests for Information.
 3. Rejected or unreturned submittals.
 4. Notations on returned submittals.
 5. Pending modifications affecting the Work and Contract Time.
 6. Inspections by Authorities Having Jurisdiction (AHJ).
 7. Trade pre-installation conference.
- G. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.
- H. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
- I. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time impact analysis to demonstrate the effect of the proposed change on the overall project schedule.
- J. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
 1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.
 4. Changes in activity durations in workdays.
 5. Changes in the critical path.
 6. Changes in total float or slack time.
 7. Changes in the Contract Time.

2.2 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording information concerning events at the site and submit each month to Architect:
 1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.
 4. Rental equipment at Project site.
 5. Material deliveries.
 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 7. Accidents.
 8. Meetings and significant decisions.

9. Unusual events (see special reports).
 10. Stoppages, delays, shortages, and losses.
 11. Meter readings and similar recordings.
 12. Emergency procedures.
 13. Orders and requests of Authorities Having Jurisdiction (AHJ).
 14. Change Orders received and implemented.
 15. Construction Change Directives received and implemented.
 16. Services connected and disconnected.
 17. Equipment or system tests and startups.
 18. Partial completions and occupancies.
 19. Substantial Completions authorized.
- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
1. Material stored prior to previous report and remaining in storage.
 2. Material stored prior to previous report and since removed from storage and installed.
 3. Material stored following previous report and remaining in storage.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report and contact Architect Field Representative. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents to Architect Field Representative.
- D. Special Reports: Submit special reports directly to Owner within 24 hours of an occurrence. Distribute copies of report to parties affected by the occurrence.
1. Reporting Unusual Events: When an event of an unusual and significant nature occurs at site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, and response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner & Architect in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule with a pencil copy of pay application.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate final completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and interested parties identified by Contractor with a need to know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

3.2 SCHEDULE DEVIATION

A. *The following milestone completion dates shall be indicated in the A101 Owner Contractor Agreement provided by the General Contractor. If completion of these construction milestone dates are not met according to the schedule, the General Contractor, at no additional expense to Owner, shall provide additional manpower, equipment, overtime pay, or any other means necessary to expedite construction progress to get back on the original construction schedule and meet the next chronological milestone date. If agreed upon milestone dates are not met, the Owner shall have the right to impose daily Liquidated Damages as indicated in the Supplementary Conditions to the Contract until construction progress is found to be back on schedule.*

1. *Milestone Dates:*

- a. Foundation 50% Complete and Steel Erection Underway
- b. Foundation, Steel Erection, and Roof Decking Complete
- c. Envelope Wall and Sheathing Complete & Roof Dried-in
- d. Chiller Startup

END OF SECTION 01 32 00

SECTION 01 32 33 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Periodic construction photographs.
 - 3. Final completion construction photographs.

1.3 SUBMITTALS

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph or video recording. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- B. Digital Photographs: Submit image files within three days of taking photographs.
 - 1. Digital Camera: Minimum sensor resolution of 8 megapixels.
 - 2. Format: Minimum 3200 by 2400 pixels, in unaltered original files, with same aspect ratio as the sensor, uncropped, date and time stamped, in folder named by date of photograph, accompanied by key plan file.
 - 3. Identification: Provide the following information with each image description in file metadata tag:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Date photograph was taken.
 - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - g. Unique sequential identifier keyed to accompanying key plan.
- C. Construction Photographs: Submit two prints of each photographic view within seven days of taking photographs.
 - 1. Format: 8 inch by 10 inch (203 mm by 254 mm) smooth surface matte prints on single weight, commercial grade photographic paper; mounted on card stock to allow a 1 inch (25 mm) wide margin punched for standard three-ring binder.
 - 2. Identification: On back of each print, provide an applied label or rubber-stamped impression with the following information:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Date photograph was taken if not date stamped by camera.
 - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - g. Unique sequential identifier keyed to accompanying key plan.

1.4 QUALITY ASSURANCE

- A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.

1.5 USAGE RIGHTS

- A. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

- A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of 8 megapixels, and at an image resolution of not less than 3200 by 2400 pixels.

PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

- A. Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- B. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image editing software.
 - 1. Date and Time: Include date and time in file name for each image.
 - 2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Architect.
- C. Preconstruction Photographs: Before commencement of the Work, take photographs of site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
 - 1. Flag construction limits before taking construction photographs.
 - 2. Take minimum of 20 photographs to show existing conditions adjacent to property before starting the Work.
 - 3. Take minimum of 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
 - 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- D. Periodic Construction Photographs: Take minimum of 20 photographs monthly, coinciding with cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
 - 1. Take photographs as evidence of existing project conditions as follows:
 - a. Site: Take four (4) site aerial photographs at project corners.
 - b. Interior views: Take four (4) minimum interior photographs of each space under construction from differing directions or as required.
 - c. Exterior views: Take two (2) photographs of each elevation.
 - d. Details: Take as required to document concealed conditions, including, but not limited to, underground construction, utility penetrations and installation, steel erection, concrete and masonry reinforcing, waterproofing and flashing, and roofing installation.

- E. Architect Directed Construction Photographs: From time to time, Architect will instruct photographer about number and frequency of photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.
- F. Time Lapse Sequence Construction Photographs: Take minimum of 20 photographs as indicated, to show status of construction and progress since last photographs were taken.
 - 1. Frequency: Take photographs monthly, coinciding with the cutoff date associated with each Application for Payment.
 - 2. Vantage Points: Following suggestions by Architect and Contractor, photographer to select vantage points. During each of the following construction phases, take not less than two of the required shots from same vantage point each time to create a time lapse sequence.
 - a. Commencement of the Work, through completion of subgrade construction.
 - b. Above grade structural framing.
 - c. Exterior building enclosure.
 - d. Interior Work, through date of Substantial Completion.
- G. Final Completion Construction Photographs: Take minimum of 20 color photographs after date of Substantial Completion for submission as project record documents. Architect will inform photographer of desired vantage points.
 - 1. Do not include date stamp.
- H. Additional Photographs: Architect may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.
 - 1. Three days' notice will be given, where feasible.
 - 2. In emergency situations, take additional photographs within 24 hours of request.
 - 3. Circumstances that could require additional photographs include, but are not limited to, the following:
 - a. Special events planned at Project site.
 - b. Immediate follow up when on site events result in construction damage or losses.
 - c. Take photographs at fabrication locations away from site.
 - d. Substantial Completion of a major phase or component of the Work.
 - e. Extra record photographs at time of final acceptance.
 - f. Owner's request for special publicity photographs.

END OF SECTION 01 32 33

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.3 DEFINITIONS

- A. Submittals: Written and graphic information and physical samples that require Architect's responsive action or are for information and do not require the architect's action.
- B. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- C. Portable Document Format (PDF): An open standard file format used for representing documents in a device independent and display resolution independent fixed layout document format.

1.4 SUBMITTALS

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
 - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 - 2. Initial Submittal: Submit concurrently with construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 - 3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule. Submit revised submittal schedule to reflect changes in current status and timing for submittals.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.
 - 1. Upon request, Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.
 - a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
 - b. Digital Drawing Software Program: The Contract Drawings are available in Revit.
 - c. Contractor shall execute a data licensing agreement in the form of AIA Document C106, Digital Data Licensing Agreement.
 - d. The following digital data files will be furnished for each appropriate discipline:

- 1) Floor plans.
 - 2) Reflected ceiling plans.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Submit submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow ten (10) days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process in same manner as initial submittal.
 3. Resubmittal Review: Allow ten (10) days for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
 5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow ten (10) days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.
- D. Electronic Submittals: Identify and incorporate information in each electronic submittal file:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
 3. Transmittal Form for Electronic Submittals: Use software generated form from electronic project management software acceptable to Owner, containing the following information:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Name of firm or entity that prepared submittal.
 - g. Names of subcontractor, manufacturer, and supplier.
 - h. Category and type of submittal.
 - i. Submittal purpose and description.
 - j. Specification Section number and title.
 - k. Specification paragraph number or drawing designation and generic name for each of multiple items.
 - l. Drawing number and detail references, as appropriate.
 - m. Location(s) where product is to be installed, as appropriate.

- n. Related physical samples submitted directly.
 - o. Indication of full or partial submittal.
 - p. Transmittal number, numbered consecutively.
 - q. Submittal and transmittal distribution record.
 - r. Other necessary identification.
 - s. Remarks.
4. Metadata: Include the following information as keywords in the electronic submittal file metadata:
- a. Project name.
 - b. Number and title of appropriate Specification Section.
 - c. Manufacturer name.
 - d. Product name.
- E. Options: Identify options requiring selection by Architect.
- F. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- G. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
- 1. Note date and content of previous submittal.
 - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 - 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- H. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- I. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
- 1. Submit electronic submittals via email as PDF electronic files.
 - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 - 2. Certificates and Certifications Submittals: Provide statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
 - b. Provide a notarized statement on original paper copy certificates and certifications where indicated.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams showing factory installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data before or concurrent with Samples.
 6. Submit Product Data in PDF electronic file.
- C. Shop Drawings: Prepare Project specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 2. Sheet Size: Except for templates, patterns, and similar full size drawings, submit Shop Drawings on sheet size indicated in specification section.
 3. Submit Shop Drawings in PDF electronic file.
 4. BIM File Incorporation: Develop and incorporate Shop Drawing files into Building Information Model established for Project.
 - a. Prepare Shop Drawings in same digital data software program, version, and operating system as the original Drawings.
 - b. Refer to Section 01 31 00 for requirements for coordination drawings.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of applicable Specification Section.
 - e. Specification paragraph number and generic name of each item.

3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
 4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 5. Samples: Submit full size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Key Items Review Time: Submit samples to the Architect at least 30 days prior to the date the Contractor needs the reviewed submittals returned. The Contractor shall be prepared to submit color samples on any key items in Division 09 finishes within 30 days of the award of Contract. Once samples of all key items are received, the Architect will finalize color selections.
 - b. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
 5. Submit product schedule in PDF electronic file.
- F. Coordination Drawing Submittals: Comply with requirements specified in Division 01.
- G. Contractor's Construction Schedule: Comply with requirements specified in Division 01.
- H. Application for Payment and Schedule of Values: Comply with requirements specified in Section 01 29 00.
- I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 45 23.
- J. Closeout Submittals required for Substantial Completion: Comply with requirements specified in Section 01 77 00.

- K. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- L. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- M. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- N. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- O. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- P. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- Q. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- R. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- S. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.
- T. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- U. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- V. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

- W. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and required submittals, submit digitally signed PDF electronic file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.
- C. BIM File Incorporation: Incorporate delegated design drawing and data files into Building Information Model established for Project.
 - 1. Prepare delegated design drawings in the same digital data software program, version, and operating system as the original Drawings.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

- A. Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- B. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- C. Incomplete submittals are not permitted, will be considered nonresponsive, and will be returned for resubmittal without review.
- D. Submittals not required by the Contract Documents will be returned by the Architect without action.

END OF SECTION 01 33 00

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality assurance and quality control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality assurance and quality control procedures that facilitate compliance with Contract Document requirements.
 - 3. Requirements for Contractor to provide quality assurance and quality control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions.
 - 4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

- A. Quality Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
 - 1. Laboratory Mockups: Full size physical assemblies constructed at testing facility to verify performance characteristics.
 - 2. Integrated Exterior Mockups: Mockups of exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
 - 3. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.

- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- F. Source Quality Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- G. Field Quality Control Testing: Tests and inspections performed on site for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform particular construction operations, including installation, erection, application, and similar operations.
 - 1. Use of trade specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- J. Experienced: When used with an entity or individual, *experienced* means having successfully completed a minimum of five years documented experience with projects similar in nature, size, and extent; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 SUBMITTALS

- A. Shop Drawings: Submit plans, sections, and elevations, indicating materials and size of mockup construction.
 - 1. Indicate manufacturer and model number of individual components.
 - 2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.
- B. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting Work on the following systems:
 - 1. Seismic force resisting system, designated seismic system, or component listed in the designated seismic system quality assurance plan prepared by Architect.
 - 2. Main wind force resisting system or wind resisting component listed in the wind force resisting system quality assurance plan prepared by Architect.

- C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.
 - 4. Identification of applicable standards.
 - 5. Identification of test and inspection methods.
 - 6. Number of tests and inspections required.
 - 7. Time schedule or time span for tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality control service.

1.6 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
 - 1. Name, address, and telephone number of technical representative making report.
 - 2. Statement on condition of substrates and their acceptability for installation of product.
 - 3. Statement that products at site comply with requirements.
 - 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 - 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 6. Statement whether conditions, products, and installation will affect warranty.
 - 7. Other required items indicated in individual Specification Sections.
- C. Factory Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory authorized service representative's tests and inspections specified in other Sections. Include the following:
 - 1. Name, address, and telephone number of factory-authorized service representative making report.
 - 2. Statement that equipment complies with requirements.
 - 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 4. Statement whether conditions, products, and installation will affect warranty.
 - 5. Other required items indicated in individual Specification Sections.

- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.
- E. Trade Preinstallation Conferences: Meeting minutes to be Contractor provided.

1.7 QUALITY ASSURANCE

- A. Qualifications establish the minimum qualification levels required; refer to individual Specification Sections for additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated and sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated and with record of successful in service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling Work similar in material, design, and extent to that indicated for this Project, whose Work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the State of Texas, experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
 - 1. Requirements of authorities having jurisdiction supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
 - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products.
- I. Factory Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - 1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens with sufficient time for testing and analyzing results to prevent delaying the Work.

- c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site assembled test assemblies and mockups using installers who will perform same tasks for Project.
 - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.
 2. Testing Agency Responsibilities: Submit certified written report of each test, inspection, and similar quality assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
 1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
 2. Notify Architect a minimum of seven days in advance of dates and times when mockups will be constructed.
 3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction.
 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 5. Obtain Architect's approval of mockups before starting Work, fabrication, or construction. Allow **seven** days for initial review and each re-review of each mockup.
 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 7. Demolish and remove mockups when directed unless otherwise indicated.
- L. Integrated Exterior Mockups: Mockup of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies shall be constructed. Mockup, if not specifically shown on the drawings, shall be minimum 8'x8'. Mockup shall include all major façade elements and at least one window minimum 2'x2' in size. Prior to constructing mockup verify requirements with architect. Pre-installation conferences for trades involved in Integrated Exterior Mockup shall be held after mock up is completed.
- M. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.
- N. Trade Preinstallation Conferences: Meeting minutes to be Contractor provided.

1.8 QUALITY CONTROL

- A. Owner Responsibilities: Where quality control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform the services.
 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality control activities required to verify that the Work complies with requirements, whether specified or not.
1. Unless otherwise indicated, provide quality control services specified and those required by authorities having jurisdiction. Perform quality control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform the quality control services. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 4. Where quality control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality control service.
 5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a factory authorized service representative to inspect field assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300.
- D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
- G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.

6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.9 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency or special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner:
- B. Special Tests and Inspections: Conducted by a qualified testing agency or special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections.
1. Verifying that manufacturer maintains detailed fabrication and quality control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 3. Submitting a certified written report of each test, inspection, and similar quality control service to Architect with copy to Contractor and to authorities having jurisdiction.
 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 5. Interpreting tests and inspections and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
 6. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 00.
- B. Protect construction exposed by or for quality control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality control services.

END OF SECTION 01 40 00

SECTION 01 42 00 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK REQUIREMENTS

- A. General: This Section specifies procedural and administrative requirements for compliance with governing regulations and codes and standards imposed upon the Work. These requirements include the obtaining of permits, licenses, inspections, releases, and similar statements, as well as payments, associated with regulations, codes, and standards.
- B. "Regulations" is defined to include laws, statutes, ordinances, and lawful orders issued by governing authorities, as well as those rules, conventions and agreements within the construction industry which effectively control the performance of the Work regardless of whether they are lawfully imposed by governing authority or not.
- C. Governing Regulations: Refer to General and Supplementary Conditions for requirements related to compliance with governing regulations.

1.3 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized", "selected", "required", and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown", "noted", "scheduled", and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

- J. "Testing Agencies": A testing agency is an independent entity engaged to perform specific inspections or tests, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.4 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference. Individual Specification Sections indicate which codes and standards the Contractor must keep available at the project site for reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Conflicting Requirements: Where compliance with two or more standards is specified, and where these standards establish different or conflicting requirements for minimum quantities or quality levels, the most stringent requirement will be enforced, unless the Contract Documents specifically indicate a less stringent requirement. Refer requirements that are different, but apparently equal, and uncertainties as to which quality level is more stringent to the Architect/Engineer for a decision before proceeding.
- D. Minimum Quantities or Quality Levels: In every instance the quantity or quality level shown or specified is intended to be the minimum for the Work to be provided or performed. Unless otherwise indicated, the actual Work may either comply exactly, within specified tolerances, with the minimum quantity or quality specified, or may exceed that minimum within reasonable limits. In complying with these requirements, the indicated numeric values are either minimum or maximum values, as noted, or as appropriate for context of the requirements. Refer instances of uncertainty to the Architect/Engineer for decision before proceeding.

1.5 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the trade association, standards-producing organization, authorities having jurisdiction or other entity applicable to the context of the text provision.
- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the Agency.
- C. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations.

1.6 SUBMITTALS

- A. Permits, Licenses and Certificates: For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, correspondence, and records established in conjunction with compliance with standards and regulations bearing upon performance of the Work.

PBK Architects
Project No. 220537

Humble High School Additions and Renovations Phase Two
Humble Independent School District

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 42 00

SECTION 01 45 23 – STRUCTURAL TESTING AND INSPECTION SERVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. The testing laboratory shall make all inspections and perform all tests in accordance with the building code, local authorities, ASTM specifications and the Contract Documents.
- B. The testing laboratory shall provide as a part of the project's close-out documents or as required by any regulatory authority, all appropriate signed and sealed Special Inspection Certificates whose purpose would be to provide consistency and direction for compliance with the referenced Building Code. These Special Inspection Certificates shall confirm that that all work requiring special inspection has been adequately performed, and the special inspections have been made by an individual or firm that is qualified to make special inspections per the referenced Building Code.
- C. Materials and workmanship not meeting the required standards are to be removed and replaced. Replacement and subsequent testing shall be at the expense of the Contractor.
- D. Testing, inspection, and certifications specified in other sections of these Specifications shall be paid by the Owner, unless otherwise indicated.
- E. Inspection by the laboratory shall not relieve the Contractor or Fabricator of his responsibility to furnish materials and workmanship in accordance with the Contract Documents.

1.3 REFERENCED STANDARDS

- A. The latest adopted edition of all standards referenced in this Section shall apply, unless noted otherwise.
- B. ACI 311 – ACI Manual of Concrete Inspection
- C. ACI 301 - Specification for Structural Concrete
- D. In case of conflict between these Contract Documents and a referenced standard, the Contract Documents shall govern. In case of conflict between these Contract Documents and the Building Code, the more stringent shall govern.

1.4 QUALITY ASSURANCE

- A. Testing Laboratory shall meet the requirements of ASTM E329 and ASTM E543.
- B. Testing Laboratory shall be insured against errors and omissions by a professional liability insurance policy having a limit of liability not less than \$500,000.

- C. Testing Laboratory shall be under the direction of a Registered Engineer who is legally authorized to practice in the jurisdiction where Project is located and having at least five years experience in inspection and testing of construction materials.
- D. Laboratory staff monitoring concrete work shall be ACI certified inspectors.
- E. Laboratory staff performing structural steel inspection shall be currently certified AWS Certified Welding Inspectors (CWI), in accordance with the provisions of AWS QCI, "Standard and Guide for Qualification and Certification of Welding Inspectors". The inspector may be supported by assistant inspectors who may perform specific inspection functions under the supervision of the inspector. Assistant inspectors shall be currently certified AWS Certified Associate Welding Inspectors (CAWI). The work of the assistant inspectors shall be regularly monitored by the inspector, generally on a daily basis.
- F. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants.

1.5 LABORATORY RESPONSIBILITIES

- A. Attend preconstruction meetings and progress meetings as required to coordinate work with the Contractor and address quality control issues.
- B. Test samples of design mixes submitted by Contractor.
- C. Provide qualified personnel at site. Cooperate with Architect/Engineer and Contractor in performance of services.
- D. Perform specified inspecting, sampling, and testing of Products in accordance with specified standards.
- E. Ascertain compliance of materials and mixes with requirements of Contract Documents.
- F. Promptly notify Architect/Engineer and Contractor of observed irregularities or non conformance of Work or Materials.
- G. Perform all inspections and tests in accordance with building code requirements for "Special Inspection" whether or not such inspections are specified in the Contract Documents.
- H. Testing Laboratory shall write a letter at the completion of the project, signed, and sealed by a registered engineer in the state of the project, summarizing the inspections performed, the dates they were performed, and whether the observed construction complied with the Contract Documents.

1.6 LABORATORY REPORTS

- A. After each inspection and test, promptly submit copies of laboratory reports to Architect, Engineer, Owner and to Contractor.
- B. Include:

1. Date issued
2. Project title and number
3. Name of inspector
4. Date and time of sampling or inspection
5. Identification of product and specifications section
6. Location in the Project
7. Type of inspection or test
8. Date of test
9. Results of tests
10. Conformance with Contract Documents

1.7 LIMITS ON TESTING LABORATORY AUTHORITY

- A. Laboratory may not release, revoke, alter, or enlarge the requirements of the Contract Documents.
- B. Laboratory may not approve or accept any portion of the Work, except where such approval is specifically called for in these specifications.
- C. Laboratory may not assume any duties of Contractor.
- D. Laboratory has no authority to stop the Work.

1.8 CONTRACTOR RESPONSIBILITIES

- A. See technical sections of these specifications for specific requirements.
- B. Deliver to the laboratory, without cost to the Owner, adequate samples of materials proposed for use which are required to be tested.
- C. Advise laboratory sufficiently in advance of construction operations to allow laboratory to complete any required checks or tests and to assign personnel for field inspection and testing as specified.
- D. Provide facilities for safe storage and proper curing of concrete test samples on project site for the first 24 hours and also for subsequent field curing as required by ASTM specifications C31.
- E. Provide incidental labor and equipment as required to assist laboratory personnel in obtaining and handling samples at the site and in accessing work for inspection.
- F. Furnish concrete mix designs, in accordance with ACI 301, section 3.9, made by an independent testing laboratory or qualified concrete supplier. Where mix designs are required, the laboratory shall be selected and paid by the Contractor.
- G. Provide current welder certifications for each welder to be employed.
- H. Furnish fabrication and erection inspection of all welds in accordance with AWS D1.1, Chapter 6.
- I. Prequalification of all welding procedures to be used in executing the work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PIER DRILLING

- A. A representative of the Owner's Geotechnical Engineer shall provide the services specified in this section.
- B. The laboratory representative shall make continuous inspections to determine that the proper bearing stratum is obtained and that shafts are clean and dry before placing concrete.
- C. The laboratory shall furnish complete pier log showing the diameter, top and bottom elevations of each pier, whether or not casing is required, bell size (if required), actual penetration into bearing stratum, and elevation of top of bearing stratum.

3.2 CONCRETE REINFORCING STEEL AND EMBEDDED METAL ASSEMBLIES

- A. Inspect all concrete reinforcing steel prior to placing of concrete for compliance with the Contract Documents and approved shop drawings. All instances of noncompliance shall be immediately brought to the attention of the Contractor for correction. If uncorrected by the Contractor, they shall be listed in the report.
- B. Observe and report on the following:
 - 1. Number and size of bars
 - 2. Bending and lengths of bars
 - 3. Splicing
 - 4. Clearance to forms including chair heights
 - 5. Clearance between bars or spacing
 - 6. Rust, form oil, and other contamination
 - 7. Grade of Steel
 - 8. Securing, tying and chairing of bars
 - 9. Excessive congestion of reinforcing steel
 - 10. Installation of anchor bolts and placement of concrete around anchor bolts
 - 11. Fabrication and installation of embedded metal assemblies, including visual inspection of all welds.
 - 12. Visually inspect studs and deformed bar anchors on embedded assemblies for compliance with Contract Documents
- C. Provide a qualified, experienced inspector to inspect reinforcing steel. Inspector shall have a minimum of three years experience inspecting reinforcing steel in projects of similar size.

3.3 REINFORCING STEEL MECHANICAL SPLICES

- A. Each mechanical splice shall be visually inspected to ensure compliance with the ICBO Reports and the manufacturer's published criteria for acceptable completed splices.
- B. Special emphasis shall be placed on inspection of the end preparation of each bar to be spliced, as required by the ICBO report.

- C. Reports on each mechanical splice shall indicate location of the splice, size of bars spliced, and whether splice is accepted or rejected. Reasons for rejection shall be shown on each report.

3.4 CONCRETE INSPECTION AND TESTING

- A. Secure composite samples of concrete at the jobsite in accordance with ASTM C172.
- B. Mold and cure specimens from each sample in accordance with ASTM C31. The test cylinders shall be stored in the field 24 hours and then carefully transported to the laboratory and cured in accordance with ASTM C31.
- C. Test specimens in accordance with ASTM C39. Two specimens shall be tested 7 days, two specimens shall be tested at 28 days for strength acceptance. A spare cylinder shall be made and kept for a 56-day break if the 28-day break does not meet strength requirements. If the plans require 56-day break (such as for mass concrete), two samples shall be tested at 56 days for acceptance.
- D. Make one strength test (four or five cylinders) for each:
 - 1. 100 cubic yards or fraction thereof, of each mix design placed in one day.
 - 2. OR, for each 5000 sq. ft. of slab area placed in one day.
 - 3. When the total quantity of a given class of concrete is less than 25 cu. yds., the strength tests may be waived by the Architect/Engineer, if in his judgment, adequate evidence of satisfactory strength is provided.
- E. Make one slump test for each set of cylinders following the procedural requirements of ASTM C143 and ASTM C172. Make additional slump tests whenever the consistency of the concrete appears to vary. Do not permit placement of concrete having measured slump outside the limits given on the drawings, except when approved by the Architect. Slump tests corresponding to samples from which strength tests are made shall be reported with the strength test results. Other slump tests need not be reported.
- F. Determine total air content of air entrained normal-weight concrete sample for each strength test in accordance with ASTM C231.
- G. Determine air content and unit weight of lightweight concrete sample for each strength test in accordance with ASTM C173 and ASTM C567.
- H. Determine temperature of concrete sample for each strength test and one test for each concrete load discharged when air temperature is 80 degrees F. and above.
- I. Monitor the addition of water at the jobsite and the length of time the concrete is allowed to remain in the truck before placement. Report any significant deviation from the approved mix design and the project requirements to the Architect, the Contractor, and the Concrete Supplier.
- J. Monitor the slump and air content of the concrete. If the measured slump or air content of air entrained concrete falls outside the specified limits, a check test shall be made immediately on another portion of the same sample. In the event of a second failure, the concrete shall be considered to have failed to meet the project requirements and specifications and shall be rejected.

- K. The testing laboratory shall certify each delivery ticket indicating class of concrete delivered (or placed), amount of water added and the time at which the cement and aggregate was dispensed into the truck, and the time at which concrete was discharged from the truck.

- L. Laboratory reports shall contain the following information:
 - 1. Class of concrete and specific location.
 - 2. Specified strength of concrete.
 - 3. Air temperature.
 - 4. Batch time.
 - 5. Specified time that discharge of concrete must be completed, based on air temperature.
 - 6. Time concrete is placed.
 - 7. Amount of water withheld at the plant for latter addition at the project site (Note that the total amount of water shall not exceed the maximum water/cement ratio for the approved mix design).
 - 8. Amount of water added at the site.
 - 9. Allowable slump range on the approved mix design.
 - 10. Slump.
 - 11. Maximum and minimum allowable concrete temperature on the approved mix design.
 - 12. Temperature of the concrete mix.
 - 13. Air content range on the approved mix design.
 - 14. Air content.
 - 15. Statement that concrete is in compliance with the project documents and the approved mix designs.

- M. Evaluation and Acceptance:
 - 1. The strength level of the concrete will be considered satisfactory if the averages of all sets of three consecutive strength test results are equal to or exceed the specified strength and no individual test result (average of two cylinders) is below the specified strength by more than 500 psi.
 - 2. Completed concrete work will be accepted when the requirements of "Specifications for Structural Concrete for Buildings," ACI 301 have been met.

- N. Observe the placing of all concrete, except site work. Observe and report on placing method, consolidation, cold joints, length of drop and displacement of reinforcing. Report deficiencies to the Contractor immediately for corrective action. Inspections may be reduced to a periodic basis when all procedures have been deemed satisfactory by the laboratory.

- O. Comply with ACI 311, "Guide For Concrete Inspection" and "ACI Manual of Concrete Inspection" (SP-2).

- P. Inspect the application of curing compound and monitor all curing conditions to assure compliance with Specification requirements. Report curing deficiencies to the Contractor immediately and submit a report to the Architect.

3.5 MASONRY

- A. Inspection

1. Provide a qualified inspector to inspect all structural masonry work.
 - a. Inspect masonry for compliance in accordance with the "Level 1 or 2 Special Inspection" provisions of the building code. Refer to the contract documents regarding which level of special inspections is required.
 2. In combination with inspections required by the building code, inspect the following:
 - a. Preparation of masonry prisms for testing.
 - b. Placement of reinforcing.
 - c. Cavities to be grouted (prior to grouting and prior to closing cleanouts).
 - d. Mortar mixing operations, including proportion of materials and method of measuring materials (materials should be measured with a mixing box and not a shovel).
 - e. Bedding of mortar for each type of unit and placing of units.
 - f. Grouting operations.
 - g. Condition of units before laying for excessive absorption.
 3. Provide report of each inspection.
- B. Field Compressive Tests for Grout:
1. Secure composite samples of grout at the jobsite in accordance with ASTM C 1019.
 2. Mold and cure three specimens from each sample in accordance with ASTM C 1019. Supervise the curing protection provided (by others) for test specimens in the field and the transportation from the field to the laboratory. The test specimens shall be stored in the field 24 to 48 hours and then be carefully transported to the laboratory and cured in accordance with ASTM C 1019.
 3. Test specimens in accordance with ASTM C 1019. Two specimens shall be tested at 28 days for acceptance and one specimen shall be tested at 7 days for information.
 4. Make one strength test (three specimens) for each 10 cubic yards of grout poured but not less than one strength test for each 5000 square feet of wall area.
- C. Prism Tests:
1. Build prisms at the jobsite using the same materials and methods as being used for the wall construction. Store prisms in a place where they will be undisturbed for two days and have approximately same curing conditions as masonry construction. After 48 hours, move prisms to the laboratory and test in accordance with ASTM C1314.
 2. Make prism tests in advance of operations using materials under same conditions, with the same bonding and construction methods as is being used for the structure. When building prisms, moisture content of the units at time of laying, consistency of mortar and width and thickness of mortar joints shall be same as used in the structure.
 3. Build prisms of hollow masonry units the same width as unit by 16" long by 16" high. Apply mortar to face shells only. Do not fill hollow core with grout. Compute value of ultimate net compressive strength, by dividing ultimate load by net face shell area of masonry units.
 4. Cure and test prisms in accordance with applicable provisions of ASTM C1314. Test five specimens of each type of masonry unit before delivering material to the jobsite and submit results for approval. During construction, test three specimens of each type of masonry unit for each 5000 square feet of wall placed.
 5. The prisms shall be tested after 28 days but may be tested at seven days provided the relationship between seven and 28 day strengths has been established for the materials used prior to the start of construction.

6. When the average strength of a set of prisms falls below the specified compressive strength (f'_m), the masonry corresponding to the test shall be deemed unacceptable. In such a case, notify the Architect and Contractor immediately.

3.6 STRUCTURAL STEEL

- A. Inspect all structural steel during and after erection for conformance with Contract Documents and shop drawings.
- B. Field Inspection
 1. Proper erection of all pieces.
 2. Proper installation of all bolts, including the checking of calibration of impact wrenches used with high strength bolts.
 3. Plumbness of structure and proper bracing.
 4. Field Painting.
 5. Visual examination of all field welding.
 6. Ultrasonic testing of all penetration welds.
 7. Installation of field welded shear studs.
 8. Measure and record camber of all beams upon arrival and before erection for compliance with the specified camber. Measure lying flat with web in horizontal position. Members outside specified camber tolerance shall be returned to the shop for remedial work.
- C. Qualification of Welders: Fabricator and erector shall provide the testing laboratory with names of welders to be employed in the work, together with certification that welders have passed qualification tests within the last year using procedures specified in the AWS D1.1. Testing laboratory shall verify all welder's qualifications.
- D. Inspection of shop and field welding shall be "verification inspection," in accordance with Section 6 of AWS D1.1 and as follows:
 1. Visually inspect the welding of all shop fabricated members and note the location of all cover plates, connectors, bearing stiffeners, splices, and fillet welds for proper return around ends and check for seams, folds, and delamination.
 2. Ultrasonically test all penetration welds in accordance with AWS D1.1.
 3. Inspect surfaces to be welded. Surface preparations, fit-up and cleanliness of surface shall be noted.
 4. The welding inspector shall be present during alignment and fit-up of members being welded and shall check for correct surface preparation of root openings, sound weld metal, and proper penetration in the root pass. Where weld has not penetrated completely, the inspector shall order the joint to be chipped down to sound metal or gouged out and rewelded. Root passes shall be thoroughly inspected for cracks. All cracks shall be gouged out and rewelded to two inches beyond each end of crack.
 5. The inspector shall check that all welds have been marked with the welder's symbol. The inspector shall mark the welds requiring repairs and shall make a reinspection. The inspector shall maintain a written record of all welds. Work completed and inspected shall receive an identification mark by the inspector.
 6. The testing laboratory shall advise the Owner and the Architect of any shop and/or field conditions which, in his opinion, may require further tests and examination by means other

than those specified. Such further tests and examinations shall be performed as authorized by the Owner and the Architect.

7. The Owner reserves the right to use ultrasonic or radiographic inspection to verify the adequacy of all welds. Testing procedures and acceptance criteria shall be as specified in AWS D1.1.
- E. Inspection of bolted construction shall be in accordance with AISC "Specification for Structural Steel Buildings" and as follows:
1. All bolts shall be visually inspected to ensure that the plies have been brought into snug contact.
 2. High strength bolting shall be inspected in accordance with Section 9 of the AISC "Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
 3. For all high strength bolts, unless specifically noted on the Drawings to require only "snug-tight" installation, the inspector shall observe the required jobsite testing and calibration and shall confirm that the procedure to be used provides the required tension.
 4. For slip critical connections, inspect the contact surfaces for compliance with specifications prior to bolting.
- F. Inspection of stud welding shall be in accordance with Section 7.8 of AWS D1.1 and as follows:
1. A minimum of two shear studs shall be welded at the start of each day's production period in order to determine proper generator, control unit and stud welding setting. These studs shall be capable of being bent at 45 degrees from vertical without weld failure.
 2. When the temperature is below 32 degrees Fahrenheit, one stud in each 100 shall be tested after cooling. Studs shall not be welded below zero degrees Fahrenheit or when the surface is wet due to rain, snow, or ice. If a stud fails, two new studs shall pass the test before resumption of the welding.
 3. Visually inspect studs for compliance with the Contract Documents. Check number, spacing, and weld quality. If, after welding, visual inspection reveals that a sound weld or a full 360-degree fillet has not been obtained for a particular stud, such stud shall be struck with a hammer and bent 15 degrees off perpendicular. Studs failing this test shall be replaced.

3.7 OPEN WEB JOISTS AND JOIST GIRDERS

- A. Inspect all joists either in the plant or at the jobsite for conformance with specified fabrication requirements. Check welded connections between web and chord, splices, and straightness of members. Inspection at the plant may be performed by the manufacturer's qualified QC personnel.
- B. Inspect installation of joists at the jobsite. Check connections to supporting members, chord extensions, number of rows of bridging, and bridging connections for conformance with the Contract Documents and referenced standards.
- C. Check welder qualification certificates for field welding operators.

3.8 STEEL FLOOR DECK

- A. Field Inspection shall consist of the following:

1. Check types, gauges, and finishes for conformance with the Contract Documents and shop drawings.
2. Examination of proper erection of all metal deck, fastenings, reinforcing of holes, deck reinforcing, miscellaneous deck supports, hanger tabs, shear studs, deck closures, painting or other coating.
3. Certification of welders.
4. Field welded shear studs used to fasten metal floor decking to supporting steel shall be inspected and tested as described in the structural steel section of this specification section.

3.9 STEEL ROOF DECK

- A. Field inspection shall consist of the following:
1. Checking types, gauges, and finishes for conformance with the Contract Documents and Shop Drawings.
 2. Examination for proper erection of all metal deck, including fastenings at supports and sidelaps, reinforcing of holes, and miscellaneous deck supports.
 3. Certification of welders.
 4. Visual inspection of at least 20 percent of all welds.

3.10 SPRAYED FIREPROOFING

- A. Verify that applied thickness, density, and bond strength of sprayed fireproofing meets fire rating requirements of approved design.
- B. Verify that installation meets fire rating requirements of approved design.
- C. Inspect and test for thickness as follows:
1. Test 20 percent of structural frame columns and beams in each building level.
 2. Test 10 percent of beams other than structural frame in each building level.
 3. Test one slab per each 5000 square feet of building area.
- D. Inspect and test for density on slabs, beams, and columns. Perform one of each test for each 10,000 square feet of building area.
- E. Inspect and test for bond strength, one test for beams and one test for slabs for each 10,000 square feet or area.
- F. Inspection and test procedures shall be performed in accordance with ASTM E605 and E736.

3.11 EXPANSION BOLT INSTALLATION

- A. Inspect the drilling of each hole and installation of each expansion bolt for compliance with the Contract Documents.
- B. Verify the installation torque for each expansion bolt for compliance with manufacturer's installation instructions.

3.12 TESTING OF NON-SHRINK GROUT

- A. Make one strength test for every 15 base plates grouted and for every 15 bags of grout used in joints between members.
- B. Each test shall consist of four cubes, two to be tested at seven days, and two at 28 days, made and tested in accordance with ASTM C109, with the exception that the grout shall be restrained from expansion by a top plate.

3.13 EXCAVATION

- A. A representative of the Owner's Geotechnical Engineer shall provide the services specified in this section.
- B. Review geotechnical parameters and assumptions used in the development of calculations and drawings for retention systems, including lateral design forces, rock wedge stability analysis, rock bolt lengths and spacing, and surcharge effects.
- C. Observe the excavation process, the exposed faces of the excavation and the installation of retention systems. Check for compliance with the Contract Documents and make alternative recommendations as may be required to suit field conditions.
- D. Review required submittals as they pertain to geotechnical requirements.
- E. Check the adequacy and accuracy of the Contractor's monitoring program, equipment, procedures, and measurements related to movements of the excavated face and adjacent structures.
- F. Immediately report any observed unsafe conditions. Request additional shoring, bracing, or rock bolting where judged to be necessary as the excavation progresses.

3.14 WATER PRESSURE INJECTION OR LIME SLURRY PRESSURE INJECTION

- A. The representative of the Owner's Geotechnical Engineer shall make continuous observations throughout the injection operations as per the geotechnical report.
- B. The representative of the Owner's Geotechnical Engineer may propose to perform additional tests if required to properly evaluate the injected soil. The representative of the Owner's Geotechnical Engineer shall evaluate the results of the tests to determine the acceptability of the injected areas and to determine if additional injections are required.

3.15 FILLING AND BACKFILLING

- A. A representative of the Owner's Geotechnical Engineer shall provide the services specified in this section.
- B. The Contractor shall make available to the laboratory, adequate samples of each fill and backfill material from the proposed sources of supply not less than 10 days prior to the start of the work.
- C. Laboratory shall analyze samples as required to provide a soil description and to determine compliance with quality requirements. Perform the following tests:

1. Test for liquid limit in accordance with ASTM D423.
 2. Test for plastic limit of soils and plasticity index of soils in accordance with ASTM D424.
 3. Tests for moisture density relations of soil in accordance with ASTM D698 or D1557, as applicable.
- D. Furnish a report for each individual test and state whether sample conforms to specified requirements or reasons for nonconformance.
- E. Inspect under slab drainage material and placement for compliance with specified gradation, quality, and compaction.
- F. Make in-place compaction test for moisture content, moisture-density relationship, and density of fill material after compaction to determine that backfill materials have been compacted to the specified density. Number of tests shall be as follows:
1. One test for each 5000 square feet of area of each lift placed under floor slab. Stagger test locations in each lift from those in the previous lift. Perform a minimum of three tests for each lift.
 2. One test for each 150 linear feet, or portion thereof, of each lift placed against foundation walls, with locations staggered from those in the previous lift.
 3. One test of each lift placed below any isolated footing, and every 100 linear feet under continuous footings, with locations taken on a different side from that in the lift below.

3.16 TILT-UP PANELS

- A. Concrete Reinforcing Steel and Embedded Metal Assemblies: Inspect in accordance with the Concrete Reinforcing Steel and Embedded Metal Assemblies section of this Specification.
- B. Concrete Inspection and Testing: Perform in accordance with the Concrete and Inspection and Testing section of this specification.
- C. Inspection of Tilt-up concrete during erection:
1. Inspect members for cracks, spalls, and other deficiencies after erection.
 2. Inspect erection of tilt-up members for placement tolerances, and to ensure that connections, bearing lengths, welding and grouting conform to the Contract Documents.

3.17 POST-TENSIONING

- A. Verify certification of calibration of jacking equipment used in post-tensioning operations.
- B. Observe and report on placement and anchorage of tendons immediately prior to concreting.
- C. Provide a qualified, experienced inspector to observe the stressing and elongation measurement of each tendon. Inspector shall have a minimum of five years' experience inspecting post-tensioning operations.
- D. The Contractor shall log and submit detailed reports of the stressing and elongation of each tendon. The laboratory representative shall observe the recording of information by the Contractor and make such spot checks as necessary to verify the accuracy of the post tensioning reports.

- E. Receive and review final stressing and elongation reports prepared by the contractor. Compare the actual and required elongation of each tendon and the actual and required load on each tendon. Grant permission to cut tails of tendons which are within the specified tolerance, unless otherwise noted on the Drawings, and submit reports of those which are not within the specified tolerance to the Architect for further evaluation.
- F. Observe and report on grouting of tendons noted to be bonded.
- G. Reports shall be submitted to the Architect within 48 hours after stressing.
- H. The post-tensioning subcontractor shall provide a letter at the completion of the project, signed and sealed by a registered engineer in the state of the project, stating that the post-tensioning work was completed in accordance with the contract documents. The post-tensioning subcontractor shall review the stressing records and certify that the required forces shown on the contract documents have been provided.

3.18 FOOTING EXCAVATIONS

- A. A representative of the Owner's Geotechnical Engineer shall inspect each footing excavation to determine that the proper bearing stratum is obtained and that excavations are properly clean and dry before the concrete is placed.

END OF SECTION 01 45 23

SECTION 01 45 23 - TESTING AND INSPECTING SERVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements and qualifications including but not limited to:
 - 1. Professional testing and laboratory services.
 - 2. Accessories necessary for the completion of testing and laboratory services.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality assurance and quality control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality assurance and quality control procedures that facilitate compliance with Contract Document requirements.
 - 3. Requirements for Contractor to provide quality assurance and quality control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions.
 - 4. Specific test and inspection requirements are not specified in this Section.
- C. A qualified independent testing laboratory and/or geotechnical engineering service selected and paid by Owner.
 - 1. The Owner will pay for the initial laboratory services of materials that comply with the requirements of the Contract Documents. The Contractor shall pay for testing and retesting of materials that do not comply with the requirements of the Contract Documents.
- D. Inspecting agency shall perform inspections and tests in accordance with the rules and regulations of the building code, local authorities, Specifications of ASTM, and the Contract Documents.
- E. Materials and workmanship found not in compliance with required standards or performance obligations shall be removed and replaced. Replacement and subsequent testing shall be at Contractor's expense.
- F. Where terms "Inspector" and "Laboratory" are used, it is meant and in reference to an officially designated and accredited inspector of the testing laboratory or geotechnical service engaged by Owner.
- G. Laboratory inspections shall not relieve the Contractor or Fabricator of his responsibility to furnish materials and workmanship in accordance with the Contract Documents.
- H. Contractor or Fabricator shall cooperate with the testing laboratory in matters pertaining to the Work.
- I. Contractor to address deficiency and failed reports.

1.3 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, documented according to ASTM E 329 and ASTM E534; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
 - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
 - 3. Testing agencies shall be insured against errors and omissions by a professional liability insurance policy having a minimum limit of liability of \$500,000.00.
- B. Inspection and testing services the of testing agency shall be under the direction of a Registered Engineer licensed in the State of Texas, charged with engineering managerial responsibility, and having a minimum of five (5) years engineering experience in inspection and testing of construction materials.
- C. Concrete Inspectors: Inspecting personnel monitoring concrete Work shall be ACI certified inspectors.
- D. Structural Steel: Primary inspectors performing structural steel inspection shall be currently certified AWS Certified Welding Inspectors (CWI), in accordance with the provisions of AWS QCI, *Standard and Guide for Qualification and Certification of Welding Inspectors*.
 - 1. Inspector may be supported by assistant inspectors who perform specific inspection functions under the direct supervision of the Primary Inspector. Assistant inspectors shall be currently certified AWS Certified Associate Welding Inspectors (CAWI). Work of assistant inspectors shall be monitored daily by the inspector.
- E. Testing Equipment: Equipment shall be calibrated at intervals not exceeding 12 months by devices of accuracy traceable to the National Bureau of Standards.
- F. Referenced Standards: Latest adopted edition of standards referenced apply to the Work. In the event of conflict between the Contract Documents and referenced standards, the Contract Documents shall govern. In case of conflict between Contract Documents and the Building Code, the more stringent shall govern.

1.4 QUALITY CONTROL

- A. Owner Responsibilities: Where quality control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform the services.
 - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 - 2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality control activities required to verify that the Work complies with requirements, whether specified or not.
 - 1. Refer to the individual specification sections for specific requirements.
 - 2. Unless otherwise indicated, provide quality control services specified and those required by authorities having jurisdiction. Perform quality control services required of Contractor by authorities having jurisdiction, whether specified or not.
 - 3. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform the quality control services. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

4. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 5. Where quality control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality control service.
 6. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 7. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
 8. Associated Responsibilities and Services: Cooperate with agencies performing required tests, inspections, and similar quality control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
 - a. Provide access to the Work.
 - b. Deliver of samples to testing laboratory, without cost to Owner, in adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 - c. Advise laboratory and Architect sufficiently in advance of construction operations to allow laboratory to complete required inspections or tests and to assign personnel for field inspection and testing as specified.
 - d. Provide facilities for storage and curing of concrete test samples on site for the first 24 hours and for subsequent field curing required by ASTM C31.
 - e. Incidental labor, facilities, and equipment necessary to assist laboratory personnel in obtaining and handling samples at the site.
 - f. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 - g. Provide concrete mix designs in accordance with ACI 301 Section 3.9 made by an independent testing laboratory or qualified concrete supplier. Where mix designs by an independent testing laboratory are required, select and pay for laboratory.
 - h. Obtain required inspections or approvals of the building official. Inspection requests and notifications required by building code are responsibility of the Contractor.
 - i. Provide current welder certificates for each welder employed.
 - j. Provide fabrication and erection inspection and testing of welds in accordance with AWS D1.1, Chapter 6.
 - 1) Use prequalification of welding procedures in executing the Work.
 - k. Security and protection for samples and for testing and inspecting equipment at Project site.
 9. Retesting/Reinspecting: Regardless of payment responsibility of the original tests or inspections, provide quality control services, including retesting and reinspecting, for construction that replaced Work failing to comply with the Contract Documents or Code requirements.
- C. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.

6. Do not perform any duties of Contractor.

- D. Coordination: Coordinate sequence of activities to accommodate required quality assurance and quality control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.5 AUTHORITY AND DUTIES OF LABORATORY PERSONNEL

- A. A representative of the testing laboratory, who has reviewed and is familiar with the project and specifications, shall participate in preconstruction conferences. The representative shall coordinate material testing and inspection requirements with the Contractor and its subcontractors consistent with the planned construction schedule. The laboratory representative shall attend conferences required or requested to address quality control issues.
- B. Laboratory personnel shall inspect and test materials, assemblies, specimens, and Work performed, including design mixes, methods and techniques and report the progress to the Architect.
- C. If material or Work fails to meet requirements of Contract Documents, laboratory inspector shall notify the Construction Manager, Architect, Engineers, supplier or subcontractor providing or preparing the materials or Work being tested of such failure.
- D. Laboratory personnel shall not perform the Work of the Contractor or act as foremen or superintendents. Work will be inspected as it progresses, but failure to detect defective Work or materials shall not prevent later rejection when a defect is discovered.
- E. Laboratory personnel are not authorized to revoke, alter, relax, enlarge, or release the requirements of the Contract Documents or approve or accept portions of Work, except where approval is specifically specified in the Specifications.
- F. Comply with building code requirements for Special Inspections.

1.6 SUBMITTALS

- A. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
- B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
1. Specification Section number and title.
 2. Entity responsible for performing tests and inspections.
 3. Description of test and inspection.
 4. Identification of applicable standards.
 5. Identification of test and inspection methods.
 6. Number of tests and inspections required.
 7. Time schedule or time span for tests and inspections.
 8. Requirements for obtaining samples.
 9. Unique characteristics of each quality control service.
- C. Test and Inspection Reports: Prepare and submit certified written reports specified. Include the following:
1. Date of issue.
 2. Project title and number.
 3. Name, address, and telephone number of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making tests and inspections.

6. Description of the Work and test and inspection method.
 7. Identification of product and Specification Section.
 8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- D. Submit copies of reports of each inspection and test:
1. Owner, Program or Project Manager, Architect, and each Engineer or outside consultants regarding their particular phase of the project: One copy each.
 2. Construction Manager and Contractor: Two copies each.
- E. In addition to furnishing a written report, notify Construction Manager and Contractor verbally of uncorrected conditions or failures to comply with requirements of the Contract Documents, and immediately fax and email corresponding report to the Architect and Engineer.
- F. At completion of each trade or branch of Work requiring inspecting and testing, submit a final certificate attesting to satisfactory completion of Work and full compliance with requirements of Contract Documents.
- G. Submit copies of test results sealed by a Registered Engineer to municipal authorities having jurisdiction, as required.

1.7 TESTING LABORATORY GUIDELINES AND PROCEDURES

- A. Technicians scheduled to perform specific testing services must be qualified to review and perform other services that overlap, i.e. earthwork, foundation inspections, rebar inspection, and concrete when scheduled concurrently at the site.
- B. Technician time for services performed will be reimbursed at a regular time rate. Compensation at the overtime rate will be considered for hours over eight hours spent at the site on a single day, field testing services performed on a Saturday or Sunday, and field services performed on a recognized holiday.
- C. There shall be a three hour minimum for each scheduled testing service. Vehicle charges will be included on a \$25.00 per trip basis.
- D. Cylinder pick up will be controlled by the technician performing test on a scheduled pick up day. If there are no testing services scheduled, the cylinder pick up fee is \$40.00 on week days and \$50.00 on weekends and holidays with no technician or vehicle charge.
- E. The Contractor shall bear the responsibility of scheduling the testing services. The Contractor and the testing laboratory shall assume full responsibility to coordinate the testing services. Cancellations or failed test shall be reimbursable to the Owner by the responsible party for the cancellations or failure of a test or service.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 - 1. Date test or inspection was conducted.
 - 2. Description of the Work tested or inspected.
 - 3. Date test or inspection results were transmitted to Architect.
 - 4. Identification of testing agency or special inspector conducting test or inspection.
 - 5. Deficiency log.
- B. Maintain log at site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 TESTING AND INSPECTION SERVICES

- A. Testing services shall include, but not be limited to those specified below or which are necessary or required during course of construction to ascertain specification compliance and which may be deemed necessary by Architect, Engineer, or Owner to ensure the quality of the Work.
- B. The Owner reserves the right to add to or delete any or all inspection and testing specified, excluding testing required by the applicable building codes.
- C. If conflicts arise between Drawings and Specifications, notify Architect immediately. The most stringent requirements shall dictate procedure.

3.3 TESTING OF EARTHWORK

- A. Testing Services (As specified or required):
 - 1. References (As applicable for tests required):
 - a. American Society for Testing and Materials (ASTM):
 - 1) D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft³ (600 kN-m/m³).
 - 2) D2922, Standard Test Method for Density of Soil and Soil-Aggregate In Place By Nuclear Methods (Shallow Depth).
 - 3) D4318, Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
 - b. American Association of State Highway and Transportation Officials (AASHTO)
 - 1) T89, Determining the Liquid Limit of Soils.
 - 2) T90, Determining the Plastic Limit and Plasticity Index of Soils.
 - 3) T99, Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305-mm (12-in) Drop.
 - 4) T238, Density of Soil and Soil Aggregates In Place By Nuclear Methods (Shallow Depth).
 - 2. Perform sieve analysis to develop grain size distribution curves for materials to be used for subgrade, fill under slab on grade, and backfills.
 - 3. Establish the moisture density relation of soils to be used as fill using the method best suited to the type of fill material.
 - 4. Determine moisture content of all fill materials before placement and advise Contractor when it is or is not suitable to achieve required compaction.
 - 5. Determine Liquid Limit in accordance with ASTM D4318 or AASHTO T89, Plastic Limit in accordance with ASTM D4318, and Plasticity Index in accordance with ASTM D4318 of all fill material,

6. Perform one in place density test for each 4,000 square feet (445 square yards) of existing subgrade material.
7. Perform Moisture-Density curve in accordance with ASTM D698 or AASHTO T99 for one type of fill material. If the original choice of material does not meet the specifications, the Contractor shall pay for additional testing.
8. Perform in place density tests of each lift of compacted fill at locations adequate to evaluate the degree of compaction of all fill areas. Conduct one test for each 4,000 square feet (445 square yards) of each lift of compacted fill.
9. Perform testing at a frequency of one in-place density and moisture test for each 75 lineal feet or less of utility trench, with a minimum of three tests per lift.

B. Reports: Submit reports with the following information:

1. Type and condition of soil at footing bottoms.
2. Level of water table in the excavated areas.
3. Grain size distribution of fill materials (average of three tests).
4. Moisture density test results.
5. In place density test results with moisture content and relative density of each layer of compacted fill. Include with in place density test results, a plan showing location of each test.
6. Notify Architect by telephone within one hour of the discovery of the following conditions and follow up telephone notification with written report.
 - a. Materials used, or degree of soil compaction not meeting specified requirements.
 - b. Frost and freeze protection requirements for excavation bottoms not being complied with.
 - c. Water in excavations which is not being removed prior to Work being performed in excavation.

3.4 INSPECTION OF PIPED SITE UTILITIES

A. Laboratory representative shall observe and report on the following:

1. Proper alignment and grade of trenches.
2. Pipe bedding and supports.
3. Pipe, joints, jointing material, and thrust blocks prior to installation of pipe.
4. Installation of pipe and joints.
5. Testing of piped utilities performed by Contractor.

3.5 PAVING

A. Testing Services: Perform field tests for moisture density properties:

1. Provide field testing of the subgrade as specified.
2. Paving Subbase: Provide one field test for every 7,500 square feet of area of crushed limestone or caliche subbase.
3. Lime Treated Subgrade: Provide one field test for every 7,500 square feet of area of lime treated subgrade for content of lime and subgrade compaction.
4. Cement Soil Stabilization: Provide one field test for every 7,500 square feet of area of cement stabilized subgrade for content of cement and subgrade compaction.

3.6 PIER DRILLING OPERATION

- A. A representative of a qualified geotechnical laboratory shall provide services specified.
- B. Laboratory representative shall make continuous inspections to determine that proper bearing stratum is obtained and utilized for bearing and that shafts are properly clean and dry before placing concrete.

- C. Laboratory shall furnish complete pier log showing the diameter, top and bottom elevations of each pier, casing required or not required, actual penetration into bearing stratum, elevation of top of bearing stratum, volume of concrete used, and deviations from specified tolerances.
- D. Laboratory representative shall make continuous inspections of drilled pier construction to check the following:
 - 1. Verify soundness of bearing stratum and desired penetration.
 - 2. Verify pier dimensions and reinforcing used.
 - 3. Monitor condition of hole and removal of water and loose material from bottom.
 - 4. Monitor placement of concrete and use of tremie or pumps.
 - 5. Monitor the extraction of casing, if used.
- E. Request probe holes when deemed necessary to confirm safe bearing capacity.

3.7 CONCRETE REINFORCING STEEL AND EMBEDDED METAL ASSEMBLIES

- A. Inspect concrete reinforcing steel prior to placing concrete for compliance with Contract Documents and approved shop drawings. Noncompliance with Contract Documents and approved shop drawings shall be immediately brought to the attention of the Contractor for correction and, if left uncorrected, reported to the Architect.
- B. Laboratory representative shall observe and report on the following:
 - 1. Number and size of bars.
 - 2. Bending and lengths of bars.
 - 3. Splicing.
 - 4. Clearance to forms, including chair heights.
 - 5. Clearance to sides and bottom of trench if soil formed.
 - 6. Clearance between bars or spacing.
 - 7. Rust, form oil, and other contamination.
 - 8. Grade of steel.
 - 9. Securing, tying, and chairing of bars.
 - 10. Excessive congestion of reinforcing steel.
 - 11. Installation of anchor bolts and placement of concrete around such bolts.
 - 12. Fabrication and installation of embedded metal assemblies, including visual inspection of all welds.
 - 13. Visually inspect studs and deformed bar anchors on embedded assemblies for compliance with Contract Documents. Check number, spacing and weld quality. If, after welding, visual inspection reveals that a sound weld or a full 360 degree fillet has not been obtained for a particular stud or bar, such stud or bar shall be struck with a hammer and bent 15 degrees off perpendicular and then bent back into position. Anchors failing this test shall be replaced.
- C. Provide a qualified, experienced inspector to inspect reinforcing steel. Inspector shall have a minimum of three years' experience inspecting reinforcing steel in projects of similar size.

3.8 CONCRETE INSPECTION AND TESTING

- A. Receive and evaluate proposed concrete mix designs submitted by Contractor. If mix designs comply with Drawings and Specifications, the laboratory shall submit a letter to the Architect certifying compliance. Mix designs not complying with Drawings and Specifications shall be returned by the laboratory as being unacceptable. Check the proposed mixes for proportions, water cement ratio and slump in accordance with ACI 613 and 318.
- B. Comply with ACI 311 *Guide For Concrete Inspection* and ACI *Manual of Concrete Inspection* (SP-2).

- C. Sample and test concrete placed at the site in accordance with ASTM C172. Each sample shall be obtained from a different batch of concrete on a random basis.
- D. Test concrete:
 - 1. Mold and cure five specimens from each sample.
 - a. For each 50 cubic yards or fraction thereof of structural building concrete; and
 - b. For each 100 cubic yards or fraction thereof of nonstructural concrete and site Work paving and sidewalks.
 - c. Laboratory cure two cylinders in accordance with ASTM C192.
 - d. Field cure remaining cylinders in accordance with ASTM C31.
 - 2. Two specimens shall be tested at seven days for information, two shall be tested at 28 days for acceptance.
- E. Deviations from the requirements of ASTM Specifications shall be recorded in the test report. Test concrete specimens in accordance with ASTM C39.
- F. Specimens for pumped concrete shall be taken at the discharge end of pumping equipment.
- G. Supervise curing and protection provided for test specimens in field, and transportation from the field to laboratory. Test cylinders shall be stored in the field 24 hours and then carefully transported to laboratory and cured in accordance with ASTM C31.
- H. Make one strength test (four cylinders) of each mix design of concrete placed in any one day.
- I. Make one slump test for each set of cylinders following procedural requirements of ASTM C143 and ASTM C172. Make additional slump tests whenever consistency of concrete appears to vary. Slump tests corresponding to samples from which strength tests are made shall be reported with strength test results. Other slump tests need not be reported.
- J. Determine total air content of air entrained normal weight concrete sample for each strength test in accordance with ASTM C231.
- K. Determine air content and unit weight of lightweight concrete sample for each strength test in accordance with ASTM C173 and ASTM C567.
- L. Determine temperature of concrete sample for each strength test.
- M. Inspect each batch of concrete, monitor addition of mixing water to assure uniform consistency from truck to truck. Check mixing form mixers before mix begins to set and within time limits set forth in ASTM C94.
 - 1. Monitor addition of water and high range water reducer to concrete at job site and length of time concrete is allowed to remain in truck during placement.
- N. Testing agency shall furnish and maintain a competent inspector at the mixing plant at the start of each day's mixing. Inspector shall examine concrete materials for compliance with Specifications and approved mix design, weighing and measuring devices, proportioning and mixing of materials, water and cement content of each batch, general operation of the plant, and transportation of concrete to jobsite. Inspector shall verify that amount of free surface moisture contained in fine and course aggregate has been properly accounted for in the concrete mixing to achieve required consistency and water cement ratio.
- O. Testing laboratory shall monitor addition of water to concrete at the jobsite and the length of time concrete is allowed to remain in the truck before placement. Inspector shall compare mixture with criteria on the approved mix design and report any significant deviation to the Architect, Contractor and concrete supplier. Do not permit addition of water which will exceed maximum water/cement ratio for the mix as given on the approved mix design.

- P. Observe placing of concrete, except nonstructural slabs on grade and site Work. Observe and report on placing method, consolidation, cold joints, length of drop, and displacement of reinforcement. Report deficiencies to Contractor immediately for corrective action. Inspections may be reduced to a periodic basis when all procedures have been deemed satisfactory by the laboratory.
- Q. Test reports shall include but no be limited to the following information: date of concrete placement, concrete mix identification number or proportion of ingredients, truck ticket number, time test was made, time of batching, location of each placement, slump, unit weight, water content (microwave test) and air content of concrete sampled and date and results of strength test.
- R. Report promptly to Architect all details of reasons for rejection of any and all quantities of concrete. Give all information concerning locations of the concrete pours, quantities, date of pours, and other pertinent facts concerning concrete represented by the specimens.
- S. Testing laboratory shall certify each delivery ticket indicating class of concrete delivered (or placed), amount of water added and time at which cement and aggregate were dispensed into the truck, and time at which concrete was discharged from the truck.
- T. Evaluation and Acceptance:
1. If measured slump, or air content of air entrained concrete, falls outside specified limits, a check test shall be made immediately on another portion of the same sample. In the event of a second failure, concrete shall be considered to have failed to meet the requirements of the specifications, and shall not be used in the structure.
 2. Strength level of concrete will be considered satisfactory if the averages of sets of three consecutive strength tests results are equal to, or exceed, specified strength and no individual test result (average of two cylinders) is below specified strength by more than 500 psi.
 3. Completed concrete Work will be accepted when requirements of ACI 301 Chapter 18 *Specifications for Structural Concrete for Buildings* have been met.
- U. Concrete Test Reports: Reports shall be made and distributed immediately after respective tests or inspections are made.
1. Where reports indicate deviations from Contract Documents, they shall also include a determination of the probable cause of deviation and where applicable, a recommendation for corrective action.
- V. Furnish a statistical analysis for each class of concrete placed on the project in accordance with ACI 214 and ACI 318. Information shall be updated and distributed once a month as directed by the Architect. Information shall include, but not be limited to, the following:
1. Strength tests at 7 days of one cylinder.
 2. Strength tests at 28 days of two cylinder averages.
 3. 28 day moving average strength tests of last three test groups.
 4. Standard deviation and coefficient of variation based on 28 day strength tests.
 5. Average strength and number of 28 days tests for most recent month.
- W. Test Footings (Shafts) (Piers) (Caissons): Same diameter and type specified for footings, placed in same manner. Accepted test footings may be used in the Work.
- X. Noncompliant Test Reports: Fax test reports indicating noncompliance immediately to each party on the test report distribution list. Copies shall be on different colored paper.
- Y. Inspect application of curing compound and monitor curing conditions to assure compliance with specification requirements. Report curing deficiencies to the Contractor immediately and submit a written report to the Architect.

3.9 TESTING OF NONSHRINK GROUT

- A. Make one strength test for all plates grouted and for all grout used in joints between members.
- B. Each test shall consist of four cubes, two tested at 7 days and two at 28 days, made and tested in accordance with ASTM C109, with the exception that grout shall be restrained from expansion by a top plate.

3.10 STRUCTURAL STEEL

- A. Inspect structural steel during and after erection for compliance with Contract Documents and shop drawings. Review and report on fabricator's quality control procedures and capabilities.
- B. Field Inspection:
 - 1. Proper erection of pieces.
 - 2. Proper touch up painting of shop primed structural steel exposed to view or in crawl space.
 - 3. Proper installation of bolts.
 - 4. Plumbness of structure and proper bracing.
 - 5. Proper field painting.
 - 6. Initial inspection of welding process and periodically thereafter as necessary.
 - 7. Visual examination of completed welds.
 - 8. Ultrasonic testing of penetration field welds.
 - 9. Installation of field welded shear studs.
 - 10. Inspect shop fabricated members, upon arrival at the site, for defects incurred during transit and handling.
 - 11. Measure and record camber of beams upon arrival and before erection for compliance with specified camber. Measure lying flat with web horizontal. Return members outside specified camber tolerance to shop for correction.
- C. Qualifications of Welders: Fabricator and erector shall provide the testing laboratory with names of welders employed on Work, along with certification that each welder has passed qualification tests within the past 12 months, using procedures covered in AWS D1.1 *Structural Welding Code - Steel*. Verify welder qualifications.
- D. Inspection of field welding shall include:
 - 1. Visually inspect fillet welds for size, soundness, and proper return around ends. Inspect seams, folds, and delaminations.
 - 2. Visually inspect welds for proper repair of painting.
 - 3. Ultrasonically test penetration welds in accordance with ASTM E164.
 - 4. Inspect surfaces to be welded. Note surface preparations, fit up, and cleanliness of surface. Verify electrodes for size, type, and condition.
 - 5. Welding inspector shall be present during alignment and fit up of members being welded, and shall verify for correct surface preparation of root openings, sound weld metal, and proper penetration in the root pass. Where weld has not penetrated completely, inspector shall order the joint to be chipped down to sound metal, or gouged out, and rewelded. Thoroughly inspect root passes for cracks. Gouge out cracks and rewelded to 2 inches beyond each end of crack.
 - 6. Inspector shall verify that welds have been marked with welder's symbol and shall mark welds requiring repairs and reinspection. Inspector shall maintain a written record of welds. Work completed and inspected shall receive an identification mark by the inspector. Identify unacceptable material and Work identified by word *reject* or *repair* marked directly on the material.
 - 7. Testing agency shall advise the Owner and Architect of any shop and/or field conditions which may require further tests and examination by means other than those specified. Additional tests and examinations shall be performed as authorized by the Owner and Architect.

8. Owner reserves the right to use ultrasonic or radiographic inspection to verify adequacy of welds. Testing procedures and acceptance criteria shall be as specified in AWS D1.1.
 9. Weld quality to comply with the American Institute of Steel Construction (AISC) Manual of Steel Construction.
 10. Determine percentage of weld tested by the number of welds that fail the initial testing.
 11. Reweld and retest welds that fail until the welds pass. Test two additional welds for every weld failure.
- E. Inspect bolted construction in accordance with AISC *Specification for Structural Steel Buildings*:
1. Visually inspect bolts ensuring that plies have been brought into snug contact.
 2. Inspect high strength bolt in accordance with Section 9 of the *Specifications for Structural Joints Using ASTM A325 or A490 Bolts*.
- F. Inspect stud welding in accordance with Section 7.8, of AWS D1.1 *Structural Welding Code*:
1. Weld at least two shear studs at the start of each production period to determine correct generator, control unit, and stud welder setting. The studs shall be capable of being bent 45 degrees from vertical without weld failure.
 2. When the temperature is below 32 degrees F (0 degrees C), test one stud in each 100 after cooling. Do not weld studs at temperatures below 0 degrees F or when surface is wet with rain or snow. If stud fails in the weld, two new studs shall pass the test before resumption of welding.
 3. Visually inspect studs for compliance with the requirements of the Contract Documents. Verify number, spacing, and weld quality. If, after welding, visual inspection reveals that a sound weld or a full 360 degree fillet has not been obtained for a particular stud, that stud shall be struck with a hammer and bent 15 degrees off perpendicular in the direction away from the missing weld. Studs failing test shall be replaced.

3.11 REINFORCING STEEL MECHANICAL SPLICES

- A. Inspection and Observation Services:
1. Visually inspect and report on completed condition of each mechanical splice of reinforcing steel.
 2. Visually inspect each mechanical splice to ensure compliance with the ICC-ES Reports and the manufacturer's published criteria for acceptable completed splices.
 3. Place special emphasis on the inspection of the end preparation of each bar to be spliced required by the ICC-ES Report.
- B. Reports: Submit reports to Architect:
1. Submit copies of manufacturer's published criteria for acceptable completed splices prior to observing mechanical splices.
 2. Reports on each mechanical splice shall indicate location of the splice, size of bars spliced, and acceptability or rejection of splice. Indicate reasons for rejection on each report.

3.12 OPEN WEB JOISTS AND JOIST GIRDERS

- A. Inspect joists at jobsite for compliance with specified fabrication requirements. Verify welded connections between web and chord, splices, and straightness of members.
- B. Inspect installation of joists at jobsite. Check connections to supporting members, chord extensions, number of rows of bridging, and bridging connections for compliance with Contract Documents and referenced standards.
- C. Verify welder qualification certificates for both shop and field welding operators.

3.13 METAL FLOOR DECK

- A. Field inspection shall consist of:
 - 1. Verifying types, gauges and finishes for compliance with Contract Documents and shop drawings.
 - 2. Examine composite floor deck exposed to crawl space for damage to galvanizing due to welding or construction activities. Repair galvanized composite floor deck in accordance with the specifications.
 - 3. Examine the erection of metal deck, fastenings, reinforcing of holes, deck reinforcing, miscellaneous deck supports, hanger tabs, shear studs, deck closures, painting or other coating.
 - 4. Certification of welders.
 - 5. Inspect and test field welded shear studs used to fasten metal floor decking to supporting steel as specified for structural steel.

3.14 METAL ROOF DECK

- A. Field inspection shall consist of:
 - 1. Verify types, gauges and finishes for compliance with Contract Documents and shop drawings.
 - 2. Examine the erection of the metal deck, including fastenings at supports and side laps, reinforcing of holes, and miscellaneous deck supports.
 - 3. Certification of welders.
 - 4. Visual inspection of at least 25 percent of welds.

3.15 SPRAYED FIREPROOFING

- A. Verify applied thickness, density, and bond strength of sprayed fireproofing meets fire rating requirements of approved design.
- B. Verify installation complies with fire rating requirements of approved design.
- C. Inspect and test for thickness:
 - 1. Test 25 percent of structural frame columns and beams in each building level.
 - 2. Test 10 percent of beams other than structural frame in each building level.
 - 3. Test one slab per 5,000 square feet of building area.
- D. Inspect and test in accordance procedures of ASTM E605 and ASTM E736.

3.16 EXPANSION BOLT INSTALLATION

- A. Inspect drilling of each hole and installation of each expansion bolt for compliance with Contract Documents and shop drawings.
- B. Verify installation torque for each expansion bolt for compliance with manufacturer's installation instructions.

3.17 LIGHTWEIGHT INSULATING CONCRETE FILL

- A. Inspection and Observation Services (As required):
 - 1. Inspection of roof deck prior to start of Work.
 - 2. Inspection during installation of insulation and lightweight insulating concrete fill Work to ascertain compliance with Contract Documents.
 - 3. Observation of base ply fastener pull tests performed by Contractor to ascertain minimum withdrawal resistance of 40 pounds per fastener.
- B. Testing Services (As required):

1. References (As applicable for tests required):
 - a. American Society for Testing and Materials (ASTM)
 - 1) C177 - Standard Test Method for Steady State Heat Flux Measurements and Thermal Transmission Properties By Means of the Guarded Hot Plate Apparatus.
 - 2) C495 - Test Method for Compressive Strength of Lightweight Insulating Concrete.
 - 3) C578 – Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
2. Test EPS insulation board for thermal insulation value in accordance with ASTM C177.
3. Test lightweight insulating concrete fill in accordance with ASTM C495 for:
 - a. Mix design compressive strength.
 - b. Mix design wet and dry density range.
 - c. Number of Tests:
 - 1) One per 5,000 square feet.
 - 2) Not less than one for each day's Work.
4. Test EPS insulation board for density in accordance with ASTM C578.

3.18 TESTING OF ROOFING

- A. Inspection and Observation Services (As required):
 1. Inspection of roof deck prior to start of Work.
 2. Inspect on site condition of stored roofing materials.
 3. Inspection during roofing, roof insulation, and sheet metal Work to ascertain compliance with Contract Documents.
 4. Observation of roof test cuts performed by Contractor to ascertain that they are properly made.
 5. Observation of patching of roof test cuts to ascertain that they are properly made.
- B. Testing Services (As required):
 1. Perform dissection and analysis on cuts provided by Contractor to confirm number of plies, bonding of plies, weight of bitumen and softening temperature to ascertain compliance with specifications.

3.19 MASONRY

- A. Inspection and Observation Services:
 1. Inspection of placement of reinforcement including condition, grade, size, location, spacing, and lap splices.
 2. Review mortar design mixes.
 3. Inspection of laying, mortaring, and grouting of concrete masonry units and elements.
- B. Testing Services:
 1. References (As applicable for tests required):
 - a. ASTM International (ASTM)
 - 1) C140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units.
 - 2) C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
 - 3) C1019 - Standard Test Method for Sampling and Testing Grout.
 2. Testing of Concrete Masonry Units (CMU):
 - a. Preconstruction: Perform the following tests in accordance with ASTM C140.
 - 1) Compressive Strength

- 2) Absorption
 - 3) Weight
 - 4) Moisture Content
 - 5) Dimensions.
3. Mortar Tests:
- a. Preconstruction: Perform the following tests in accordance with ASTM C780 on each type of mortar mix used on the Project.
 - b. 28 Day Compressive Strength
 - c. Water Retention
 - d. Construction: Perform 28 day compressive strength test in accordance with ASTM C780 on each type of mortar mix used on the Project at the rate of one test per 2,000 square feet of masonry.
4. Refer to and include Work for reinforcing steel specified.
5. Grout Tests:
- a. Preconstruction: Perform the following tests in accordance with ASTM C1019 on each type of grout mix used on the Project.
 - 1) 28 Day Compressive Strength
 - 2) Construction: Perform 28 day compressive strength test in accordance with ASTM C1019 on each type of grout mix used on the Project at the rate of one (1) test per 2,000 square feet of masonry.
 - 3) Prism Test: Perform preconstruction 28 day compressive strength test on concrete masonry walls in accordance with ASTM E447-97, Method B.

3.20 REPAIR AND PROTECTION

- A. On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 29.
- B. Protect construction exposed by or for quality control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality control services.

END OF SECTION 01 45 23

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements for temporary utilities, support facilities, and security and protection facilities, including but not limited to:
 1. Water service and distribution.
 2. Sanitary facilities, including toilets, wash facilities, and drinking water facilities.
 3. Heating and cooling facilities.
 4. Ventilation.
 5. Electric power service.
 6. Lighting.
 7. Telephone service.
 8. Project signs.
 9. Waste disposal facilities.
 10. Field office.
 11. Storage and fabrication sheds.
 12. Lifts and hoists.
 13. Construction aids and miscellaneous services and facilities.
 14. Environmental protection.
 15. Pest control.
 16. Enclosure fence.
 17. Security enclosure and lockup.
 18. Barricades, warning signs, and lights.
 19. Temporary partitions.
 20. Fire protection.
 21. Accessories necessary for a complete installation.

1.3 USE CHARGES

- A. Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.
- B. Water and Sewer Service: Pay sewer service use charges for water used and sewer usage by all entities for construction operations.
- C. Electric Power Service: Pay electric power service use charges for electricity used by all entities for construction operations.

1.4 SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Moisture Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.

1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
 2. Indicate procedures for discarding water damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water damaged work.
 3. Indicate sequencing of Work that requires water, such as sprayed fire resistive materials, plastering, and tile grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
- C. Dust and HVAC Control Plan: Submit coordination drawing and narrative that indicates the dust and HVAC control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
1. HVAC system isolation schematic drawing.
 2. Location of proposed air-filtration system discharge.
 3. Waste handling procedures.
 4. Other dust control measures.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
1. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board ADA-ABA Accessibility Guidelines (ADAAG), ICC/ANSI A117.1, and Texas Accessibility Standards (TAS) 2012.
- B. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- C. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Architect. Provide materials suitable for use intended.
- B. Chain Link Fencing: Minimum 2 inch (50 mm), 0.148 inch (3.8 mm) thick, galvanized steel, chain link fabric fencing; minimum 6 feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8 inch (60 mm) OD line posts and 2-7/8 inch (73 mm) OD corner and pull posts.
- C. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10 mils (0.25 mm) minimum thickness, with flame spread rating of 15 or less per ASTM E 84.
- D. Dust Control Adhesive Surface Walk off Mats: Provide mats minimum 36 inches by 60 inches (914 mm by 1624 mm).

- E. Insulation: Unfaced mineral fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame spread and smoke developed indexes of 25 and 50, respectively.
- F. Lumber and Plywood: Comply with requirements in Section 06 10 00.
- G. Gypsum Board: Minimum 1/2 inch (12.7 mm) thick by 48 inches (1219 mm) wide by maximum available lengths; Type X or Type C panels with tapered edges. Comply with Section 09 29 00.
- H. Paint: Comply with requirements in Section 09 90 00.
- I. Tarpaulins: Fire resistive labeled with flame-spread rating of 15 or less.
- J. Water: Potable.

2.2 TEMPORARY FACILITIES

- A. Contractor's Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading. Provide elevated, stabilized concrete walkway from parking area to field offices.
- B. Architect's Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading. Provide elevated, stabilized concrete walkway from parking area to field offices.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. Air Filtration Units: HEPA primary and secondary filter equipped portable units with four stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.
- C. Drinking Water: Containerized, tap dispenser, bottled water drinking water units, including paper cup supply. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 degrees F to 55 degrees F (7.2 degrees C to 12.7 degrees C).
- D. Electrical Outlets: Properly configured, NEMA polarized outlets to prevent insertion of 110V to 120V plugs into higher voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.
- E. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.
- F. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid propane gas or fuel oil heaters with individual space thermostatic control.
 - 1. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
 - 2. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of **8** at each return air grille in

system and remove at end of construction. Clean HVAC system as required in Section 01 77 00 and install new filter with MERV 11 or greater.

- G. Air Filtration Units: Primary and secondary HEPA filter equipped portable units with four stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Locate facilities where they will serve project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
 - 1. Locate facilities to limit site disturbance as specified in Section 01 10 00.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. Install temporary service. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 - 1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
 - 1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
 - 2. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel who handle materials that require wash up. Dispose of drainage properly. Supply cleaning compounds appropriate for each type of material handled. Provide safety showers, eyewash fountains, and similar facilities for convenience, safety, and sanitation of personnel.
- E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
 - 1. Prior to commencing Work, isolate the HVAC system in area where Work is to be performed according to coordination drawings.
 - a. Disconnect supply and return ductwork in Work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within Work area using HEPA equipped air filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.

2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust producing equipment. Isolate limited Work within occupied areas using portable dust containment devices.
 3. Perform daily construction cleanup and final cleanup using approved, HEPA filter equipped vacuum equipment.
- G. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- H. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations. Install electric power service underground unless otherwise indicated.
1. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and equipment.
 - a. Provide waterproof connectors to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length voltage ratio.
 - b. Provide warning signs at power outlets other than 110 to 120 V.
 - c. Provide metal conduit, tubing, or metallic cable for wiring exposed to possible damage. Provide rigid steel conduits for wiring exposed on grades, floors, decks, or traffic areas.
 - d. Provide metal conduit enclosures or boxes for wiring devices.
 - e. Provide 4 gang outlets, spaced so 100 foot (30 m) extension cord can reach each area for power hand tools and task lighting. Provide a separate 125-V ac, 20-A circuit for each outlet.
- I. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
 2. Install lighting for Project identification sign.
- J. Telephone Service: Provide temporary telephone service in common use facilities for use by construction personnel. Install one telephone line(s) for each field office.
1. Provide dedicated telephone line for each facsimile machine in each field office.
 2. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Contractor's emergency after-hours telephone number.
 - e. Architect's office.
 - f. Engineers' offices.
 - g. Owner's office.
 - h. Principal subcontractors' field and home offices.
 3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.
- K. Electronic Communication Service: Provide a desktop computer and printer/scanner in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications.

1. Provide high speed wireless internet access (provide access to the Owner and Architect); DSL or broadband. Dial-up connection is not acceptable.
2. Internet Service: Broadband modem, router and ISP, equipped with hardware firewall.
3. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.
4. Backup: External hard drive, minimum 1 terabyte, with automated backup software providing daily backups.

3.3 SUPPORT FACILITIES INSTALLATION

- A. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
 1. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
 1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
 2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Section 31 20 00.
 3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
 4. Delay installation of final course of permanent pavement until immediately before Substantial Completion.
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Parking: Provide temporary parking areas for construction personnel.
- E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 2. Remove snow and ice as required to minimize accumulations.
- F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
 1. Furnish and install a project sign 6'-0" by 8'-0" in size. Image will be provided to the graphics printing company by the Architect after Award of Contract. Contractor will be responsible for the cost of printing the image, mounting the sign on an aluminum substrate and installing the sign at the site. The sign will include the name of the project, District, name and title of Board of Trustees, District Superintendent, Contractor, Architect, and each of the project consultants.
 2. Other signs permitted at the site:
 - a. Warning signs.
 - b. Directional signs.
 - c. Identification signs at field offices.
 - d. Emergency medical services sign.

- e. Signs required by Authorities Having Jurisdiction.
 - f. Storm Water Pollution Prevention Plan sign (SWPPP)
3. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
- a. Provide temporary, directional signs for construction personnel and visitors.
4. Maintain and touchup signs so they are legible at all times.
5. Contractor shall allow no other signs to be displayed at the project site, unless authorized by the Owner.
- G. Waste Disposal Facilities: Provide waste collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300.
- H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
- 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- I. Temporary Elevator Use: Use of elevators is not permitted.
- J. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- K. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities to the satisfaction of Owner and Architect.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
- 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree or plant protection zones.
 - 2. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
 - 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 - 4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

- E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- F. Pest Control: Engage pest control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.
- G. Site Enclosure Fence: Before construction operations begin. Provide site enclosure fence to prevent people and animals from easily entering site except by entrance gates.
 - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
- H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each Work day.
- I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- J. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- L. Temporary Partitions: Provide floor to ceiling dustproof partitions to limit dust and dirt migration and to separate occupied areas occupied from fumes and noise.
 - 1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire retardant treated plywood on construction operations side.
 - 2. Construct dustproof partitions with two layers of 6 mil (0.14 mm) polyethylene sheet on each side. Cover floor with two layers of 6 mil (0.14 mm) polyethylene sheet, extending sheets 18 inches (460 mm) up the sidewalls. Overlap and tape full length of joints. Cover floor with fire retardant treated plywood. Do not apply tape to finish floor surfaces.
 - a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches (1219 mm) between doors. Maintain water dampened foot mats in vestibule.
 - 3. Where fire resistance rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
 - 4. Insulate partitions to control noise transmission to occupied areas.
 - 5. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
 - 6. Protect air handling equipment.
 - 7. Provide walk off mats at each entrance through temporary partition.
- M. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
 - 1. Prohibit smoking in construction areas.
 - 2. Supervise welding operations, combustion type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.

3. Develop and supervise an overall fire prevention and protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture Protection Plan: Avoid trapping water in finished Work. Document visible signs of mold that may appear during construction.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 1. Protect porous materials from water damage.
 2. Protect stored and installed material from flowing or standing water.
 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 4. Remove standing water from decks.
 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 2. Keep interior spaces reasonably clean and protected from water damage.
 3. Periodically collect and remove waste containing cellulose or other organic matter.
 4. Discard or replace water-damaged material.
 5. Do not install material that is wet.
 6. Discard, replace, or clean stored or installed material that begins to grow mold.
 7. Perform Work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Condition Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
 1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 2. Use permanent HVAC system to control humidity.
 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits and moisture control.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum based products, which become wet during the course of construction and remain wet for 48 hours are considered defective and are to be removed and replaced.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 - c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.6 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24 hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion unless otherwise required and approved by Owner and Architect.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 77 00."

END OF SECTION 01 50 00

SECTION 01 50 00 - TEMPORARY FACILITIES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION OF REQUIREMENTS

- A. Specific administrative and procedural minimum actions are specified in this Section, as extensions of provisions in other Contract Documents. These requirements have been included for special purposes as indicated. Nothing in this Section is intended to limit types and amounts of temporary work required, and no omission from this Section will be recognized as an indication that such temporary activity is not required for successful completion of the Work and compliance with requirements of the Contract Documents. Provisions of this Section are applicable to, but are not limited to the temporary power, temporary water, temporary heat, field office, mobile telephone, sanitary facilities, storage facilities, signs, barriers, security, construction fence, cleaning, first aid facilities, fire protection, construction aids, parking facilities, storm water control and pollution prevention plan, as further expanded in this Section.

1.2 JOB CONDITIONS

- A. General: Establish and initiate use of each temporary facility at time first reasonably required for proper performance of the Work. Terminate use and remove facilities at earliest reasonable time, when no longer required or when permanent facilities have, with authorized use, replaced their need.
- B. Conditions of Use:
1. Install, operate, maintain and protect temporary facilities in a manner and at locations which will be safe, non-hazardous, sanitary, and protective of persons and property, and free of deleterious effects.
 2. Be responsible for overloading or excess use of or damage resulting from the overloading or excess use of existing utilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials, not specifically described herein, but required for proper completion of Work of this Section, may be new or used as selected by the Contractor, but shall be of design, type, size, and strength recommended to suit intended purpose.
- B. Items required to protect the tenants, workmen, and public from danger, shall be sufficiently designed to protect them. Where required, exclude the public from all hazards.

PART 3 - EXECUTION

3.1 UTILITIES

- A. Temporary Power: Provide temporary power and all wiring, lamps, distribution of power, and equipment required for construction, inspection and testing of Work. The Owner shall be responsible for and shall pay for all reasonable utility costs after permanent utility connections have been made.

- B. Temporary Water: Provide temporary water and all hoses and equipment required for construction, inspection and testing of Work. The Owner shall be responsible for and shall pay for all reasonable utility costs after permanent utility connections have been made.
- C. Temporary Climate Control: Provide temporary climate control (heating, cooling and humidity control) required for construction of Work.
 - 1. Provide heat to prevent freezing and to avoid damage to materials in storage, during and after installation, and during curing and drying of materials and finishes. Provide and maintain such dependable source of supply of heat, cooling, and humidity control as necessary until the Work is accepted. No open fire heaters will be permitted. No mold, mildew, rust, or sagging materials due to humidity will be allowed. Contractor shall remediate any and all evidence of mold, mildew, or rust per applicable state standards and requirements.

3.2 FIELD OFFICE

- A. Furnish a job trailer installed at a suitable location on site for use by the Contractor and the Architect.
- B. Provide adequate parking area adjacent to job trailer to match construction standards specified in 01 57 25.
- C. Provide and maintain a weather tight building with operable and lockable door and windows, to serve as a job office available to the Contractor, subcontractors, and the Owner and Architect. Provide lights, electricity, air conditioning and heat, as required. Remove office from premises when one can be set up inside the building. Provide job telephone and other miscellaneous items as outlined below.
 - 1. Provide a separate locked room to serve as an office for the Owner and Architect, of an area of 100 SF, or provide in a separate building in close proximity to Contractor's office.
 - 2. Contractor's office shall be of a size, and furnished, so that it may be used for progress meetings.
 - 3. Provide adequate artificial lighting, heating and cooling to provide comfortable conditions for occupants.
 - 4. Provide direct line telephone service, for both voice communication and facsimile machines at Contractor's office and Owner/Architect's office.
 - 5. Provide high speed wireless internet access; DSL or broadband. Dial-up connection is not acceptable. Wireless connection password to be made available to all Owner and Architect representatives.
 - 6. Maintain a complete set of Construction Documents, Submittals, Record Documents, and other pertinent information for Contractor, Architect, Engineer, and Owner use.
 - 7. Furnishings Required:
 - a. For Contractor's office: Racks and files for Contract Documents and for Record Documents; conference table and chairs; and desks and chairs as required by Contractor.
 - b. For Owner/Architect's office: Two four (4) drawer metal file cabinets, one layout drafting table 36 inch by 72 inch by 36 inch high; and drafting stool. Provide one drawing rack for 30 inch by 42 inch drawings. The Contractor will pay the monthly phone charges for all calls and base service charges for phone lines and fax lines that are brought into the Owner/Architect office. Provide the Owner and Architect with a key to the Owner/Architect office only.

3.3 MOBILE TELEPHONE

- A. Furnish and maintain a mobile telephone for his superintendent's use for the duration of the Project.

3.4 SANITARY FACILITIES

- A. Furnish and maintain temporary sanitary facilities. Comply with regulations of State Department of Health and other authorities having jurisdiction. The Contractor may not use the Owner's facilities.

3.5 STORAGE FACILITIES

- A. Provide and maintain adequate weathertight lockable storage facilities, raised above the ground, with sides and top enclosed.
- B. Replace materials improperly stored and damaged by weathered conditions.
- C. Remove storage facilities when materials can be stored within the structure in a secure and weathertight condition.
- D. Provide for temporary freeze protection as needed.

3.6 SIGNS

- A. Furnish and install a project sign 8'-0" by 8'-0" in size. Image will be provided to the graphics printing company by the Architect after Award of Contract. Contractor will be responsible for the cost of printing the image, mounting the sign on an aluminum substrate and installing the sign at the site. The sign will include the name of the project, District, name and title of Board of Trustees, District Superintendent, Contractor, Architect, and each of the project consultants.
- B. Other signs permitted at the site:
 - 1. Warning signs.
 - 2. Directional signs.
 - 3. Identification signs at field offices.
 - 4. Emergency medical services sign.
 - 5. Signs required by Authorities Having Jurisdiction
 - 6. Storm Water Pollution Prevention Plan sign (SWPPP)
- C. Contractor shall allow no other signs to be displayed at the project site, unless authorized by the Owner.

3.7 BARRIERS

- A. Provide temporary barricades on all portions of the site adjacent to the construction and accessible to the public.
- B. Provide approved barriers around trees and plants designated to remain. Protect against vehicular traffic, stored materials, dumping, chemically injurious materials, water puddling and continuous running water.

3.8 SECURITY

- A. Determine if and when watchmen are necessary for protection of the Work, and provide such services when necessary. Neither the provision of watchmen nor the failure to

provide watchmen shall relieve the Contractor of responsibility in event of injury to persons or damage to property.

3.9 CONSTRUCTION FENCE

- A. Provide a minimum 6 feet-0 inch high chain link construction fence around the perimeter of the construction area for the duration of the construction period. Said temporary construction fence shall have lockable access gates necessary to adequately access the site in order to execute the project. Access gates shall be locked at the completion of each day's work. No gaps or openings will be allowed.

3.10 CLEANING

- A. Trash removal: Clear the building daily, and site of trash at least once a week. When rapid accumulation occurs, make more frequent removals. Remove highly combustible trash such as paper and cardboard daily. Dumpsters will not be allowed to overflow and should be emptied on a regular basis.
- B. Disposition of Debris: Remove debris from site and make legal disposition. Locations for disposal shall be of the Contractor's choice within the above restriction. Neither debris nor material may be buried or burned at the site. Take necessary precautions to prevent accidental burning of materials by avoiding large accumulations of combustible materials.
- C. Final Cleaning: Thoroughly clean the Work, including the removal of smudges, marks, stains, fingerprints, soil, dirt, paint spots, dust, lint, discolorations, and other foreign materials.

3.11 TEMPORARY FIRST AID FACILITIES

- A. Provide first aid equipment and supplies, with qualified personnel continuously available to render first aid at the site.
- B. Provide a sign, posted at the field office telephone, listing the telephone numbers for emergency medical services: Physicians, ambulance services and hospitals.

3.12 TEMPORARY FIRE PROTECTION

- A. Provide a fire protection and prevention program for employees and personnel at the site; and provide and maintain fire extinguishing equipment ready for instant use at all areas of the Project and at specific areas of critical fire hazard.
- B. Equipment:
 - 1. Hand extinguishers of the types and sizes recommended by the National Board of Fire Underwriters to control fires from particular hazards.
 - 2. Barrels of water with buckets designated for fire-control purposes.
 - 3. Water hoses connected to an adequate water pressure and supply system.
 - 4. Construction period use of permanent fire protection system.
- C. Enforce fire-safety discipline:
 - 1. Store volatile materials in an isolated, protected location.
 - 2. Avoid accumulations of flammable debris and waste in or about the Project.
 - 3. Prohibit smoking in the vicinity of hazardous conditions.
 - 4. Closely supervise and provide fire watches as required by authorities having jurisdiction during and after welding and torch-cutting operations in the vicinity of combustible materials and volatile conditions.
 - 5. Supervise locations and operations of portable heating units and fuel.

- D. Contractor shall maintain fire-extinguishing equipment in working condition, with current inspection certificate attached to each extinguisher.

3.13 CONSTRUCTION AIDS

- A. Provide construction aids and equipment required to assure safety for personnel and to facilitate the execution of the Work; Scaffolds, staging, ladders, stairs, ramps, runways, platforms, railings, hoists, cranes, chutes and other equipment.
- B. Maintain all equipment in a first-class, safe condition.

3.14 PARKING FACILITIES

- A. Coordinate location of parking for personnel and employees at the facility to avoid interference with traffic, walks, work and storage areas, or with materials-handling equipment.
- B. Grade and provide drainage facilities to assure runoff of rainwater and to avoid blockage of flow from adjacent areas.

3.15 STORM WATER CONTROL & POLLUTION PREVENTION PLAN

- A. Grade and provide drainage facilities to assure runoff of rainwater and to avoid blockage of flow from adjacent areas. Refer to Civil Drawings for additional requirements.
- B. Provide and maintain a Storm Water Pollution Prevention Plan in accordance with Federal EPA requirements. All inspections and reports / observations are to be forwarded to the Owner and Architect.
- C. File an EPA "Notice of Intent" Form with the EPA **before construction begins.**

END OF SECTION

SECTION 01 55 26 TRAFFIC CONTROL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Refer to Harris County Engineering Department (HCED) Specifications, dated October 10, 2023 or City of Humble specifications when working in public right of way.
- C. This section contains HCED items:
 - 1. 694 – Temporary Traffic Control

ITEM 694

TEMPORARY TRAFFIC CONTROL

694.1 DESCRIPTION.

This Item shall govern for furnishing, installing, moving, replacing, maintaining, cleaning, and removing all temporary traffic control devices, detours, and providing flaggers as shown on the Contract Documents or as directed by HCED.

694.2 REFERENCES.

- A. Harris County "General Conditions for Roads, Bridges and Related Work"
- B. TMUTCD

694.3 MATERIALS.

Materials meeting the requirements of the following Items shall be use for traffic control.

- A. Item 636 "Signs"
- B. Item 662 "Work Zone Pavement Markings"
- C. Item 696 "Barricades"
- D. Item 698 "Low Profile Concrete Barrier"
- E. Item 699 "Temporary Polyethylene Water-Filled Barrier"
- F. Item 860 "Sign Face Materials"

694.4 CONSTRUCTION.

General. A Traffic Control Plan (TCP) shall be established for projects in accordance with the TMUTCD. The Contractor may submit an alternate TCP for approval. The alternate TCP must be prepared in accordance with Harris County's Standard Traffic Drawings and sealed by a Professional Engineer registered in the State of Texas, proficient in the field of Traffic Engineering. If the alternate TCP is approved by HCED, the plan may be used.

Prior to beginning work, the Contractor shall designate in writing a competent individual who will be responsible and available on the project site or in the immediate area to insure compliance with the TCP.

The Contractor shall comply with the traffic control requirements in Harris County's "General Conditions for Roads, Bridges, and Related Work." If the Contractor does not comply with the requirements of this Item, any requirement HCED deems necessary for the safety, comfort, and convenience of the travelling public shall be completed at the Contractor's expense. Traffic control provided during delays caused by the Contractor shall be at the Contractor's expense.

Traffic Control Devices. The Contractor shall be responsible for furnishing, erecting and maintaining all traffic control devices over the entire length of the project as necessary to adequately advise and protect the traveling public, workers, and the project site until accepted by Harris County. Reflective traffic control devices shall be maintained at all times. Clean and/or replace reflective traffic control devices when the reflective characteristics do not equal or exceed the retroreflective characteristics of HCED's standard reflective panels.

Temporary pavement markings shall be in accordance with Item 662 "Work Zone Pavement Markings."

Temporary signs and supports shall be made from wood, metal, or other approved materials. Wood for signs shall be minimum 1/2 inch, medium density and outdoor grade plywood. Aluminum signs and sign supports shall be in conformance with Item 636 "Signs." Reflectorized sign sheeting shall be in conformance with Item 860 "Sign Face Materials." Signs may be erected on portable, temporary, or fixed supports for use in the work zone. Signs erected on portable supports shall be for daytime use only. All wood supports shall be painted white. Sandbags shall be used where portable or temporary sign supports require the use of weights to prevent a sign assembly from falling over. All signs shall be placed in accordance with the Contract Documents and the TMUTCD.

Detours and Temporary Structures. Detours and temporary structures for public travel during construction of the project shall be indicated on the TCP. Required temporary structures not shown or specified in the Contract Documents shall be at the Contractor's expense. Maintenance costs incurred to an established road, street, or highway from detoured traffic shall not be considered a cost of maintaining detours and shall be at the Contractor's expense.

The Contractor shall provide at his expense, means of ingress and egress for all residents and businesses along any closed section of the work and shall provide property owners a means of access to a public road.

Temporary access for commercial and/or residential driveways shall provide an all-weather surface and shall be maintained by the Contractor in a condition acceptable to HCED. Where indicated in the bid documents, asphalt millings may be used for temporary driveways.

No section of the work shall be closed to traffic until directed by HCED. No bridge, culvert or drainage structure shall be closed until an adequate detour has been arranged and constructed.

Flaggers. The Contractor shall provide flaggers for the work associated with the control, safety of all traffic, flow of traffic through the construction site, and pedestrian flow throughout the project as shown in the traffic control plan (TCP), Harris County Standard Traffic Drawings, the TMUTCD, and as directed by HCED. The primary function is to move vehicles and pedestrians safely and expeditiously through or around the construction area. The flaggers are provided at work sites to stop traffic intermittently, as required to protect the Contractor's workmen, equipment, pedestrians, and motorists.

It is the responsibility of the Contractor to ensure that all flaggers are properly trained in flagging procedures and possess the minimum qualifications in accordance with the TMUTCD. Flaggers must be courteous and able to effectively communicate with the public. When directing traffic, flaggers must dress appropriately, wear high-visibility safety apparel, use lights, flags, signs, stop/slow paddles, and other hand-signaling devices, and follow the flagging procedures in the TMUTCD. The Contractor shall provide 2 radios, 2 stop/slow paddles, 2 temporary white stop bars, 2 flags, 2 high-visibility safety vests, and 2 safety caps for the flagging operation.

The use of flaggers does not relieve the Contractor of his responsibility to insure proper protection of the public and of the construction. The Contractor shall be liable for all damages that occur at the construction site, as a result of accidents with citizens and motorists.

When flaggers are not present, temporary white stop bars shall be used. Flags should be limited to emergencies, low-speed and/or low volume locations that can be best served by a single flagger.

694.5 SUBMITTAL.

If the Contractor elects to use an alternate TCP, the alternate TCP shall be submitted to HCED for approval.

694.6 MEASUREMENT.

This Item shall be measured by the month or per each project, including the preparation of an alternative Traffic Control Plan when approved by HCED.

Temporary Driveways. Temporary driveways shall be measured by each type of driveway.

694.7 PAYMENT.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" shall be paid for at the unit price bid for "Temporary Traffic Control" as shown on the Contract Documents. The price is full compensation for furnishing, installing, moving, replacing, maintaining, cleaning and removing all barricades, signs, barriers, barrels, cones, lights, delineators, other devices, and detours; providing trained and qualified flaggers; furnishing all materials, including flagging equipment; tools, equipment, labor, and incidentals necessary to complete the work.

Temporary Driveways. Temporary driveways furnished in accordance with this Item and measured as provided under "Measurement" shall be paid for at the unit price bid for "Temporary Commercial Driveway" or "Temporary Residential Driveway." The price is full compensation for furnishing all materials; hauling, shaping, and maintaining driveways; removal of driveways and disposal of excess material; tools, equipment, labor, and incidentals necessary to complete the work.

Detours. Detours shall be paid for in accordance with Item 697 "Constructing Detours."

Temporary Pavement Markings. Temporary pavement markings shall be paid for in accordance with Item 662 "Work Zone Pavement Markings."

Low Profile Concrete Barrier. Low profile concrete barriers shall be paid for in accordance with Item 698 "Low Profile Concrete Barrier."

Temporary Polyethylene Water-Filled Barrier. Temporary polyethylene water-filled barrier shall be paid for in accordance with Item 699 "Temporary Polyethylene Water-Filled Barrier."

There are item code(s), description(s) and unit(s) for this Item:

NOTE: This Item requires other Standard Specifications.

Item 636 "Signs"

Item 662 "Work Zone Pavement Markings"

Item 696 "Barricades"

Item 697 "Constructing Detours"

Item 698 "Low Profile Concrete Barrier"

Item 699 "Temporary Polyethylene Water-Filled Barrier"

Item 860 "Sign Face Materials"

END OF ITEM 694

END OF SECTION 01 55 26

SECTION 01 56 00 – TEMPORARY JOBSITE PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Temporary jobsite protection including the following:
 1. Temporary floor and wall protection.
 2. Door jamb protection.
 3. Small project floor and wall protection.
 4. Seaming tape for floor protection.
 5. Recyclable, portable jobsite trash containers.

1.3 RELATED SECTIONS

- A. Section 03300 - Cast-In-Place Concrete.
- B. Section 06415 - Countertops.
- C. Section 08100 - Doors and Frames.
- D. Section 09200 - Plaster and Gypsum Board.
- E. Section 09600 - Flooring.
- F. Section 09300 - Tiling.
- G. Section 09700 - Wall Finishes.
- H. **Section 09900 - Painting and Coatings.**

1.4 REFERENCES

- A. Forest Stewardship Council (FSC).

1.5 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 1. Preparation instructions and recommendations.
 2. Storage and handling requirements and recommendations.
 3. Installation methods.

1.6 QUALITY ASSURANCE

- A. Manufacturer: Minimum Five (5) years' experience manufacturing similar products.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.

- B. Handle materials to avoid damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Manufacturer: Manufacturer: Ram Board, which is located at: 27460 Avenue Scott; Valencia, CA 91355; Tel: 855-848-8678; Fax: 818-848-0099; Email: [request info \(info@ramboard.com\)](mailto:request_info@ramboard.com); Web: www.ramboard.com. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

2.2 TEMPORARY FLOOR AND WALL PROTECTION

- A. Ram Board: Model # RB 38-100 Ram Board as manufactured by Ram Board. Heavy-duty temporary and reusable floor and wall protection.
1. Standards Compliance: FSC certified. Recycled and recyclable materials.
 2. Wall Guard Feature: Fold lines allowing corner, horizontal and vertical wall protection.
 - a. Wall guard fold lines at 4 inches (101 mm), 8 inches (203 mm) and 12 inches (305 mm) from edge of board.
 3. Flex-Fiber Technology: Provides unmatched protection from impact while remaining flexible.
 4. Vapor-Cure Technology: Allows protected substrates and finishes to cure while being protected so work may continue.
 5. Spill Guard Technology: Provides added protection against water, paint, mud, and more.
 6. Roll Dimensions (W x L): 38 in x 100 ft (965 mm x 30.5 m). 317 sq ft (29.5 sq m).
 7. Rolls per Pallet: 16.
- B. Ram Board Plus: Model # RB PLUS 38-100 Ram Board Plus as manufactured by Ram Board. Board is pre-taped for faster installs.
1. Standards Compliance: FSC certified. Recycled and recyclable materials.
 2. Pre-Taped for Faster Installs saving up to 30% on installation of surface protection.
 3. Wall Guard Feature: Fold lines allowing corner, horizontal and vertical wall protection.
 - a. Wall guard fold lines at 4 inches (101 mm), 8 inches (203 mm) and 12 inches (305 mm) from edge of board.
 4. Flex-Fiber Technology: Provides unmatched protection from impact while remaining flexible.
 5. Vapor-Cure Technology: Allows protected substrates and finishes to cure while being protected so work may continue.
 6. Spill Guard Technology: Provides added protection against water, paint, mud, and more.
 7. Roll Dimensions (W x L): 38 in x 100 ft (965 mm x 30.5 m). 317 sq ft (29.5 sq m).
 8. Rolls per Pallet: 16. C. Ram Board: Model # RB 48-100 Ram Board as manufactured by Ram Board. Heavy-duty temporary and reusable floor and wall protection.
 9. Standards Compliance: FSC certified. Recycled and recyclable materials.
 10. Wall Guard Feature: Fold lines allowing corner, horizontal and vertical wall protection.
 - a. Wall guard fold lines at 4 inches (101 mm), 8 inches (203 mm) and 12 inches (305 mm) from edge of board.

11. Flex-Fiber Technology: Provides unmatched protection from impact while remaining flexible.
 12. Vapor-Cure Technology: Allows protected substrates and finishes to cure while being protected so work may continue. Ram Board Plus tape isn't breathable.
 13. Spill Guard Technology: Provides added protection against water, paint, mud, and more.
 14. Roll Dimensions (W x L): 48 in x 100 ft (1219 mm x 30.5 m). 400 sq ft (37.1 sq m).
 15. Rolls per Pallet: 16.
- D. Ram Board Home Edition: Model # RBHE 36-50 Ram Board Home Edition as manufactured by Ram Board. Re-usable protection for small projects.
1. Standards Compliance: FSC certified. Recycled and recyclable materials.
 2. Wall Guard Feature: Fold lines allowing corner, horizontal and vertical wall protection.
 3. Flex-Fiber Technology: Provides unmatched protection from impact while remaining flexible.
 4. Vapor-Cure Technology: Allows protected substrates and finishes to cure while being protected so work may continue.
 5. Spill Guard Technology: Provides added protection against water, paint, mud, and more.
 6. Roll Dimensions (W x L): 36 in x 50 ft (914 mm x 15.24 m). 150 sq ft (13.9 sq m).
 7. Rolls per Box: 9.
- E. Ram Board Painter's Board: Model # 20RB 35-50 Ram Board Painter's Board as manufactured by Ram Board. Floor protection for painting projects.
1. Standards Compliance: FSC certified. Recycled and recyclable materials.
 2. Flex-Fiber Technology: Provides unmatched protection from impact while remaining flexible.
 3. Vapor-Cure Technology: Allows protected substrates and finishes to cure while being protected so work may continue.
 4. Spill Guard Technology: Provides added protection against water, paint, mud, and more.
 5. Stronger than red rosin papers
 6. Roll Dimensions (W x L): 35 in x 50 ft (89.9 cm x 15.24 m). 145.83 sq ft (13.54 sq m).

2.3 DOOR JAMB PROTECTION

- A. Door Jamb Protection: Model # RBJP 60 or RBJP 36 Ram Jamb as manufactured by Ram Board. Heavy-duty flexible re-usable door jamb protection.
1. Materials: Recycled and recyclable materials.
 2. Door Jamb Sizes: Fits 4 in - 9 in (102 mm - 229 mm).
 3. Length: 36 in or 60 in (914 and 1524 mm).
 4. Material Thickness: 65 mils (1.65 mm).
 5. Units per Box: 50.

2.4 SEAMING AND EDGE TAPES FOR FLOOR PROTECTION

- A. Seaming Tape: Model # RT 3-164 as manufactured by Ram Board. Used to cover Ram Board seams.
1. Backing: Unique kraft backing tears easily and creates an extremely durable, smooth finish.
 2. Recyclable: 100 percent.
 3. Dimensions (W x L): 3 in x 164 ft (76 mm x 50m).
 4. Rolls per Box: 16.

- B. Vapor-Cure Tape: Model # RB VCT 3-108 as manufactured by Ram Board. Used to cover Ram Board seams which prevents tape lines.
 - 1. Performance: Allows vapors and moisture to escape from concrete, glue down floors, stained floors, epoxy floors, refinished floors, vinyl composition tile, and most other floor types.
 - 2. Dimensions (W x L): 3 in x 108 ft (76 mm x 32.9 m).
 - 3. Rolls per Box: 16.

- C. Edge Tape: Model #RB ET 2.5-180 as manufactured by Ram Board. Used to secure Ram Board Temporary Floor Protection edges to flooring or wall surfaces.
 - 1. Performance: Easy Release, low tack tape for up to 14 days. Grips tightly to Ram Board while easy release on flooring surfaces up to 14 days. 2. Dimensions (W x L): 2.5 in x 180 ft (63.5 mm x 55 m)
 - 2. Rolls per Box: 20.

2.5 RECYCLABLE, PORTABLE JOBSITE TRASH CONTAINERS

- A. Portable Jobsite Trash Containers: Model # RBTB 16-36 Trash Box as manufactured by Ram Board. Portable, reusable jobsite trash container. 1. Fits Trash Bags: 42 gal - 50 gal (159 to 189 L)
 - 2. Recycled and Recyclable Materials: 100%.
 - 3. Unique folds for easy storage.
 - 4. Quick self-locking assembly, no tape required.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation. Proceed with installation or protection products only after unsatisfactory conditions have been corrected.
- B. Do not begin protection installation until substrates have been properly prepared.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 INSTALLATION

- A. Install protection products in accordance with manufacture's written instructions and approved submittals.

3.3 PROTECTION

- A. Protection installed products may be left in place until completion of project or adjacent work.

END OF SECTION 01 56 00

SECTION 01 56 23 TEMPORARY BARRICADES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Refer to Harris County Engineering Department (HCED) Specifications, dated October 10, 2023 or City of Humble specifications when working in public right of way.
- C. This section contains HCED items:
 - 1. 696 – Barricades

ITEM 696

BARRICADES

696.1 DESCRIPTION.

This Item shall govern for furnishing, installing, moving, replacing, maintaining, cleaning, and removing upon completion of work all barricades.

696.2 REFERENCES.

A. TMUTCD

696.3 MATERIALS.

All barricades shall be in accordance with the requirements of the TMUTCD.

Markings for permanent Type III barricade rails shall be alternating red and white chevron striping sloping downward at an angle of 45 degrees in the direction traffic is to pass. All parts of the barricade not striped shall be painted white.

Markings for temporary Type III barricade rails shall be alternating orange and white chevron striping sloping downward at an angle of 45 degrees in the direction traffic is to pass. All parts of the barricade not striped shall be painted white.

Where a Type III barricade extends entirely across a roadway, the stripes shall slope downward in the direction toward which traffic must turn when detouring. Where both right and left turns are provided for, the chevron striping shall slope downward in both directions from the center of the barricade.

Reflectorized sheeting used for the chevron striping on both permanent and temporary barricades shall be, as a minimum, in accordance with Item 860 "Sign Face Materials."

The above does not preclude the requirements of the "Harris County General Conditions."

696.4 CONSTRUCTION.

All barricades shall be installed in accordance with the drawings, the TMUTCD and Item 694 "Temporary Traffic Control."

696.5 RESPONSIBILITY FOR DAMAGE OR CLAIMS.

The Contractor shall hold harmless the County and all its representatives from all suits, actions or claims, of any character brought on account of any injuries or damages sustained by any person or property in consequence of any neglect in safeguarding the work or through the use of unacceptable materials in the construction of the improvement, or on account of any act of omission by the Contractor. He shall not be released from said responsibility until the roadway has been completed and accepted, and so much of the money due the said Contractor under and by virtue of his contract may be retained by the County, or his Surety may be held until such claims have been settled and suitable evidence to that effect furnished to the County.

All barricades, whether temporary or permanent, shall be checked daily to see if they are in their proper location.

696.6 MEASUREMENT.

Except for Permanent Type III barricades, this Item shall not be measured for payment. Permanent Type III barricades shall be measured by each unit of barricade constructed, complete in place.

696.7 PAYMENT.

Except for Permanent Type III barricades, payment shall not be made for this Item. Temporary Barricades shall be paid for in accordance with Item 694 "Temporary Traffic Control."

The basis of payment for Type III barricades shall be the contract unit price bid per each unit, which price shall be full compensation for furnishing and placing all materials and for all labor, tools, equipment and incidentals necessary to complete the work.

There are item code(s), description(s), and unit(s) for this Item.

NOTE: This Item requires drawings that shall be incorporated into the contract documents.

NOTE: This Item requires other Standard Specifications

Item 694 "Temporary Traffic Control"
Item 860 "Sign Face Materials"

END OF ITEM 696

END OF SECTION 01 56 23

TEMPORARY BARRICADES
01 56 23

SECTION 01 57 13 - GENERAL SOURCE CONTROLS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

- A. This Section describes erosion and sedimentation control and other control related practices, which shall be utilized during construction activities.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General Conditions, Special Conditions, and Division 1 Specification Sections, apply to this Section.

PART 2 – PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 GENERAL

- A. No clearing and grubbing or rough cutting shall be permitted until erosion and sedimentation control systems are in place.
- B. Equipment and vehicles shall be prohibited by the Contractor from maneuvering on areas outside of dedicated construction area. Damages caused by construction traffic or others to erosion and sedimentation control systems shall be repaired immediately by the Contractor.
- C. The Contractor shall be responsible for collecting, storing, hauling, and disposing of spoils, silt, and waste materials as specified on the Drawings and in this or other Technical Specifications and in compliance with applicable federal, state, and local rules and regulations.
- D. Contractor shall conduct all construction operation under this Contract in conformance with the erosion control practices described on the Drawings, the Storm Water Pollution Prevention Plan and this Section.
- E. The Contractor shall install, maintain, and inspect erosion and sediment control measures and practices as specified on the Drawings and in this and other Technical Specifications.
- F. Contractor shall employ protective measures to avoid damage to existing trees to be retained on the project site.

3.2 TOPSOIL PLACEMENT FOR EROSION AND SEDIMENTATION CONTROL SYSTEMS

- A. When topsoil is called for as a component of another Section, the Contractor shall conduct erosion control practices described in this Section during topsoil placement operation.
- B. When placing topsoil, maintain erosion and sedimentation control systems.
- C. Maintain grades, which have been previously established on areas to receive topsoil.

- D. After the areas to receive topsoil have been brought to grade, and immediately prior to dumping and spreading the topsoil, the subgrade shall be loosened by discing or by scarifying to a depth of at least two (2) inches to permit bonding of the topsoil to the subsoil.
- E. No sod or seed shall be placed on soil, which has been treated with soil sterilants until sufficient time has elapsed to permit dissipation of toxic materials.

3.3 DUST CONTROL

- A. Dust control methods shall be implemented to control dust creation and movement on construction sites and roads and to prevent airborne sediment from reaching receiving stream or storm water conveyance system, to reduce on and offsite damage, to prevent health hazards, and to improve traffic safety.
- B. Contractor shall control dust blowing by utilizing one or more of the following methods:
 - 1. Mulches bound with chemical binders.
 - 2. Temporary vegetative cover.
 - 3. Spray-on adhesives on mineral soils when not used by traffic.
 - 4. Tillage to roughen surface and bring clods to the surface.
 - 5. Irrigation by water sprinkling.
 - 6. Barriers using solid board fences, snow fences, burlap fences, crate walls, bales of hay, or similar materials.
- C. Dust control methods shall be implemented immediately whenever dust can be observed blowing on the project site.

3.4 KEEPING STREETS CLEAN

- A. Contractor shall keep the streets clean of construction debris, dirt, and mud generated by construction vehicles and equipment. If necessary, to keep the streets clean, Contractor shall provide stabilized construction exits at construction, staging, storage, and disposal areas. A vehicle/equipment wash area (stabilized with coarse aggregate) may be installed adjacent to the location of stabilized construction exit, as needed. Wash water shall be released into a drainage swale or inlet protected by erosion and sediment control measures.
- B. In lieu of or in addition to stabilized construction exits, Contractor shall shovel and/or sweep the pavement to the extent necessary to keep the street clean. Water hosing or sweeping of debris and mud off the street into adjacent areas is not allowed.

3.5 EQUIPMENT MAINTENANCE AND REPAIR

- A. Maintenance and repair of construction machinery and equipment shall be confined to areas specifically designated for that purpose. Such designated areas shall be located and designed so that oils, gasoline, grease, solvents, and other potential pollutants cannot be washed into receiving streams or storm water conveyance systems. These areas shall be provided with adequate waste disposal receptacles for liquid as well as solid waste. Maintenance areas shall be inspected and cleaned daily.
- B. On the construction site where designated equipment maintenance areas are not feasible, care shall be taken during each individual repair or maintenance operation to prevent potential pollutants from becoming available to be washed into streams or conveyance systems. Temporary waste disposal receptacles shall be provided.

3.6 WASTE COLLECTION AND DISPOSAL

- A. Contractor shall formulate and implement a plan for the collection and disposal of waste materials

on the construction site. The plan must designate locations for trash and waste receptacles and establish a collection schedule. Methods for ultimate disposal of waste shall be specified and carried out in accordance with applicable local, state, and federal health and safety regulations. Special provisions shall be made for the collection and disposal of liquid wastes and toxic or hazardous materials.

- B. Receptacles and other waste collection areas shall be kept neat and orderly to the extent possible. Waste shall not be allowed to overflow its container or accumulate for excessively long periods of time. Trash collection points shall be located where they will least likely be affected by concentrated storm water runoff.

3.7 WASHING AREAS

- A. Vehicles such as concrete or dump trucks and other construction equipment shall not be washed at locations where the runoff will flow into a watercourse or storm water conveyance system. Special areas shall be designated for washing vehicles. These areas should be located where the wash water will spread out and evaporate or infiltrate directly into the ground, or where the runoff can be collected in a temporary holding or seepage basin. Wash areas shall have gravel or rock bases to minimize mud generation. These areas shall be completely cleaned up, have waste remains hauled off, and be stabilized and seeded after the area is no longer required.

3.8 STORAGE OF CONSTRUCTION MATERIALS, CHEMICALS, ETC.

- A. Sites where chemicals, cements, solvents, paints, or other potential water pollutants are to be stored, shall be isolated in areas where they will not cause runoff pollution.
- B. Toxic chemicals and materials, such as pesticides, paints, and acids shall be stored in accordance with manufacturers' guidelines. Groundwater resources shall be protected from leaching by placing a plastic mat, packed clay or other impervious materials on any areas where toxic liquids are to be opened and stored.

3.9 DEMOLITION AREAS

- A. Demolition work, which generates large amounts of dust, shall be provided with dust control techniques to limit the transport of the airborne pollutants. However, water or slurry used to control dust shall not be allowed to run directly into watercourses or storm water conveyance systems. Methods of ultimate disposal of these materials shall be carried out in accordance with applicable local, state and federal health and safety regulations.

3.10 SANITARY FACILITIES

- A. The construction site must be provided with adequate sanitary facilities for workers in accordance with Division 1 and applicable health regulations.

3.11 PESTICIDES

- A. The use of pesticides shall be approved by the Owner prior to application. A one-week notice will be required of the Contractor.
- B. Pesticides used during construction shall be stored and used in accordance with manufacturers' guidelines and with local, state and federal regulations. Overuse of pesticides, which could generate contaminated runoff, shall be avoided and great care shall be taken to prevent accidental spillage. Pesticide containers shall never be washed in or near flowing streams or storm water conveyance systems.

3.12 PROTECTION OF TREES IN CONSTRUCTION AREAS

- A. Heavy equipment, vehicular traffic, and stockpiles of construction materials, including topsoil, are not permitted within the dripline of any tree to be retained. Contractor shall avoid all contact with trees to be retained unless otherwise directed by the Owner or required by the work under this Contract.
- B. Specimen trees shown on the Drawings shall be boxed or fenced. When called for in the Drawings, tunnel under the root system for the installation of utility lines.
- C. Tree trunks, exposed roots, and limbs of the trees designated to be retained, which are damaged during construction operations, will be cared for as prescribed by a forester or licensed tree expert at the expense of the Contractor.

3.13 MEASUREMENT AND PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price, or in the unit price for Storm Water Pollution Prevention Plan.

END OF SECTION 01 57 13

SECTION 01 57 13.13 - FILTER FABRIC FENCE

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

- A. This Section describes the installation of erosion and sedimentation control filter fabric fences (FFF) utilized during construction. The filter fabric fences are to be used to contain pollutants from overland flow. This practice shall not be used in channelized flow areas.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General Conditions, Special Conditions, and Division 1 Specification Sections, apply to this Section.

1.3 REFERENCE STANDARDS

- A. The publications listed below forms a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. American Society for Testing and Materials (ASTM).
- C. ASTM D-3786 - Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method.
- D. ASTM D-4632 - Standard Test Method for Breaking Load and Elongation of Geotextile (Grab Method).

1.4 SUBMITTALS

- A. Manufacturer's catalogue sheets and other pertinent information on geotextile fabric.

PART 2 - PRODUCTS

2.1 FILTER FABRIC

- A. Provide woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material. Geotextile fabric shall have a grab strength of 100 psi in any principal direction (ASTM D-4632), Mullen burst strength exceeding 200 psi (ASTM D-3786), and the equivalent opening size between 50 and 140, with the appropriate opening size to be selected based on the grain size characteristics of the disturbed soil. Filter fabric material shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six (6) months of expected usable construction life at a temperature range of 0 degrees F to 120 degrees F.
Representative Manufacturers: TenCrate Mirafi or preapproved equivalent.

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide erosion and sedimentation control systems at the locations shown on the Drawings. Such systems shall be of the type indicated and shall be constructed in accordance with the requirements shown on the Drawings and set out in this Section.

- B. No clearing and grubbing or rough cutting shall be permitted until erosion and sedimentation control systems are in place.
- C. Regularly inspect and repair or replace components of all erosion and sedimentation control systems as specified for each type of system. Unless otherwise directed, maintain the erosion and sedimentation control systems until the project area stabilization is accepted by the Owner. Remove erosion and sedimentation control systems promptly when directed by the Owner. Discard removed materials as required by these Specifications.
- D. Remove and dispose sediment deposits at the project designated spoil site. Sediment shall not be allowed to flush into stream or drainage way. If sediment has been contaminated, it shall be disposed of in accordance with existing federal, state and local regulations.
- E. Equipment and vehicles shall be prohibited by the Contractor from maneuvering on areas outside of construction limits. Damages caused by construction traffic to erosion and sedimentation control systems shall be repaired immediately.
- F. Contractor shall employ protective measures described in Section 01 57 19 - General Source Controls to avoid damage to existing trees to be retained on the project site. Conduct all construction operations under this Contract in conformance with the erosion control practices described in that Section.

3.2 CONSTRUCTION METHODS

- A. Provide filter fabric fence systems at locations shown on the Drawings in accordance with the Detail at the end of this Section or on the Drawings, entitled "Filter Fabric Fence". Filter fabric fence systems shall be installed in such a manner that surface runoff will percolate through the system in sheet flow fashion and allow sediment to be retained and accumulated.
- B. Attach the filter fabric to 1-inch by 2-inch wooden stakes spaced a maximum of 3 feet apart and embedded in the ground a minimum of 1 foot. If factory preassembled fence with support netting is used, spacing of the post may be increased to 8 feet maximum. The wooden stakes shall be installed at a slight angle toward the source of anticipated runoff.
- C. Trench in the toe of the filter fabric fence with a spade or mechanical trencher so that the downward face of the trench is flat and perpendicular to the direction of flow or for V-trench configuration as shown on the Detail. Lay filter fabric along the edges of the trench. Backfill and compact trench.
- D. Filter fabric shall have a minimum height of 18 inches and a maximum height of 36 inches above the natural ground.
- E. The filter fabric should be provided in continuous rolls and cut to the length of the Silt Fence to minimize the use of joints. When joints are necessary, the fabric should be spliced together only at a support post with a minimum 6-inch overlap and sealed securely.
- F. Inspect sediment filter fabric fence systems after each rainfall, daily during periods of prolonged rainfall, and at a minimum once a week. Repair or replace damaged section immediately to restore the requirements of this Section. Remove sediment deposits when silt reaches one-third of the height of the fence in depth or 6 inches, whichever is less.

3.3 MEASUREMENT AND PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price, or in the unit price for Storm Water Pollution Prevention Plan.

END SECTION 01 57 13.13

SECTION 01 57 13.14 - REINFORCED FILTER FABRIC BARRIER

PART 1 - GENERAL

1.1 SCOPE

- A. This Section describes the installation of erosion and sedimentation control of reinforced filter fabric barriers (RFB) which must be utilized during construction. Reinforced filter fabric barrier is to be utilized to retain pollutants from passing downstream in channelized flow areas.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General Conditions, Special Conditions, and Division 1 Specification Sections, apply to this Section.

1.3 REFERENCE STANDARDS

- A. The publications listed below forms a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM).
- C. ASTM D-3786 - Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method.
- D. ASTM D-4632 - Standard Test Method for Breaking Load and Elongation of Geotextile (Grab Method).

1.4 SUBMITTALS

- A. Manufacturer's catalogue sheets and other pertinent information on geotextile fabrics.

PART 2 - PRODUCTS

2.1 FILTER FABRIC

- A. Provide woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material. Geotextile fabric shall have a minimum grab strength of 100 psi in any principal direction (ASTM D-4632), Mullen burst strength exceeding 200 psi (ASTM D-3786), and the equivalent opening size between 50 and 140, with the appropriate opening size to be selected based on the grain size characteristics of upstream disturbed soils. Filter fabric material shall contain ultraviolet inhibitors and stabilizers to provide a minimum of six (6) months of expected usable construction life at a temperature range of 0 degrees F to 120 degrees F. Representative Manufacturers: Mirafi, Inc. or preapproved equivalent.
- B. Provide woven galvanized steel wire fence with minimum thickness of 14 gauge and a maximum mesh spacing of 6 inches.

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide erosion and sedimentation control systems at the locations shown on the Drawings. Such systems shall be of the type indicated and shall be constructed in accordance with the requirements shown on the Drawings and specified in this Section. No clearing and grubbing or rough cutting shall be permitted until erosion and sedimentation control systems are in place.

- B. Regularly inspect and repair or replace components of all erosion and sedimentation control systems as specified for each type of system. Unless otherwise directed, maintain the erosion and sedimentation control systems until the project area stabilization is accepted by the Owner. Remove erosion and sedimentation control systems promptly when directed by the Owner. Discard removed materials as required by these Specifications.
- C. Remove and dispose sediment deposits at the project designated spoil site. Sediment shall not be allowed to flush into stream or drainage way. If sediment has been contaminated, it shall be disposed of in accordance with existing federal, state and local regulations.
- D. Equipment and vehicles shall be prohibited by the Contractor from maneuvering on areas outside of construction limits. Damages caused by construction traffic to erosion and sedimentation control systems shall be repaired immediately. Contractor shall employ protective measures described in Section 01560 - General Source Controls to avoid damage to existing trees to be retained on the project site. Conduct all construction operations under this Contract in conformance with the erosion control practices described in that Section.

3.2 CONSTRUCTION METHODS

- A. Provide reinforced filter fabric barrier systems at locations specified on the Drawings in accordance with the Detail, found at the end of this Section or on the Drawings, entitled "Reinforced Filter Fabric Barrier". Filter fabric barrier systems shall be installed in such a manner that surface runoff will percolate through the system in sheet flow fashion and allow sediment to be retained and accumulated.
- B. Attach the woven wire support to steel fence posts (min. of 1.25 lbs. per linear foot & Brinell Hardness greater the 140) or 1-inch by 2-inch wooden stakes spaced a maximum of 6 feet apart and embedded a minimum of 8 inches. Steel post shall be made of hot rolled steel, at least 4 feet long with Tee or Y-bar sections with the surface painted or galvanized. Provide safety caps on top of metal posts. The posts shall be installed at a slight angle toward the source of the anticipated runoff.
- C. Trench in the toe of the reinforced filter fabric barrier with a spade or mechanical trencher so that the downward face of the trench is flat and perpendicular to the direction of flow as shown on the Detail. Lay filter fabric along the edges of the trench. Backfill and compact trench.
- D. Reinforced filter fabric shall have a minimum height of 18 inches and a maximum height of 36 inches above the natural ground.
- E. The filter fabric should be provided in continuous rolls and cut to the length of the fence to minimize the use of joints. When joints are necessary, the fabric should be spliced together only at a support post with a minimum 6-inch overlap and sealed securely.
- F. Inspect sediment filter barrier systems after each rainfall, daily during periods of prolonged rainfall, and at a minimum once a week. Repair or replace damaged section immediately to restore the requirements of this Section. Remove sediment deposits when silt reaches one-third of the height of the barrier in depth or 6 inches, whichever is less.

3.3 MEASUREMENT AND PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price, or in the unit price for Storm Water Pollution Prevention Plan.

END OF SECTION 01 57 13.14

SECTION 01 57 13.15 - STABILIZED CONSTRUCTION EXIT

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

- A. This Section describes the installation of erosion and sedimentation control for stabilized construction exits utilized during construction and prior to the final development of the site.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General Conditions, Special Conditions, and Division 1 Specification Sections, apply to this Section.

1.3 REFERENCE STANDARDS

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM).
- C. ASTM D 4632 - Standard Test Method for Breaking Load and Elongation of Geotextile (Grab Method).

1.4 SUBMITTALS

- A. Manufacturer's catalog sheets and other pertinent information on geotextile fabric.
- B. Sieve analysis of aggregates conforming to requirements of this Section.

PART 2 - PRODUCTS

2.1 SEPARATION GEOTEXTILE

- A. Provide woven or nonwoven geotextile fabric made of either polypropylene, polyethylene, ethylene, or polyamide material. Geotextile fabric shall have a minimum grab strength of 270 psi in any principal direction (ASTM D-4632) and the equivalent opening size between 50 and 140, with the appropriate opening size to be approved in the review process based on the characteristics of the disturbed material. Both the geotextile and threads shall be resistant to chemical attack, mildew and rot and shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0 degrees F to 120 degrees F. Representative Manufacturers: TenCrate Mirafi or preapproved equivalent.

2.2 COARSE AGGREGATES

- A. Coarse aggregates shall consist of crushed stone, gravel, crushed blast furnace slag, or combinations thereof. Aggregate shall be composed of clean, hard, durable materials free from adherent coatings, salt, alkali, dirt, clay, loam, shale, soft or flaky materials, or organic and injurious matter.

- B. Coarse aggregates shall conform to the following gradation requirements.

<u>Sieve Size</u> <u>(Square Mesh)</u>	<u>Percent Retained</u> <u>(By Weight)</u>
2-1/2"	0
2"	0 - 20
1-1/2"	15 - 50
3/4"	60 - 80
No. 4	95 - 100

PART 3 - EXECUTION

3.1 GENERAL

- A. To keep the street clean of mud generated by construction vehicles and equipment, Contractor shall provide stabilized construction exits at the construction site, staging, parking, storage, and/or disposal areas. Such erosion and sediment control system shall be constructed in accordance with the Detail - Stabilized Construction Exit attached hereto or shown on the Drawings, and any additional requirements shown on the Drawings and set out in this Section.
- B. No clearing and grubbing or rough cutting, other than as specifically directed by the Owner to allow soil testing and surveying, shall be permitted until erosion and sedimentation control systems are in place.
- C. Maintain existing erosion and sedimentation control systems located within the project site until acceptance of the project or until directed by the Owner to remove and discard the existing system.
- D. Regularly inspect and repair or replace components of stabilized construction exists. Unless otherwise directed, maintain the erosion and sedimentation control systems until the project is accepted by the Owner. Remove erosion and sedimentation control systems promptly when directed by the Owner. Discard removed materials offsite.
- E. Remove and dispose sediment deposits at the project designated spoil site. If a project spoil site is not designated on the Drawings, dispose of sediment offsite at location not in or adjacent to stream or floodplain. Off-site disposal will be the responsibility of the Contractor. Sediment to be placed at the project site should be spread evenly throughout the site, compacted and stabilized. Sediment shall not be allowed to flush into stream or drainage way. If sediment has been contaminated, it shall be disposed of in accordance with existing federal, state and local rules and regulations.
- F. Equipment and vehicles of the Contractor, or on-site for his use, shall be prohibited from maneuvering on areas outside of the construction limits. Damages caused by construction traffic to erosion and sedimentation control systems shall be repaired immediately.
- G. Conduct all construction operations under this Contract in conformance with the erosion control practices described in the Section 01 57 13 - General Source Controls.

3.2 CONSTRUCTION METHODS

- A. Provide stabilized exits, entrances, access roads, parking areas, and other on-site vehicle transportation routes where shown on the Drawings.

- B. Vehicles leaving construction areas shall have their tires cleaned to remove sediment prior to entrance onto area roadways. When washing is needed to remove sediment, Contractor shall construct a truck washing area. Truck washing shall be done on stabilized areas, which drain into a drainage system protected by erosion and sediment control measures.
- C. Details for stabilized construction exit are shown on the Detail herein or as shown on the Drawings. Construction of other stabilized areas shall be to the same requirements. Roadway width shall be at least 30 feet and shall be sufficient for all ingress and egress to the site. Furnish and place geotextile fabric as a permeable separator to prevent mixing of coarse aggregate with underlying soil. Exposure of geotextile fabric to the elements between laydown and cover shall be a maximum of fourteen days to minimize damage potential.
- D. Roads and parking areas shall be graded to provide sufficient drainage away from stabilized areas. Use sandbags, gravel, boards, or similar methods to prevent sediment from entering area roadways, receiving stream or storm water conveyance system.
- E. The stabilized areas shall be inspected and maintained daily. Provide periodic top dressing with additional coarse aggregates to maintain the required depth. Repair and clean out damaged measures used to trap sediment. All sediment spilled, dropped, washed, or tracked onto area roadways shall be remove immediately.
- F. The length of the stabilized area shall be as shown on the Detail or as shown on the Drawings, but not less than 50 feet in length. The thickness shall not be less than 8 inches. The width shall not be less than full width of all points of ingress or egress.
- G. Stabilization for other areas shall have the same thickness, and width requirements as the stabilized construction exit, except where specified otherwise on the Drawings. The aggregate shall be a compacted limestone base material, 8 inches in thickness, with an application of emulsified asphalt. The emulsified asphalt material shall be reapplied periodically following any regrading of the limestone surface.
- H. Stabilized area may be widened or lengthened to accommodate truck-washing area as required by the Contractor and approved by the Owner.
- I. Alternative methods of construction, when preapproved by the Owner, may include the following.
 - 1. Cement Stabilized Soil - Compacted cement stabilized soil or other fill material in an application thickness of at least 8 inches.
 - 2. Wood Mats/Mud Mats - Oak or other hardwood timbers placed edge to edge and across support wooden beams which are placed on top of existing soil in an application thickness of at least 6 inches.
 - 3. Steel Mats - Perforated mats placed across perpendicular support members.

3.3 MEASUREMENT AND PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this Section. Include all costs in the lump sum price, or in the unit price for Storm Water Pollution Prevention Plan.

END OF SECTION 01 57 13.15

SECTION 01 57 26 - TEXAS POLLUTION DISCHARGE ELIMINATION SYSTEM (TPDES)

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

- A. This project is subject to the Texas Commission on Environmental Quality (TCEQ) Texas Pollution Discharge Elimination System (TPDES) Construction Storm Water Discharge Regulations and Requirements. The Contractor will be required to execute a Notice of Intent (NOI) and implement the Pollution Prevention Plan included in the Contract Documents and comply with all reporting and inspection requirements set forth in the TPDES regulations.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General Conditions, Supplementary Conditions, and relevant Division 2 Specification Sections, apply to this Section.

1.3 SUMMARY

- A. The Contractor shall be responsible for the preparation, implementation, maintenance, and inspection of storm water pollution prevention control measures including, but not limited to, erosion and sediment controls, storm water management plans, waste collection and disposal, off-site vehicle tracking and other practices described in the Storm Water Pollution Prevention Plan (SWPPP) Drawing, and as specified elsewhere in this or other Technical Specifications.
- B. Contractor shall present his plan for implementation of the SWPPP in a meeting with the Owner/Architect/Engineer prior to start of construction.

1.4 MEASUREMENT AND PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 - PRODUCTS

2.1 COMPONENTS

- A. The components shall consist of the control measures necessary to comply with the NPDES and The Clean Water Act. Example erosion and sediment control measure components are found on the Storm Water Pollution Prevention Plan Drawing, and this or other Technical Specifications.

PART 3 - EXECUTION

3.1 NOTICE OF INTENT / CERTIFICATION REQUIREMENTS

- A. The Contractor shall execute, along with the Contract Documents, a Contractor/Subcontractor Certification, which shall identify the responsibilities for construction activity during the contract. Each Subcontractor's responsibility with regard to the SWPPP shall be identified.
- B. The Contractor shall be responsible for signing the certification statement of the NOI.
- C. A copy of the NOI shall be posted in a prominent place for public viewing at the project site. The

Contractor shall be responsible for execution of all documents and providing all inspections and certifications outlined in the SWPPP as necessary for compliance with federal, state and local guidelines.

- D. The executed Notice of Intent shall be sent to:

BY REGULAR U.S. MAIL

Texas Commission on Environmental Quality
Storm Water & General Permits Team; MC-228
P.O. Box 13087
Austin, Texas 78711-3087

3.2 RETENTION OF RECORDS

- A. The Contractor shall retain a copy of the SWPPP from the date that it became effective to the date of project completion.
- B. Contractor shall retain copies of all inspection and maintenance reports, as well as copies of all modifications and adjustments to the SWPPP until the date of project completion.
- C. Contractor shall return to the Owner, all records stated above at the completion of the project. Owner will retain all SWPPP records and data for a period of three (3) years from the date project completion.

3.3 REQUIREMENTS

- A. The following notices are to be posted from the date that the SWPPP goes into effect until the date of final stabilization:
1. Copies of the Notice of Intent, submitted by the Owner and General Contractor, along with the Project Description Form of the SWPPP, are to be posted at the construction site or at the Contractor's office in a prominent place for public viewing.
 2. Notice to drivers of equipment/vehicles to stop, check, and clean tires for debris and mud before equipment/vehicles can enter traffic lanes are to be posted at every stabilized construction exit area.
 3. Notice of waste disposal procedures are to be posted at a location onsite.
 4. Notice of hazardous material handling and emergency procedures are to be posted with the NOI on site. Copies of Material Safety Data sheets are to be kept at a location onsite that is clearly made known to all personnel.
 5. A copy of the signed Certification forms included in this Section shall be kept at the construction site or at the Contractor's office.
- B. Construction may not begin until 60 days after the NOI is filed.
- C. Construction sites that will disturb 10 acres or more shall meet current numeric discharge limit requirements.
- D. If earth disturbance will be stopped for 14 days or more, the contractor must immediately stabilize the area using straw or hydraulic mulch, soil binders, erosion control blankets, or hydroseeding.

3.4 NOTICE OF TERMINATION

- A. A Notice of Termination (NOT) of Coverage under the TPDES General Permit for Storm Water Discharges Associated with Industrial Activity and storm water run-off from the construction activities does not cause sediment transport or erosion from the site. The A/E and inspector will make final determination of the final stabilization. Final stabilization is when all soil-disturbing

activities at the site have been completed and when a uniform perennial vegetative cover with a density of 85% of the cover for unpaved areas has been established. The Contractor will be required to maintain structural controls until this vegetative cover meets the above requirement.

3.5 ATTACHMENTS

For the current forms, visit the TCEQ's website at:

<https://www.tceq.texas.gov/assistance/water/stormwater/sw-construction.html#tpdes>.

END OF SECTION 01 57 13.15

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Administrative and procedural requirements for selection of products, including but not limited to:
 1. Product delivery, storage, and handling.
 2. Manufacturers' written warranties on products.
 3. Special warranties.
 4. Comparable products.

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term *product* includes the terms *material*, *equipment*, *system*, *assembly*, and terms of similar intent.
 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature current as of date of the Contract Documents.
 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis of Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words *basis of design product*, including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 1. Include data to indicate compliance with the specified requirements.
 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Section 01 33 00.

- b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

- B. Basis of Design Product Specification Submittal: Comply with requirements in Section 01 33 00. Show compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 1. Schedule delivery to minimize long term storage at site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:
 1. Store products to allow for inspection and measurement of quantity or counting of units.
 2. Store materials in a manner that will not endanger Project structure.
 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 6. Protect stored products from damage and liquids from freezing.
 7. Provide a secure location and enclosure at site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

- B. Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 - 1. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 - 2. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 01 77 00.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and items needed for complete installation and indicated use and effect.
 - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 - 4. Where products are accompanied by the term "as selected", Architect will make selection.
 - 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
- B. Product Selection Procedures:
 - 1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - 2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - 3. Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - 4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - 5. Basis of Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and characteristics based on the product named. Comply with requirements for consideration of an unnamed product by one of the named manufacturers.
- C. Visual Matching Specification: Where Specifications require "*match Architect's sample*", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 - 1. If no product available within specified category matches and complies with specified requirements, comply with requirements of Section 01 25 00 for proposal of product.

- D. Visual Selection Specification: Where Specifications include the phrase “*selected by Architect*” or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer’s product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.

PART 3 - EXECUTION

NOT USED

END OF SECTION 01 60 00

SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 1. Construction layout.
 2. Field engineering and surveying.
 3. Installation of the Work.
 4. Coordination of Owner-installed products.
 5. Progress cleaning.
 6. Starting and adjusting.
 7. Protection of installed construction.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair Work required to restore construction to original conditions after installation of other Work.

1.4 SUBMITTALS

- A. Certificates: Submit certificate signed by **land surveyor or professional engineer** certifying that location and elevation of improvements comply with requirements.
- B. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- C. Certified Surveys: Submit two copies signed by land surveyor.
- D. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.5 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor legally qualified to practice in the State of Texas, who is experienced in providing land surveying services of the kind indicated.
- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with requirements specified in other Sections.

- B. In Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not warranted. Before beginning site Work, investigate and verify existence and location of underground utilities, mechanical and electrical systems, and construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water service piping; underground electrical services, and other utilities.
 - 2. Furnish location data for Work related to the Work that must be performed by public utilities serving the site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - 1. Description of the Work.
 - 2. List of detrimental conditions, including substrates.
 - 3. List of unacceptable installation tolerances.
 - 4. Recommended corrections.
- D. Proceed with installation after correcting unsatisfactory conditions. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 01 31 00.

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. Engage a land surveyor or professional engineer to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as necessary to locate each element of Project.
 - 2. Establish limits on use of site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical Work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control Work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other Work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Engage a land surveyor or professional engineer to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor or professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
 2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical Work plumb and make horizontal Work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions ensuring the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 2. Allow for building movement, including thermal expansion and contraction.

3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous. Materials containing asbestos and BCPs are prohibited.

3.6 OWNER INSTALLED PRODUCTS

- A. Site Access: Provide access to site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with Work performed by Owner's construction personnel.
 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's Work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.7 PROGRESS CLEANING

- A. Clean site and Work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 degrees F (27 degrees C).
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain site free of waste materials and debris.
- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
 1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed Work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 50 00.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with mechanical, plumbing, and electrical requirements.
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 01 40 00.

3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 01 73 00

SECTION 01 73 29 – CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Procedural requirements for cutting and patching.

1.3 DEFINITIONS

- A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair Work required to restore surfaces to original conditions after installation of other Work.

1.4 SUBMITTALS

- A. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
 - 1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
 - 2. Changes to In Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
 - 3. Products: List products used for patching and firms or entities that will perform patching Work.
 - 4. Dates: Indicate when cutting and patching will be performed.
 - 5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
 - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

1.5 QUALITY ASSURANCE

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
- B. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
- C. Operational Elements: Do not cut and patch operating elements and related components that results in reducing the capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 - 1. Primary operational systems and equipment.
 - 2. Fire separation assemblies.
 - 3. Air or smoke barriers.
 - 4. Fire suppression systems.
 - 5. Mechanical systems piping and ducts.

6. Control systems.
 7. Communication systems.
 8. Fire-detection and -alarm systems.
 9. Conveying systems.
 10. Electrical wiring systems.
 11. Operating systems of special construction.
- D. Miscellaneous Elements: Do not cut and patch the following elements or related components that change the load bearing capacity, resulting in a reduction of capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
1. Water, moisture, or vapor barriers.
 2. Membranes and flashings.
 3. Exterior curtain wall construction.
 4. Equipment supports.
 5. Piping, ductwork, vessels, and equipment.
 6. Noise and vibration control elements and systems.
 7. Sprayed fire resistive material.
- E. Visual Requirements: Do not cut and patch construction resulting in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
1. If possible, retain original Installer or fabricator to cut and patch exposed Work. If possible, engage original Installer or fabricator. If original installer is not available, engage recognized, experienced, and specialized firm for the Work.
 - a. Processed concrete finishes.
 - b. Ornamental metal.
 - c. Matched veneer woodwork.
 - d. Preformed metal panels.
 - e. Roofing.
 - f. Firestopping.
 - g. Window system.
 - h. Fluid applied flooring.
 - i. Wall covering.
 - j. HVAC enclosures, cabinets, or covers.
- F. Cutting and Patching Conference: Before proceeding, meet at site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.6 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with specified requirements.
- B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 1. **Compatibility:** Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. **Temporary Support:** Provide temporary support of Work to be cut.
- B. **Protection:** Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. **Adjoining Areas:** Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. **Existing Services:** Where removal, relocation, or abandonment is necessary, bypass existing services before cutting to avoid interruption of services to occupied areas.

3.3 CUTTING AND PATCHING

- A. Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at earliest feasible time, and complete without delay.
 - 1. Cut existing construction to provide for installation of components or performance of construction, and subsequently patch as necessary to restore surfaces to an original condition.
 - 2. Cut in place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. **Temporary Support:** Provide temporary support of Work to be cut.
- C. **Protection:** Protect in place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- D. **Adjacent Occupied Areas:** Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 01 10 00.
- E. **Cutting:** Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. Use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. **Finished Surfaces:** Cut or drill from exposed or finished side into concealed surfaces.
 - 3. **Concrete and Masonry:** Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.

4. Excavating and Backfilling: Comply with requirements in applicable earthwork specifications by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- F. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction to eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Floors and Walls: Where walls or partitions are removed, extend one finished area into another, patch and repair surfaces in new space. Provide even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary to achieve uniform color and appearance.
 4. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 5. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
 6. Exterior Building Enclosure: Patch components and restore enclosure to a weathertight condition.

END OF SECTION 01 73 29

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 PRE-CLOSEOUT MEETING

- A. Pre-Closeout Meeting: Schedule and convene Pre-Closeout Meeting with Owner and Architect in accordance with Section 01 31 00, Project Coordination and Management.

1.3 SUBSTANTIAL COMPLETION

- A. The items listed in the Supplementary Conditions, Paragraph 9.8 and the following items shall be completed before Substantial Completion will be issued:
 - 1. All fire alarm system components must be completed and demonstrated to the Owner.
 - 2. Local fire marshal approval certificate, or similar Certificate of Occupancy from the governing agency, must be delivered to the Owner.
 - 3. All exterior clean-up and landscaping must be complete.
 - 4. All final interior clean-up must be complete.
 - 5. All HVAC air and water balancing must be complete.
 - 6. All required commissioning must be complete.
 - 7. All Building Automation Systems (BAS) must be complete and fully operational and demonstrated to the Owner.
 - 8. All communications equipment, telephone system, and P.A. systems must be complete and demonstrated to the Owner.
 - 9. All final lockset cores must be installed and all final Owner directed keying completed.
 - 10. All room plaques and exterior signage must be completed.
 - 11. All Owner demonstrations & training must be completed including kitchen equipment, HVAC equipment, plumbing equipment, and electrical equipment.
 - 12. Architect, Project Manager and Contractor shall all agree upon duration and date for completion of all outstanding items. The Principal will be asked to review the punch list and suggest items to be included, without increasing the Project's current contracted scope of work.
- B. Date of Substantial Completion: Complete or correct items identified on Punch List and confirm that all items have been corrected prior to Architects re-inspection. Architect/Engineer, along with the Owner, will re-inspect the corrected work to establish the Date of Substantial Completion. Incomplete items remaining will be appended to the Certificate of Substantial Completion (AIA G704). The Date of Substantial Completion represents day one (1) of the closeout period, and represents the date of commencement of the Contractors correctional period and all warranty periods as described and required by the Contract Documents, except as amended in the Certificate of Substantial Completion and elsewhere in the Contract Documents.
- C. Certificate of Substantial Completion: When the Work or designated portion thereof is substantially complete, Architect will prepare the Certificate of Substantial Completion to be executed by the Owner and Contractor. Items on the appended Punch List shall be completed or corrected within the time limits established in the Certificate.

1.4 PUNCH LIST

- A. A comprehensive list prepared by the Contractor prior to Substantial Completion, and attached thereto, to establish all items to be corrected, or limited items of Work to be completed, if any. This list is intended to represent a limited number of items needing attention.
- B. Punch lists shall be furnished to the Architect in Microsoft Excel and PDF formats. The punch list shall be in matrix form and shall include the following information for each punch list item:
 - 1. Room number or other suitable location identifier
 - 2. Description of the work
 - 3. Sub-contractor/trade sign-off that the work has been verified to be 100% complete and in accordance with the Contract Documents
 - 4. Sub-contractor/trade sign-off date
 - 5. General contractor sign-off that the work has been verified to be 100% complete and in accordance with the Contract Documents
 - 6. General contractor/trade sign-off date
 - 7. A/E consultant sign-off
 - 8. A/E consultant sign-off date
 - 9. If requested by the Owner, provide two additional similar columns for their sign-off.
 - 10. In the case of excessive repetition of the same item at various locations, the punch list may contain "general notes/items" that shall be applied to the entire project; and it shall be the responsibility of the contractor/sub-contractor to thoroughly examine the entire project and make corrective measures at all applicable locations.
- C. Should the Architect determine that the Contractor's punch list lacks sufficient detail or requires extensive supplementation, the punch list will be returned to the Contractor for re-inspection and revision. The date of Substantial Completion will be delayed until the punch list submitted is a reasonable representation of the work to be done.
- D. A significantly large number of items to be completed or corrected will preclude the Architect from issuing a Certificate of Substantial Completion. The Owner and Architect will be the sole judge of what constitutes a significantly large number of items.
- E. The Contractor's superintendent shall participate in the preparation of the Contractor's punch list that is submitted to the Architect and Owner for supplementation. Upon receipt, the Architect and Consultants shall perform a spot review to determine the adequacy and completeness of the Contractor's punch list.
- F. Upon receipt of an acceptable Contractor's punch list, the Contractor's Superintendent shall accompany the Architect, his Consultants and the Owner (at his discretion) during their observation and the preparation of their supplements to the Contractor's punch list.
 - 1. The Superintendent shall record or otherwise take note of all supplementary items.
 - 2. The Architect will endeavor to furnish to the Contractor typed, hand written or recorded supplements to the punch list in a prompt manner; however, any delay in the Contractor's receiving said supplements from the Architect will not be cause for a claim for additional cost or extension of time as the Contractor's Superintendent shall have been in attendance during the inspections of the Architect and his Consultants and will have been expected to take his own notes.

1.5 OPERATIONS AND MAINTENANCE MANUAL

- A. As a requirement for Substantial Completion, the final Operation and Maintenance Manual shall be submitted to, and reviewed and accepted by the Architect prior to issuance of the Certificate.

- B. Prepare 3-ring D-slant binder cover and spline with printed title "OPERATIONS AND MAINTENANCE MANUAL", title of project, and subject matter of binder when multiple binders are required.
- C. Submit one (1) copy of preliminary Operations and Maintenance Manuals to respective consultants (Civil, MEP, Structural, *etc.*) for review of conformance with contract requirements prior to submitting final to Architect. Allow time for proper review.
- D. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- E. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- F. Contents: Prepare Table of Contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
 - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers.
 - 2. Part 2: Operation and Maintenance, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Equipment start-up instructions
 - e. Operating instructions.
 - f. Maintenance instructions for equipment and systems.
 - g. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 - 3. Part 3: Project documents and certificates, including the following:
 - a. Product data.
 - b. Air and water balance reports.
 - c. Photocopies of warranties, certificates and bonds. Submit originals with Closeout Documents as specified below.
- G. Submit one (1) final original and two (2) copies to Architect. The final original will be delivered to the Owner.
- H. Contractor shall provide a DVD, in PDF Format, the following documents after approval by the Architect, Consultants and Owner: closeout manual, MSDS binder, O&M Manuals, specifications and approved submittals. Documents shall be hyper-linked to the Table of Contents.

1.6 PROJECT CLOSEOUT PROCEDURES

- A. Final Payment will not be authorized by the Architect until the Architect finds the Work acceptable under the Contract Documents, subject to the completion and acceptance of the following requirements and other applicable Contract requirements:
 - 1. Close-out Documents: Provide bound closeout documents as described in paragraph 1.5. Refer to the Supplementary Conditions, Paragraph 9.10 for additional information.
 - 2. Record Documents: Submit as described in paragraph 1.10.
 - 3. Extra materials: Provide extra stock, materials, and products as described in paragraph 1.11 when required by individual specification sections.
 - 4. Locks: Make final changeover of permanent locks and transmit keys to the Owner. Advise the Owner's personnel of changeover in security provisions.

5. Temporary Facilities: Discontinue and remove temporary facilities from the site, along with mockups, construction aids, and similar elements.
6. Warranties, Certificates and Bonds: Execute and assemble transferable warranty documents, certificates, and bonds from subcontractors, suppliers, and manufacturers as described in paragraph 1.12.
7. Final Inspection and Acceptance by Architect is achieved as described in paragraph 1.13.

1.7 CLOSEOUT DOCUMENTS

- A. Coordinate the following items with the requirements of Supplementary Conditions of the Contract.
- B. Prepare 3-ring D-slant binder cover and spine with printed title "CLOSEOUT DOCUMENTS", title of project, and subject matter of binder when multiple binders are required. Submit one (1) original and two (2) copies.
- C. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- D. The close-out documents shall be neatly organized and easily useable as determined by the Architect and Owner. Separate Close-out Documents binders from Operations and Maintenance Manuals. Documents identified as "affidavit" shall be notarized.
- E. Contents: Prepare Table of Contents for each volume, with each item description identified, typed on white paper, in five (5) parts as follows:
 1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers. All General Contractor's vendors/suppliers and subcontractors that provided materials or performed any work related to this project must be listed on this form. Submit Final List of Subcontractors on Document AD.
 2. Part 2: Closeout Documents and Affidavits, include the following:
 - a. AIA G707 - Consent of Surety to Final Payment;
 - b. AIA G706 - Contractor's Affidavit of Payment of Debts and Claims;
 - c. AIA G706A - Contractor's Affidavit of Release of Liens;
 3. Part 3: Project documents and certificates, including the following:
 - a. Copy of Certificate of Substantial Completion (AIA G704);
 - b. Copy of All Permits;
 - c. Copy of Final Utility Bill or letter of transfer;
 - d. Copy of Certificate of Occupancy;
 - e. Copy of Certification of Project Compliance: Submit on attached **Close-out Form "B"**. Owner and Architect will initiate form and forward to Contractor for signature once Substantial Completion is established. (Owner to be provided original separately);
 4. Part 4: Warranties, Release of Liens, compile sequentially based on specification sections:
 - a. General Contractor's Warranty: Submit on company letterhead as described below. This Warranty shall state all sections of Work performed by General Contractor's own forces, and warranty period for each section of Work;
 - b. Subcontractor's Release of Lien: Include contractor's, subcontractor's and direct material and equipment supplier's separate final releases. Submit on attached **Close-out Form "A"** – Subcontractor's Affidavit of Release of Lien.
 - c. Hazardous Material Certificate: Submit on attached **Close-out Form "C"**. Affidavits from Contractor, Subcontractors and General Contractor's vendors or

- suppliers stating that no hazardous materials/products have been used or installed in this project.
- d. Subcontractor's Warranty: notarized, and submitted on attached **Close-out Form "D"**. This Warranty shall state all sections of Work performed by the subcontractor and warranty period.
 - e. Special / Extended Warranties; List and provide, notarized warranties requested by Owner, or required by or incorporated in the Contract Documents.
 - f. Spreadsheet depicting all items and materials that carry a warranty longer than one (1) year. Include information consisting of material/ supplier/ installer/ specification section/ length of warranty and contact information.
5. Part 5: Receipts:
- a. Extra Stock: Provide original receipts for delivery of "Extra Stock" items as described below. Receipts must be signed by an authorized Owner's representative;
 - b. Keys: Provide original receipts for delivery of "Keys". Receipts must be signed by an authorized Owner's representative.
 - c. Sign in sheets: provide signatures of attendees from all demonstrations.
- F. Failure to complete and close-out project after substantial completion may result in liquidated damages being assessed to the Contractor. Refer to Conditions of the Contract for additional requirements and liquidated damages.

1.8 FINAL CLEANING

- A. Execute final cleaning prior to final project inspection and acceptance.
- B. Clean interior and exterior glass, and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces, mop hard floor surfaces.
- C. Remove smudges, marks, stains, fingerprints, soil, dirt, spots, dust, lint, and other foreign materials from finished and exposed surfaces
- D. Clean equipment and fixtures to sanitary condition with cleaning materials appropriate to surface and material being cleaned.
- E. Clean and replace filters of operating equipment as required by Contract Documents
- F. Clean debris from roofs, gutters, downspouts, and drainage systems.
- G. Clean site; sweep paved areas, rake clean landscaped surfaces.
- H. Remove waste and surplus materials, rubbish, and temporary construction facilities from site.

1.9 PROTECTING INSTALLED CONSTRUCTION

- A. Protect installed Work and provide special protection where specified in individual specification sections until Work is accepted by Architect and Owner.
- B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

- D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic from landscaped areas.

1.10 STARTING OF SYSTEMS

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Architect/Engineer and Owner 48 hours prior to start-up of each item.
- C. Verify each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.
- E. Verify wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of Contractors' personnel, and installer in accordance with manufacturers' instructions.
- G. When specified in individual specification sections or required by manufacturer, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. When specified in individual specification sections or required by Owner or Architect/Engineer, submit a written report in accordance with Section 01 33 00, Submittal Procedures, that equipment or system has been properly installed and is functioning correctly.

1.11 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of products to Owner's personnel a minimum of 48 hours prior to date of Final Completion in accordance with Owner's requirements.
- B. Demonstrate Project equipment instructed by qualified manufacturer's representative who is knowledgeable about the Project and equipment.
- C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six (6) months.
- D. Utilize maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel to explain all aspects of operation and maintenance.
- E. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment.
- F. Prepare and insert additional data in maintenance manuals when need for additional data becomes apparent during instruction.

- G. Review and verify proper start-up and operation of equipment prior to scheduling demonstrations with Owner.
- H. All demonstrations are to be documented by video and submitted to the Owner in DVD format along with the close out documents. General contractor is responsible for all video and compilation onto DVD with linked menus.

1.12 PROJECT RECORD DOCUMENTS

- A. Project Record Documents, as described in Section 01 78 39, shall be submitted at Project Closeout. Final Payment will not be authorized by the Architect until final review and acceptance by Architect and Engineers is achieved in accordance with the Owners requirements.
- B. Submit reproducible to respective consultants (Civil, Structural, MEP, *etc.*) for review. Consultant will mark-up corrections and return to Contractor for final revisions. Make final revisions prior to submitting to Architect.
 - 1. Format: One (1) set of film positive reproducible and two (2) sets blueprints of approved reproducible.
 - 2. Provide the Owner with one (1) set of Record Drawings on a non-rewritable CD in AutoCAD® latest release or BIM files per Owner's request.
 - 3. Provide the Owner with one (1) set of Record Drawings on a on a non-rewritable CD in PDF format.
 - 4. Label electronic BIM files and PDF files in the same manner as the sheets (example, A2.02 First Floor Area 'A', *etc.*)
 - 5. Format: Submit all Project Record Documents as a bookmarked, indexed, searchable, annotated electronic PDF file.

1.13 EXTRA STOCK, MATERIALS AND MAINTENANCE PRODUCTS

- A. Furnish extra stock, maintenance, and extra products in quantities specified in individual specification sections.
- B. Deliver to Project site or to District Maintenance Department as directed by Owner; obtain signed receipt from Owner's authorized representative prior to final application for payment. Delivery of materials to, or obtaining receipt from anyone other than Owner's authorized representative may constitute breach of this requirement and may require delivery of additional materials at no cost to the Owner if original materials are misplaced.
- C. Include signed receipts for delivery of extra stock and materials, including keys, with Closeout Documents.

1.14 WARRANTIES, CERTIFICATES AND BONDS

- A. Definitions:
 - 1. Standard Product Warranties: preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
 - 2. Special Warranties: written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide coverage of specific defects, or both.
- B. In accordance with the general warranty obligations under Paragraph 3.5 of the General Conditions as amended by the Supplementary Conditions, the General Contractor's warranty shall be for a period of one (1) year following the date of Substantial Completion, hereinafter called the one-year warranty period. The Contractor's one-year general warranty shall include all

labor, material and delivery costs required to correct defective material and installation. This warranty shall not limit the Owner's rights with respect to latent defects, gross mistakes, or fraud.

- C. The Contractor's one-year warranty shall run concurrently with the one (1) year period for correction of Work required under Paragraph 12.2 of the General Conditions.
- D. No service charges or call out charges are allowed to investigate warranty claims.
- E. In addition to the Contractor's one-year warranty, Special Warranties as described in individual specifications sections, shall extend the warranty period for the period specified without limitation in respect to other obligations which the Contractor has under the Contract Documents.
- F. Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve the suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.
- G. Warranty Requirements:
 - 1. When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
 - 2. When Work covered by a warranty has failed and been corrected by replacement or reconstruction, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
 - 3. Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.
 - 4. Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.
 - 5. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or designated portion of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.
- H. Compile copies of each required warranty properly executed by the Contractor and the subcontractor, supplier, or manufacturer. Verify documents are in proper form, contain full information, and are notarized. Co-execute warranties, certificates and bonds when required and include signed warranties with Closeout Documents submitted to the Architect.

1.15 FINAL COMPLETION AND FINAL PAYMENT

Review of Contractors Deficiency List

- B. Review of Punch List items
- C. Review Warranty Log
- D. Submittal of O&M documents
- E. Obtain final Use and Occupancy permits from applicable regulatory agencies.

- F. As-Built documents
- G. Materials attic stock, where noted and required in the Specifications

1.16 TERMINAL INSPECTION

- A. Immediately prior to expiration of the one (1) year period for correction of the Work, the Contractor shall make an inspection of the work in the company of the Architect and the Owner. The Architect and the Owner shall be given not less than ten (10) days notice prior to the anticipated date of terminal inspection.
- B. Where any portion of the work has proven to be defective and requires replacement, repair or adjustment, the Contractor shall immediately provide materials and labor necessary to remedy such defective work and shall execute such work without delay until completed to the satisfaction of the Architect and the Owner, even if the date of completion of the corrective work may extend beyond the expiration date of the correction period.
- C. The Contractor shall not be responsible for correction of work which has been damaged because of neglect or abuse by the Owner nor the replacement of parts necessitated by normal wear in use.

PART 2 - PRODUCTS
Not Used

PART 3 - EXECUTION
Not Used

PART 4 – SCHEDULE

Item	Date of Issue
Schedule of Closeout Conference	180 days before Substantial Completion
Operations & Maintenance Manuals	60 Days before Substantial Completion
Contractor's Punch List	Include with formal request for Substantial Completion.
As-Builts	30 Days after Substantial Completion
Affidavits	30 Days after Substantial Completion
Release of Liens	60 Days after Substantial Completion
Testing and Balance Report	60 Days after Substantial Completion
Warranty Forms	60 Days after Substantial Completion

END OF SECTION 01 77 00

SECTION 01 77 00 CLOSEOUT FORMS

CLOSE-OUT FORM "A"

SUBCONTRACTOR'S AFFIDAVIT OF RELEASE OF LIEN

STATE OF _____

COUNTY OF _____

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, deposes and says:

1. That he / she is the _____ of _____, the subcontractor who supplied, installed, and /or erected the work described below, and that, he /she is duly authorized to make this Affidavit and Subcontractor Release:

Project: Humble High School Additions and Renovations Phase Two
 Owner: Humble Independent School District Architect: PBK
 Work Performed: _____ Specification Section(s): _____

2. That all work required under the subject subcontractor of the subject construction project has been performed in accordance with the terms thereof, that all material men, sub-subcontractors, mechanics, and laborers have been paid and satisfied in full and that there are no outstanding claims of any character arising out of the performance of said subcontractor which have not been paid and satisfied in full.
3. That to the best of his / her knowledge and belief, there are no unsatisfied claims for damages resulting from injury or death to any employees, sub-subcontractors, or the public at large arising out of the performance of said subcontract, or any suits or claims for any other damages of any kind, nature, or description which might constitute a lien upon the property of the Owner.
4. That he / she has received full payment of all sums due him / her for materials furnished and services rendered by the undersigned in connection with the performance of said subcontract and has and does hereby release the Owner and the Architect and his consultants and the Contractor from any and all claims of any character arising out of or in any way connected with performance of said subcontract.

ATTEST (If Corporation)

Name of Subcontractor

Secretary

(By) (Title)

JURAT

STATE OF _____

COUNTY OF _____

Sworn to and subscribed before me on this _____ day of _____, 20_____.

(Seal)

(Notary Public Signature)

CLOSE OUT FORM "B"

**CERTIFICATION
OF PROJECT
COMPLIANCE**

Completion of this form is required under the provisions of §61.1040 19 TAC for all public school district construction projects. Instructions for completion of this form can be found on page 2.

1. PROJECT INFORMATION

Facility:

Address:

City:

DISTRICT:

ARCHITECT/ENGINEER:

CONTRACTOR/CM:

CONTRACT DATE:

DATE DISTRICT AUTHORIZED PROJECT:

BRIEF DESCRIPTION OF PROJECT:

2. CERTIFICATION OF DESIGN AND CONSTRUCTION

The intent of this document is to assure that the school district has provided to the architect/engineer the required information and the architect/engineer has reviewed the School Facilities Standards as required by the State of Texas, and used his/her reasonable professional judgment and care in the architectural/engineering design and that the contractor has constructed the project in a quality manner in general conformance with the design requirements and that the school district certifies to project completion.

3. The District certifies the following:

- 1.) The educational specifications of this facility presented to the school board of trustees were provided to the prime design professional in a timely manner.
- 2.) The long range facility plan was developed presented to the school board and provided in a timely manner to the prime design professional in a timely manner.
- 3.) That a design professional was hired to achieve the goals and expectations of the long range facility plan, and if applicable educational specifications.
- 4.) The safety and security standards were provided as a directive in a timely manner to the architect.

DISTRICT:

BY:

DATE:

4. The Architect/Engineer certifies the above information was received from the school district, and that the building(s) were designed in accordance with the applicable building codes. Further, the project has been designed in reasonable accordance with the long range facility plan and educational specifications based on the School Facilities Standards as adopted by the Commissioner of Education, November 1, 2021, and as provided by the district. This includes the compliance path directives of section (g) or (h) and the safety and security directives in section (k) found in the above standard.

ARCHITECT/ENGINEER:

BY:

DATE:

5. The Contractor/CM the project has been built in reasonable accordance with the long range facility plan and educational specifications based on the School Facilities Standards as adopted by the Commissioner of Education, November 1, 2021, and as provided by the district. This includes the safety and security directives in section (k) found in the above standard. In addition, certifies that the building has been found to not have any violations by the local authority of jurisdiction or third party code inspector.

CONTRACTOR/CM:

BY:

DATE:

6. The District certifies completion of the project (as defined by the architect/engineer and contractor).

DISTRICT:

BY:

DATE:

INSTRUCTIONS FOR COMPLETION OF "CERTIFICATION OF PROJECT COMPLIANCE" FORM

Section 1. Identify the following:

- name and address of the school facility
- name of the school district
- the Architect/Engineer and Contractor
- the date of execution of the construction contract
- the date that the school district authorized the superintendent to hire an architect/engineer
- scope of the project.

Section 2. This section outlines the intent of the document. No action required.

Section 3. This section is to be executed by the school district upon transmittal of the information (as listed) to the architect/engineer and is to remain in the custody of the school district throughout the entire project.

Section 4. This section is to be executed by the architect/engineer upon completion of the plans and specifications and in conjunction with the completion of the plan review for code compliance (ref. 19 TAC §61.1040, School Facilities Standards) and returned to the school district's files.

Section 5. This section is to be executed by the contractor upon substantial completion of the project and retained in the school district's files.

Section 6. This section is to be executed by the school district upon acceptance and occupancy of the project.

NOTE: DO NOT SUBMIT THIS DOCUMENT TO THE TEXAS EDUCATION AGENCY. The school district will retain this document in their files indefinitely until review and/or submittal is required by representatives of the Texas Education Agency.

CLOSE-OUT FORM "C"

SUBCONTRACTOR HAZARDOUS MATERIAL CERTIFICATE

THE STATE OF _____ PROJECT: Humble High School Additions and Renovations
Phase Two
COUNTY OF _____ OWNER: Humble Independent School District
ARCHITECT: PBK
SPECIFICATION SECTION(S):

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, deposes and says that he / she
is the _____ of _____, the subcontractor / supplier
who constructed or provided the section(s) of work referenced above, and that he / she is duly authorized
to certify to the best of his / her information, knowledge, and belief no asbestos, lead or PCB containing
products have been incorporated into the project.

ATTEST (If Corporation)

Name of Subcontractor / Supplier

(Title)

Secretary (By)

JURAT

THE STATE OF _____

COUNTY OF _____

Sworn to and subscribed before me on this _____ day of _____, 20____.

(Seal)

(Notary Public Signature)

CLOSE-OUT FORM "D"

SUBCONTRACTOR WARRANTY

STATE OF _____

COUNTY OF _____

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, deposes and says:

1. That he / she is the Subcontractor (or the _____ of _____ the subcontractor) who supplied, installed, and / or erected the work described below, and that, he / she is duly authorized to make this Subcontractor Warranty:

Project: Humble High School Additions and Renovations Phase Two
 Owner: Humble Independent School District Architect: PBK
 Work Performed: _____ Specification Section(s): _____

2. The undersigned Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract are of good quality and new except where otherwise required or permitted by the Contract Documents, that the Work is free from defects not inherent in the quality required or permitted, and that the Work conforms with the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. The Subcontractor's warranty excludes remedy for damage or defect caused by abuse, modifications not executed by the Subcontractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage.
3. In the event of failure of materials, products, or workmanship, during the specified warranty periods, the Subcontractor shall take appropriate measures to assure correction or replacement of the defective items, whether notified by the Contractor, Owner or Architect.
4. The Subcontractor warrants the work performed for a period of _____ months from the date of Substantial Completion, except as follows: _____

ATTEST (If Corporation)

Name of Subcontractor

_____ Secretary	_____ (By)	_____ (Title)
--------------------	---------------	------------------

JURAT

STATE OF _____

COUNTY OF _____

Sworn to and subscribed before me on this _____ day of _____, 20____.

(Seal)

(Notary Public Signature)

This is the Exterior Punch List All items on this Punch List should be corrected by _____ (date).

EXTERIOR PUNCH LIST FORM

NOTE TO ARCHITECT: Circle Number next to Item to be corrected.

NOTE TO CONTRACTOR CORRECTING WORK: Initial Blank next to Circled Number after work is corrected.

DATE: _____

SITE LOCATION/ROOM NO. _____

BLDG. _____

JOB NAME: _____

DOORS/RAMPS/HARDWARE

- ____ 1. Adjust Closer
- ____ 2. Adjust Strike Plate
- ____ 3. Repair Damaged Plastic Laminate
- ____ 4. Install Silencers
- ____ 5. Repair Dent in Hollow Metal Frame
- ____ 6. Sand Corner Welds
- ____ 7. Door/Frame Not Labeled
- ____ 8. _____
- ____ 9. _____

PAINT

- ____ 1. Repair @ N E S W wall
- ____ 2. Repaint @ N E S W wall
- ____ 3. Touch up Paint @ N E S W wall
- ____ 4. Touch up Door Frame
- ____ 5. Caulk Door Frame
- ____ 6. Clean & Paint Door Jamb Return @ L/R Side
- ____ 7. Clean Glue from Wall Mold
- ____ 8. _____
- ____ 9. _____

WINDOWS

- ____ 1. Window Treatment
- ____ 2. Caulk
- ____ 3. Not Closing Properly, Correct
- ____ 4. Clean VWC Blue Off Window Frame
- ____ 5. _____
- ____ 6. _____

PLASTER CEILINGS

- ____ 1. Repair area on N E S W Ceiling
- ____ 2. Refinish @ _____
- ____ 3. Repair Flashing for Watertight Seal
- ____ 4. Rework Inside Corner
- ____ 5. Rework Outside Corner
- ____ 6. _____

WALL PLASTER

- ____ 1. Repair area on N E S W Wall
- ____ 2. Clean Mud off Door/Window Frame
- ____ 3. Refinish @ _____
- ____ 4. Screw Popping Out @ _____
- ____ 5. Repair Weep Screed _____
- ____ 6. _____

PLUMBING

- ____ 1. Tighten Drain Escutcheon
- ____ 2. Repair/Replace Downspout
- ____ 3. Caulk Flashing for watertight seal
- ____ 4. Install Concrete Splashblock(s)
- ____ 5. Install Finisher Washer on Screws
- ____ 6. Install Caulking for Watertight Seal

BRICK VENEER

- ____ 1. Repair Damaged Thin Brick @ Door/Window
- ____ 2. Repair Damaged Thin Brick N E S W Wall
- ____ 3. Repair grout joint N E S W Wall
- ____ 4. Repair Weep Screed _____
- ____ 5. _____

ELECTRICAL

- ____ 1. Clean Light Lens
- ____ 2. Level Cover Plate @ N E S W Wall
- ____ 3. Reinstall Light Fixture @ _____
- ____ 2. _____
- ____ 3. _____

MISCELLANEOUS NOTES

END OF SECTION 01 77 13

This is the Interior Punch List All items on this Punch List should be corrected by _____ (date).

INTERIOR PUNCH LIST FORM

NOTE TO ARCHITECT: Circle Number next to Item to be corrected.

NOTE TO PERSON CORRECTING WORK: Initial Blank next to Circled Number after work is corrected.

DATE: _____

ROOM NO. _____

BLDG. _____

JOB NAME: _____

DOORS/RAMPS/HARDWARE

- _____ 1. Adjust Closer
- _____ 2. Adjust Strike Plate
- _____ 3. Repair Damaged Plastic Laminate
- _____ 4. Install Silencers
- _____ 5. Repair Dent in Hollow Metal Frame
- _____ 6. Sand Corner Welds
- _____ 7. Door/Frame Not Labeled
- _____ 8. _____
- _____ 9. _____

PAINT & VINYL WALL COVERING

- _____ 1. Repair VWC @ N E S W wall
- _____ 2. Repair VWC @ N E S W wall
- _____ 3. Touch up Paint @ N E S W wall
- _____ 4. Touch up Door Frame
- _____ 5. Caulk Door Frame
- _____ 6. Clean & Paint Door Jamb Return @ L/R Side
- _____ 7. Clean Glue from Wall Mold
- _____ 8. _____
- _____ 9. _____

WINDOWS

- _____ 1. Adjusted Blinds
- _____ 2. Caulk
- _____ 3. Not Closing Properly, Correct
- _____ 4. Clean VWC Blue Off Window Frame
- _____ 5. _____

TOILET ACCESSORIES

- _____ 1. Install
- _____ 2. _____
- _____ 3. _____
- _____ 4. _____

DRYWALL

- _____ 1. Repair Nick on N E S W Wall
- _____ 2. Clean D.W. Mud Off Door Frame
- _____ 3. Refinish @ _____
- _____ 4. Screw Popping Out @ _____
- _____ 5. _____
- _____ 6. _____

CASEWORK AND MILLWORK

- _____ 1. Adjust Door @ _____
- _____ 2. Adjust Drawer @ _____
- _____ 3. Caulk _____
- _____ 4. Install Shelves @ Base/Wall Cabinet
- _____ 5. Install Finisher Washer on Screws
- _____ 6. Repair Damaged Laminate @ _____
- _____ 7. Seam Fill & Repair Seam in Countertops
- _____ 8. _____

CERAMIC & QUARRY TILE

- _____ 1. Repair Damaged Tile @ _____
- _____ 2. Caulk Window Sill
- _____ 3. _____
- _____ 4. _____
- _____ 5. _____

MECHANICAL

- _____ 1. _____
- _____ 2. _____
- _____ 3. _____
- _____ 4. _____

ACOUSTICAL CEILINGS

- _____ 1. Repair Damaged Tile @ _____
- _____ 2. Adjust Tile @ Sprinkler Head
- _____ 3. Adjust Tile @ Diffuser
- _____ 4. Install Missing Tile
- _____ 5. Repair Damaged Grid @ _____
- _____ 6. Rework Inside Corner
- _____ 7. Rework Outside Corner
- _____ 8. _____

PLUMBING

- _____ 1. Tighten Drain Escutcheon
- _____ 2. _____
- _____ 3. _____
- _____ 4. _____

ELECTRICAL

- ____ 1. Clean Light Lens
- ____ 2. Level Cover Plate @ N E S W wall
- ____ 3. _____
- ____ 4. _____

CARPET/FLOORING/BASE

- ____ 1. Clean Base Glue off N E S W Wall
- ____ 2. Straighten Base @ _____
- ____ 3. Repair Loose Base @ _____
- ____ 4. _____

MISCELLANEOUS

END OF SECTION 01 77 16

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Administrative and procedural requirements for project record documents, including but not limited to:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings:
 - 1. Number of Copies: Submit one set of marked up record prints.
 - 2. Number of Copies: Submit copies of record Drawings:
 - a. Initial Submittal:
 - 1) Submit PDF electronic files of scanned record prints and one of file prints.
 - 2) Submit record digital data files and one sets of plots.
 - 3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit PDF electronic files of scanned record prints and three sets of prints.
 - 2) Submit record digital data files and three sets of record digital data file plots.
 - 3) Plot each drawing file, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit one paper copy and one annotated PDF electronic file of the Project Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one paper copy and one annotated PDF electronic file and directory of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: Refer to the individual Specification Sections for miscellaneous record keeping requirements and submittals in connection with various construction activities. Submit one paper copy and annotated PDF electronic files and directories of each submittal.
- E. Reports: Submit written report monthly indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.4 PROJECT RECORD DOCUMENT PROCEDURES

- A. Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect's reference.
 - 1. Do not use As Built Drawings and Specifications for Record Drawings and Specifications.

- B. Recording Procedures: Update drawings and specifications on daily bases to record actual conditions. Record information concurrently with construction progress. Do not conceal Work until required information is accurately recorded.
- C. Store Record Documents and samples apart from as built documents used for construction.
 - 1. Label and file Record Documents and samples in accordance with section number listings in Table of Contents. Label each document *PROJECT RECORD* in neat, large, printed letters.
 - 2. Maintain Record Documents in clean, dry and legible condition.
 - 3. Make Record Documents and samples available for inspection upon request of Architect.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked up paper copies of the Contract Drawings and Shop Drawings.
 - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked up record prints. Show actual installation conditions where installation varies from that shown originally.
 - a. Give attention to information on concealed elements difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross reference record prints to corresponding shop drawings or archive photographic documentation.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations below first floor.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 - 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked up record prints.
 - 4. Mark record sets with erasable, red colored pencil. Use colors to distinguish between changes for different categories of the Work at same location.
 - 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 - 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked up record prints with Architect. When authorized, prepare full set of corrected digital data files of the Contract Drawings:
1. Format: Same digital data software program, version, and operating system as the original Contract Drawings and annotated PDF electronic file with comment function enabled.
 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Architect for resolution.
 4. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
 - a. Refer to Section 01 33 00 for requirements related to use of Architect's digital data files.
 - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or modification.
 2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.
- D. Format: Identify and date each record Drawing; include the designation *PROJECT RECORD DRAWING* in a prominent location.
1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: Annotated PDF electronic file with comment function enabled.
 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation PROJECT RECORD DRAWINGS.
 - d. Name of Architect.
 - e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications. Indicate actual product installation where installation varies from that indicated in Specifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.

5. Note related Change Orders, record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as annotated PDF electronic file and marked up paper copy of Specifications.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, record Specifications, and record Drawings where applicable.

B. Format: Submit record Product Data as annotated PDF electronic file. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

2.4 RECORD SAMPLES

A. Record Samples: Determine with Architect and Owner which submitted Samples are to be maintained as Record Samples. Maintain and mark one set to indicate date of review and approval by Architect; note any deviations or variations between reviewed sample and installed product or material.

2.5 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by the individual Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference. Include the following:

1. Reviewed shop drawings, product data, and samples.
2. Field test reports.
3. Inspection certificates and manufacturer's certificates.
4. Inspections by authorities having jurisdiction (AHJ).
5. Documentation of foundation depths.
6. Special measurements or adjustments.
7. Tests and inspections.
8. Surveys.
9. Design mixes.

B. Format: Submit miscellaneous record submittals as scanned PDF electronic file(s) of marked up miscellaneous record submittals. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

2.6 EXTRA STOCK, MATERIALS AND MAINTENANCE PRODUCTS

A. Furnish extra stock, maintenance, and extra products in quantities specified in individual specification sections.

B. Deliver to and store in location(s) as directed by Owner; obtain signed receipt(s) from Owner's authorized representative prior to final application for payment. Delivery of materials to or obtaining receipt from anyone other than Owner's authorized representative may constitute

breach of this requirement and may require delivery of additional materials at no cost to the Owner if original materials are misplaced.

- C. Include signed receipts for delivery of extra stock and materials, including keys, with Closeout Documents.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 01 78 39

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
 - 3. Demonstration and training video recordings.
 - 4. O&M Manuals should be uploaded into Owner's designated software (Prolog)

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules utilizing manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Qualification Data: For instructor.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.

1.4 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name and address of videographer.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Date of video recording.
 - 2. At completion of training, submit complete training manual(s) for Owner's use.

1.5 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

1.6 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
 - 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.

- e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
- a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
- a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
- a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
- a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Division 01 Section "Operations and Maintenance Data."
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Owner will furnish an instructor to describe Owner's operational philosophy.
 - 2. Owner will furnish Contractor with names and positions of participants.
- B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner through Program Manager with at least 10 days' advance notice.
- C. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
- B. Video Recording Format: Provide high-quality color video recordings with menu navigation in format acceptable to Architect.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.

END OF SECTION 01 79 00

SECTION 02 41 00 - DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Demolition and removal of buildings and site elements.
 - 2. Abandoning in-place or removing below-grade construction.
 - 3. Disconnecting, capping or sealing, and abandoning in-place or removing site utilities.
 - 4. Salvaging items for reuse by Owner.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose offsite unless indicated as salvaged or reinstallation.
- B. Remove and Salvage: Detach items from existing construction with care to prevent damage, and deliver to Owner ready for reuse and store.
- C. Remove and Reinstall: Detach items from existing construction with care to prevent damage, clean and refurbish, prepare for reuse, store as necessary, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not scheduled for salvage or reuse, as is; do not remove.
- E. Deconstruct: To remove by disassembling or detaching an item from a surface, using methods and equipment to successfully prevent damage to the item and surfaces; and dispose of items unless indicated as salvaged or for reinstallation.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and the contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner. Salvage to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of construction to be demolished.
 - 2. Review structural load limitations of existing structures.
 - 3. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review and finalize protection requirements.
 - 5. Review procedures for noise control and dust control.
 - 6. Review procedures for protection of adjacent buildings.
 - 7. Review items to be salvaged and returned to Owner.

1.6 SUBMITTALS

- A. Qualification Data: Submit copies of qualifications for refrigerant recovery technician.
- B. Engineering Survey: Submit engineering survey of condition of building.
- C. Proposed Protection Measures: Submit report, including Drawings, indicating proposed measures for protecting individuals and property, for environmental protection, dust control and noise control. Indicate proposed locations, types, and construction of barriers.
- D. Schedule of Selective Demolition Activities:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on site operations are uninterrupted.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Use of elevator and stairs.
 - 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- E. Inventory: Submit a list of items for removal and salvage and deliver to Owner prior to start of demolition.
- F. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces that could be construed as damage caused by demolition operations. Comply with Section 013230. Submit prior to commencement of the work.
- G. Statement of Refrigerant Recovery: Submit statement signed by refrigerant recovery technician responsible for recovering refrigerant, stating that refrigerant present was recovered and recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- H. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.7 QUALITY ASSURANCE

- A. Texas Department of Health and Human Services AHERA compliance rules shall be followed for all demolition projects.
- B. Regulatory Requirements:
 - 1. Demolition Standards: Comply with ASSE A10.6 and NFPA 241.
 - 2. Comply with EPA regulations prior to commencement of the work. Comply with hauling and disposal regulations of authorities having jurisdiction.
 - 3. Comply with applicable federal, state, and local codes for demolition work, dust and noise control, safety of structure, and debris removal.
 - 4. Obtain required permits from authorities having jurisdiction.
- C. Refrigerant Recovery Technician Qualifications: Certified by an EPA approved certification program.

1.8 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted. Provide minimum of 72 hours' notice to Owner of demolition activities that will affect Owner's operations including but not limited to:
 - 1. Interruption of power.

2. Interruption of utility services.
 3. Excessive noise.
- B. Condition of Structure: Conditions existing at time of inspection will be maintained by Owner as far as practical. Owner assumes no responsibility for actual condition of items or structures to be demolished.
1. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- C. Hazardous Materials: It is not anticipated that hazardous materials will be encountered in the Work.
1. Hazardous materials will be removed by Owner before start of the Work.
 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- D. Historic Areas: Demolition and hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, including temporary protection, by at least 12 inches (300 mm).
- E. Storage or sale of removed items or materials on site is not permitted.
- F. Traffic: Conduct operations and debris removal to ensure minimum interference with roads, streets, drives, fire lanes, walks, accessible paths, and adjacent occupied or used facilities.
1. Do not close, block, or obstruct streets, drives, walks, or occupied or used facilities without written permission from authorities having jurisdiction. Provide alternate routes around obstructed traffic ways.
- G. Explosives: Explosives are not permitted at the site.
- H. Flame Cutting: Do not use cutting torches for removal until flammable materials are removed. At concealed spaces, verify conditions prior to flame cutting operations. Maintain portable fire suppression devices during flame cutting operations.
- I. Environmental Controls: Use water sprinkling, temporary enclosures, or other acceptable methods to limit dust and dirt migration. Comply with governing regulations pertaining to environmental protection. Do not use water when it may create hazardous or objectionable conditions.
- J. Utility Services: Maintain existing utilities and protect against damage during demolition operations.
1. Do not interrupt utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, acceptable to Owner and governing authorities.
- K. Protections: Provide temporary barriers to protect Owner's personnel and public from injury from work.
1. Take protective measures to provide free and safe passage to occupied portions of building.
 2. Provide protection to ensure safe passage of the Owner's personnel and the public around demolition areas and to and from occupied portions of adjacent areas, buildings, and structures.
 3. Provide shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities or work to remain.
 4. Protect existing work which becomes exposed during demolition operations.
 - a. Protect existing improvements, appurtenances, and conditions to remain.
 - b. Protect adjacent floors with coverings.

- c. Protect walls, openings, roofs, and adjacent exterior construction to remain and exposed to building demolition operations.
- 5. Construct temporary insulated dustproof partitions to separate areas from noisy or extensive dirt or dust operations are performed. Equip partitions with dustproof doors and security locks. Refer to Drawings for location of partitions to be provided.
- 6. Provide temporary weather protection when exposing exterior conditions to prevent water leakage or damage to structure or interior areas of existing building.
- L. Damages: Promptly repair damages caused to adjacent facilities by demolition work.

1.9 COORDINATION

- A. Arrange selective demolition schedule to avoid interference with Owner's and the school's operations.

1.10 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor prior to proceeding. Existing warranties to be provided by Owner prior to the start of construction.
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying existing system has been inspected and warranty remains in effect. Submit supporting documentation at closeout.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ASSE A10.6 and NFPA 241.

2.2 MATERIALS

- A. Repair Materials: Use repair materials identical to existing materials.
 - 1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - 2. Use materials whose installed performance equals or surpasses that of existing materials.
 - 3. Use 60 mil vapor barrier with taped seams to maintain or repair in place radon mitigation system(s) under slabs on grade that are to be cut during renovation, including radon barriers.
- B. Comply with material and installation requirements specified in individual Specification Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that affected utilities have been disconnected and capped before commencing selective demolition operations.
- B. Review Project Record Documents of existing construction or existing condition and hazardous material information provided by Owner. Owner does not warrant existing conditions are same as those indicated in Project Record Documents.

- C. Perform an engineering survey of condition of building to determine whether removing an element might result in structural deficiency or unplanned collapse of a portion of structure or adjacent structures during selective building demolition operations.
 - 1. Perform surveys as the work progresses to detect hazards resulting from selective demolition activities.
- D. Steel Tendons: Locate tensioned steel tendons and include recommendations for detensioning.
- E. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- F. Survey of Existing Conditions: Record existing conditions with measured drawings or preconstruction photographs or video and templates.
 - 1. Comply with requirements specified in Section 01 32 33.
 - 2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
 - 3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final work, make permanent record of measurements, materials, and construction details required to make exact reproduction.
 - 4. For any electrical or low-voltage work to be performed in the project (including fire alarm, PA, intercom, or data), test entire system for operation prior to initiation of work. Notify Owner of any non-working components. Test entire system at the end of construction to ensure all systems operate properly.

3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.
- B. Salvaged Items: Comply with the following:
 - 1. Clean salvaged items of dirt and demolition debris.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to storage area.
 - 5. Protect items from damage during transport and storage.
- C. Pest Control: Employ certified, licensed exterminator to treat building and to control rodents and vermin before and during selective demolition operations.
- D. Site Access and Temporary Controls: Conduct selective demolition and debris removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities. Comply with requirements for access and protection.
- E. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling.

- F. Furnishings and Equipment: Cover and protect furniture, equipment, and fixtures from spoilage or damage as necessary.
- G. Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.
 - 1. Construct dustproof partitions of not less than nominal 4 inch (100mm) studs, 5/8 inch (16mm) gypsum wallboard with joints taped on occupied side, and 1/2 inch (13mm) fire retardant plywood on the demolition side.
 - 2. Insulate partition to provide noise protection to occupied areas.
 - 3. Seal joints and perimeter. Equip partitions with dustproof doors and security locks.
 - 4. Protect air handling equipment.
 - 5. Weatherstrip openings to prevent the spread of dust.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. Arrange to shut off utilities with utility companies.
 - 3. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
 - 4. Cut off pipe or conduit a minimum of 24 inches (610 mm) below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
 - 5. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.
 - 6. Disconnect, demolish, and remove fire suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 POLLUTION CONTROLS

- A. Dust Control: Use water mist, temporary enclosures, and suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations including, but not limited to SCAQMD Rule 403 (Fugitive Test).
 - 1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
 - 2. Wet mop floors to eliminate trackable dirt and wipe down walls and doors of demolition enclosure. Vacuum carpeted areas.

3.5 PROTECTION

- A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.
- B. Existing Utilities to Remain: Maintain utility services to remain and protect from damage during demolition operations.
 - 1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
 - 2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.
 - a. Provide at least 72 hours' notice to occupants of affected buildings if shutdown of service is required during changeover.
- C. Temporary Protection: Provide temporary barricades and protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - a. Erect temporary pathways and means of egress necessary for ongoing operations compliant with Code and accessibility regulations.
 - b. Provide temporary barricades and protection required to prevent injury and damage to adjacent buildings and facilities to remain.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - a. Protect existing work which becomes exposed during demolition operations.
 - b. Protect adjacent entrances from damage due to demolition activities.
 - c. Protect existing improvements, appurtenances, and conditions to remain.
 - d. Protect floors with covering.
 - e. Protect walls, openings, roofs, and adjacent exterior construction to remain and exposed to building demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 50 00.
 - a. Construct temporary insulated dustproof partitions to separate areas from noisy or extensive dirt or dust operations are performed. Equip partitions with dustproof doors and security locks.
 - b. Construct dustproof partitions of not less than nominal 4 inch (100mm) studs, 5/8 inch (16mm) gypsum wallboard with joints taped on occupied side, and 1/2 inch (13mm) fire retardant plywood on the demolition side.
 - c. Insulate partition to provide noise protection to occupied areas.
 - d. Seal joints and perimeter. Equip partitions with dustproof doors and security locks.
 - e. Protect air handling equipment.
 - f. Weatherstrip openings.
 - 6. Damage: Promptly repair damages to adjacent components cause by demolition activities.
- D. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.

- E. Remove temporary barricades and protections where hazards no longer exist.

3.6 SELECTIVE DEMOLITION

- A. Demolish and remove existing construction to the extent necessary for new work. Use methods required to complete the work within limitations of governing regulations and as follows:
 - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 - 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame cutting operations. Maintain portable fire suppression devices during flame cutting operations.
 - 5. Maintain fire watch during and for at least 24 hours after flame cutting operations.
 - 6. Maintain adequate ventilation when using cutting torches.
 - 7. Remove decayed, vermin infested, and dangerous or unsuitable materials and promptly dispose of offsite.
 - 8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 - 9. Locate selective demolition equipment and remove debris and materials to avoid imposing excessive loads on supporting walls, floors, or framing.
 - 10. Dispose of demolished items and materials promptly.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris removal operations to ensure minimum interference with roads, streets, walks, walkways, and adjacent occupied and used facilities.
- C. Removed and Salvaged Items: Remove items indicated for salvage. Clean and pack or crate items after cleaning. Identify contents of containers. Store items in secure area until delivery to Owner.
 - 1. Transport items to Owner's storage area designated by Owner. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items: Clean and repair items to functional condition adequate for intended reuse.
 - 1. Pack or crate items after cleaning and repairing. Identify contents of containers.
 - 2. Protect items from damage during transport and storage.
 - 3. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Owner, items may be removed to a suitable, protected storage location during selective demolition, cleaned, and reinstalled in original locations after selective demolition operations are complete.
- F. Patching and Repair: Repair damage to adjacent construction caused by selective demolition operations promptly.

3.7 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power driven saw, cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power driven saw, and then remove masonry between saw cuts.
- D. Concrete Slabs on Grade: Saw cut perimeter of area to be demolished, and then break up and remove.
- E. Interior Slab on Grade: Use best practice removal methods to prevent cracking or structurally disturbing adjacent slabs or partitions. Use power saw where possible.
- F. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in *RFCI Recommended Work Practices for the Removal of Resilient Floor Coverings*. Do not use methods requiring solvent-based adhesive strippers.
- G. Below Grade Voids: Completely fill below grade areas and voids resulting from demolition work. Provide fill consisting of approved earth, gravel, or sand, free of trash and debris, stones over 6 (150mm) inches in diameter, roots, or other organic matter.
- H. Partitions: Completely remove indicated interior partitions and interior finishes indicated. Leave adjacent work scheduled to remain sound and ready for patching or for new finishes.
- I. Doors and Frames: Remove doors, frames, and hardware where indicated. Remove from site.
 - 1. Remove doors, frames, and hardware where indicated. Clean, store, and protect for reinstallation or return hardware to Owner as directed.
- J. Cut existing masonry walls for new doors, windows, or openings indicated. Leave openings ready to receive new work or patching.
- K. Windows: Remove existing windows where indicated. Remove associated anchors, shims, blocking, operating devices, sealant, and trim. Cut back interior finishes required for plumb surface for patching. Leave openings ready for installation of new materials and finishes.
- L. Mechanical, Electrical, and Structural Elements: If unanticipated mechanical, electrical, or structural elements conflicting with intended function or design are encountered, investigate and measure both nature and extent of the conflict.
 - 1. Submit written report to Architect in accurate detail. Pending receipt of directive, rearrange selective demolition schedule as necessary to continue overall job progress without undue delay.
 - 2. HVAC Equipment: Remove air conditioning equipment without releasing refrigerants.

3.8 SITE RESTORATION

- A. Below-Grade Areas: Rough grade below-grade areas ready for further excavation or new construction.
- B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.9 REMOVAL OF STRUCTURAL ELEMENTS

- A. Foundation: Demolish foundation walls to a minimum depth of 12 inches (300mm) below existing ground surface. Demolish and remove below grade wood or metal construction. Break up below grade concrete slabs.
- B. Pneumatic Operated Hammers: When possible, reduce use of pneumatic operated hammers. When necessary to use pneumatic tools, locate compressors as remote from occupied areas as possible.
 - 1. To break large pieces of concrete, isolate concrete from floor slabs and building structure to prevent structure borne vibration.
- C. Saw Cutting: Locate compressors as remote as possible from occupied areas of facility.
 - 1. Use diamond tipped saw blades and related equipment.
 - 2. Saw cut portions of walls and slabs. Angle saw blade at floors and corners to cut as closely as possible to desired location.
 - 3. Control runoff water used with saw to prevent damage to existing materials.

3.10 DEMOLITION BY MECHANICAL MEANS

- A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.
- B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 - 1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.
- C. Salvage: Items to be removed and salvaged by Owner shall be discussed with Owner 90 days prior to demolition. Owner has right of 1st refusal of all items.
 - 1. Collection of salvaged items for Contractor use shall not delay demolition. Only 1 week is allowed for salvaged items to be removed from site.
- D. Below-Grade Construction: Abandon foundation walls and other below-grade construction. Cut below-grade construction flush with grade.
- E. Existing Utilities: Demolish existing utilities and below-grade utility structures that are within 5 feet (1.5 m) outside footprint indicated for new construction. Abandon utilities outside this area.
 - 1. Fill abandoned utility structures with satisfactory soil materials according to backfill requirements in Division 31.
- F. Existing Utilities: Demolish and remove existing utilities and below-grade utility structures.
- G. Hydraulic Elevator Systems: Demolish and remove elevator system, including cylinder, plunger, well assembly, steel well casing and liner, oil supply lines, and tanks.

3.11 ROOF REMOVAL

- A. Roof Assembly: Remove existing roofing to the extent that can be covered in one day by new roofing. Maintain building interior in watertight and weathertight condition.
 - 1. Remove existing roof membrane, flashings, copings, and roof accessories.
 - 2. Remove existing roofing system down to substrate.
- B. At new column extensions, cut through roofing as required for welding of new extension. Provide temporary watertight enclosure over stubs and temporarily flash to existing roof to make completely watertight.

- C. At existing parapets, remove portions of roofing, flashing, stone, and masonry necessary to weld new steel and set form work. Provide temporary watertight enclosures over areas of open roof and temporarily flash to make watertight.
- D. As column forms are placed, temporarily flash columns to existing roofing and cover with watertight tarpaulins before and after pouring. After column forms have been removed, temporarily flash new concrete structure into existing roofing immediately to maintain watertight roof.
- E. When removing roofing to place supports for shoring of form work to transfer loads to existing columns or approved structure or to support scaffolding, work platforms, or similar loads, temporarily flash supports to make roof watertight.
- F. Remove excess residue. Thoroughly clean and remove asphalt, dust, loose materials and leave ready for new work.

3.12 PATCHING AND REPAIRS

- A. Promptly repair damage to adjacent construction caused by selective demolition operations.
- B. Repairs: When necessary to repair existing surfaces, patch to produce surfaces suitable for new materials.
 - 1. Fill holes and depressions in existing masonry walls to remain with masonry patching material applied according to manufacturer's written recommendations.
- C. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.
- D. Floors and Walls: Where walls or partitions are demolished, extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - 1. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
 - 2. Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.
 - 3. Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
- E. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.13 DISPOSAL OF DEMOLISHED MATERIALS

- A. Legally remove demolition waste materials from site and dispose in an EPA approved construction and demolition waste landfill acceptable to authorities having jurisdiction recycle or reuse components.
 - 1. Do not allow demolished materials to accumulate on site.
 - 2. Remove and transport debris to prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or devices that convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.

3.14 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 02 41 00

SECTION 02 41 13 - SELECTIVE DEMOLITION

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Partial demolition of existing building as required to accommodate additions and renovations as shown on the drawings or required. Include removal of existing utilities as indicated or encountered; removal of masonry, and mechanical, electrical, and plumbing items as indicated or required.

1.2 SUBMITTALS

- A. Submit the following items.
 - 1. Itemized Demolition Schedule.
 - 2. Detail all demolition methods to be used.

1.3 PERMITS

- A. Procure and pay for all necessary permits or certificates required to complete the work specified. Make any and all required notifications and comply with all applicable Federal, State and local ordinances.

1.4 QUALITY ASSURANCE

- A. Provide at least one (1) person who shall be present and in charge of the Demolition Work at all times and who shall be thoroughly familiar with all phases of all work performed under this Section.
- B. Comply with all pertinent codes and regulations applying to this work.

1.5 JOB CONDITIONS

- A. Use all means necessary to prevent the spread of dust during performance of this work. Provide additional clean filters for the existing air handling system serving those areas to remain to protect them from construction dust.
- B. Use all means necessary to protect the existing building to remain from all types of damage, including fire, water damage, and unnecessary interruption of utility services. In the event of damage of any kind, immediately make all repairs and replacements necessary to the approval of the Owner at no additional cost to the Owner.
- C. Motor driven equipment shall have functional mufflers.
- D. Visit the site and examine the existing structure. Note all conditions as to the character and extent of work involved.

1.6 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13 – Project Management and Coordination

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide all barricades, shoring, and bracing necessary to protect the tenants, workmen, and Public from danger. Barricades shall be sufficiently designed to protect and or exclude the public from all hazards.
- B. All other materials, not specifically described but required for proper completion of Work of this Section, shall be as selected by the Contractor subject to the approval of the Owner.
- C. The Owner and Architect are not responsible and make no claims for the quality or quantity of the materials being demolished. The General Contractor or subcontractors that undertake or assume the benefits of salvage efforts shall assume all risks associated with that effort.

2.2 DEMOLITION WORK

- A. Perform demolition work in manner so as to allow Owner's safe use of existing facility.
- B. Perform demolition work in order to maintain Owner's construction schedule.

2.3 REMOVAL OF PARTITIONS, COLUMNS AND STRUCTURE

- A. Masonry walls or other sections of masonry shall not be permitted to fall on floors of building in masses to exceed safe carrying capacity of floors. Existing floors shall be properly protected with plywood on both sides of a partition to be demolished.
- B. Provide temporary shoring or bracing wherever necessary for the protection of occupants, workmen, walls, partitions, roofs, floors and structure to remain.
- C. Structural or load-supporting members shall not be cut or removed adjacent to existing structures to remain until all loads carried by members have been removed or adequately supported.
- D. No masonry walls shall be removed until it has been determined that the walls to be removed do not support the roof. To determine this, all adjacent materials such as finish ceilings shall be removed to provide adequate views of existing structure. Provide temporary shoring as needed. The Contractor shall take all precautions necessary to ensure the safety of the demolition workers and all occupants of the building.
- E. No demolition will be allowed above, below, adjacent to or near any occupied areas of the building.
- F. Where access holes in existing ceilings or removal of existing ceilings are required, minimize the access in order to minimize the repair work and repair or replace removed or damaged work to match adjacent undamaged work.
- G. Cut and tooth new openings in masonry where required, of correct size to permit installation of frames and anchors for new doors.

PART 3 - EXECUTION

3.1 DEMOLITION

- A. Before commencing the Work of this Section, verify with the Owner that all items to be removed by the Owner have been removed. Schedule the work in a careful manner with all necessary consideration for the Public and the Owner. All items of existing equipment and materials or any other item of value to the Owner shall be salvaged by the Owner prior to demolition.
- B. All material removed under this Contract, which is not to be salvaged or reused, shall become the property of the Contractor and be promptly removed from the site. At all times use movable debris boxes, covered, to convey the material through the building. Do not store or permit debris to accumulate on the site. Dumpsters shall not overflow and shall be emptied on a regular basis. Remove all debris from the building premises and leave the construction site "Clean" each day. All debris shall be dumped in an approved disposal facility and all fees for this shall be paid by the Contractor. Contractor is responsible for completely removing all demolished materials from the site and disposing of them in accordance with all local, State and Federal Regulations. If Contractor fails to remove debris promptly, Owner reserves the right to have debris removed at Contractor's expense.
- C. Conduct operations so as not to interfere with adjacent occupied spaces, roads, streets, drives, walks, service lines and the like.
- D. Keep all pedestrian areas clear for passage at all times.

3.2 PROTECTION OF STRUCTURES, PROPERTY

- A. Execute demolition work to ensure adjacent property no damage from falling debris or other causes.
- B. Take precautions to guard against movement, settlement, or be liable for such movement, settlement, or collapse; repair promptly such damage when so ordered.
- C. Repair damage to Owner's property or any other person or persons on or off premises by reason of required work.

END OF SECTION 02 41 13

SECTION 02 41 13.23 - ABANDONMENT OF EXISTING UTILITIES

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. Abandon water lines, storm and sanitary sewers, manholes, and associated appurtenances as indicated on the Plans in accordance with the methods outlined herein.

1.2 PAYMENT

- A. Payment will be made if an item is provided for such on the bid form; otherwise, include cost of work in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Specific products are not required. Reference other applicable sections of the specifications for material required.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate all work so that existing utilities are operable until new utilities are complete and in place. Keep any service interruptions to a minimum.

3.2 WATER LINE ABANDONMENT

- A. Remove at least one joint of existing pipe where crossing or tying-in with new water lines. Plug both ends of abandoned line with an appropriate manufactured fitting (cap or plug) or fill end of line with 3000 psi concrete. Backfill as per SECTION 31 23 00 - CONSTRUCTION OF UNDERGROUND UTILITIES.

3.3 SEWER ABANDONMENT

- A. Unless noted on drawings to be removed, abandon sewers 12 inches in diameter and smaller by filling with a liquid concrete slurry composed of a 3 sack per cubic yard mix using pea gravel (1-1/2 inch and smaller aggregate) or drilling mud. Limit length of application to individual sections between manholes. Construct a temporary dam in downstream manholes above top of pipe. Pour slurry or mud in upstream manhole or in riser pipe attached to upstream end of sewer. Fill line till slurry or mud rises above top of pipe on both ends.
- B. Sewers between 12" – 36" in diameter shall be abandoned in accordance with either 3.3.A or 3.3.C.
- C. Unless noted on drawings to be removed, abandon sewers 36 inches in diameter and larger by breaking in top of pipe and backfilling. Excavate and expose top half of existing sewer. Using appropriate equipment, cave-in the top half of pipe; as a minimum, the upper 120-degree section of pipe must be broken in. Fill open pipe with backfill material and compact to top of existing pipe. Backfill to grade in accordance with SECTION 31 23 00 - CONSTRUCTION OF UNDERGROUND

UTILITIES.

3.4 MANHOLE ABANDONMENT

- A. After abandoning sewer lines in the appropriate manner, fill manholes to be abandoned with bank sand. Excavate around top of manhole and remove manway (reducer) section of manhole. Fill manhole with bank sand in 12-inch compacted lifts to top of manhole barrel. Backfill to finished grade in accordance with SECTION 31 23 00 - CONSTRUCTION OF UNDERGROUND UTILITIES.

END OF SECTION 02 41 13.23

SECTION 02 41 19 - SELECTIVE STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Demolition and removal of selected portions of building or structure.
 - 2. Demolition and removal of selected site elements.
 - 3. Salvage of existing items to be reused or recycled.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for restrictions on the use of the premises, Owner-occupancy requirements, and phasing requirements.
 - 2. Section 01 35 91 "Historic Treatment Procedures" for historic removal and dismantling.
 - 3. Section 01 56 39 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
 - 4. Section 01 73 00 "Execution" for cutting and patching procedures.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged; or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner.
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

- A. Pre-demolition Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.

3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

- A. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control, and for noise control. Indicate proposed locations and construction of barriers.
- B. Schedule of Selective Demolition Activities: Indicate the following:
 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's and other tenants' on-site operations are uninterrupted.
 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 3. Coordination for shutoff, capping, and continuation of utility services, if any.
 4. Use of elevator and stairs.
 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- C. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
- D. Pre-demolition Photographs or Video: Submit before Work begins.
- E. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.
- B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.8 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 1. Before selective demolition, Owner will remove the following items:
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 1. Hazardous materials will be removed by Owner before start of the Work.
 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.9 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.
- C. LEED Requirements for Building Reuse:
 - 1. Credit MR 1.1 and Credit MR 1.2: Maintain existing building structure (including structural floor and roof decking) and envelope (exterior skin and framing, excluding window assemblies and nonstructural roofing material) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.
 - 2. Credit MR 1.3: Maintain existing interior nonstructural elements (interior walls, doors, floor coverings, and ceiling systems) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.
 - 3. Credit MR 1.2 and Credit MR 1.3: Maintain existing non-shell, nonstructural components (walls, flooring, and ceilings) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.
- C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

- E. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
 - 2. Steel Tendons, if any: Locate tensioned steel tendons and include recommendations for de-tensioning.
- F. Survey of Existing Conditions: Record existing conditions by use of measured drawings, preconstruction photographs, or preconstruction videotapes as appropriate.
 - 1. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.

3.2 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.

3.3 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 - 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly

- B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.4 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished and then break up and remove.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill unless otherwise directed by Owner.
1. Do not allow demolished materials to accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.6 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 02 41 19

SECTION 03 05 80 - UNDER-SLAB VAPOR RETARDER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Products Supplied Under This Section
 - 1. Vapor Retarder, seam tape, mastic, pipe boots, detail strip for installation under concrete slabs.
- B. Related Sections
 - 1. Section 03 30 00 Cast-in-place Structural Concrete
 - 2. Section 01 45 23 Structural Testing and Inspection

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM E 1745-97 (2004) Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs
 - 2. ASTM E 154-88 (2005) Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs
 - 3. ASTM E 96-95 Standard Test Methods for Water Vapor Transmission of Materials
 - 4. ASTM E 1643-98 (2005) Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
- B. American Concrete Institute (ACI)
 - 1. ACI 302.2R-06 Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.

1.4 SUBMITTALS

- A. Quality Control / Assurance
 - 1. Full set of test results as per paragraph 8.3 of ASTM E 1745.
 - 2. Manufacturer's samples, literature
 - 3. Manufacturer's installation instructions for placement, seaming and pipe boot installation.

1.5 SUBSTITUTIONS

- A. Product Review
 - 1. Request must be made 14 days prior to bid date to allow time for proper review. Reviews will be at contractor's expense.
 - 2. Independent laboratory test results showing compliance with ASTM E 1745 Class A, a permeance less than 0.01 Perms (grains/(ft² *hr * in. Hg) before and after the mandatory

conditioning tests ASTM E 154 Sections 8,11,12, and 13. (Woven, and recycled plastics are not permitted)

3. Incomplete substitutions will not be accepted.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Vapor Retarder (Performance based specification). When the specifications of different sections conflict, the contractor shall perform to the most restrictive provision. Vapor Retarder membrane must have the following properties.
 1. Permeance as tested after mandatory conditioning (ASTM E 154 sections 8,11,12,13) less than 0.01 Perms [grains/(ft² *hr. * in. Hg)]
 2. Other performance criteria
 - a. Strength: ASTM E 1745 Class A
 - b. Thickness: 15 mils minimum

2.2 ACCESSORIES

- A. Seam Tape
 1. Tape must have the following qualities:
 - a. Water Vapor Transmission Rate ASTM E 96, 0.3 perms or lower
 2. Seam Tape
 - a. Manufacturer's standard seam tape.
 - b. Stego Crete Claw (for slabs on void boxes).
- B. Vapor Proofing Mastic
 1. Mastic must have the following qualities:
 - a. Water Vapor Transmission Rate ASTM E 96 0.3 perms or lower
- C. Pipe Boots
 1. Construct pipe boots from vapor retarder material, pressure sensitive tape and/or mastic per manufacturer's instructions.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ensure that subsoil is approved by architect or geotechnical firm
 1. Level and tamp or roll aggregate, sand, or tamped earth base.

3.2 INSTALLATION

- A. Install Vapor Retarder:
 1. Installation shall be in accordance with manufacturer's written instructions and ASTM E 1643-09.
 - a. Unroll Vapor Retarder with the longest dimension parallel with the direction of the pour.
 - b. Lap Vapor Retarder over footings or seal to foundation walls.
 - c. Overlap joints 6 inches and seal with manufacturer's tape.

- d. Seal all penetrations (including pipes) per manufacturer's instructions.
- e. No penetration of the Vapor Retarder is allowed except for reinforcing steel and permanent utilities.
- f. Repair damaged areas by cutting patches of Vapor Retarder, overlapping damaged area 6 inches, and taping all four sides with tape.

END OF SECTION 03 05 80

SECTION 03 10 00 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cast-in-place concrete formwork, for the following:
 - 1. Footings and/or piers.
 - 2. Foundation walls.
 - 3. Slabs-on-grade.
 - 4. Suspended slabs.
 - 5. Concrete toppings.
 - 6. Building frame members.
 - 7. Building walls.
- B. Related Sections:
 - 1. Section 01 45 23 "Testing and Inspection Services".
 - 2. Section 03 33 00 "Architectural Concrete".
 - 3. Section 03 30 00 "Cast In Place Concrete".
 - 4. Section 03 20 00 "Concrete Reinforcing".
 - 5. Section 03 47 13 "Tilt Up Concrete".
 - 6. Section 03 38 16 "Unbonded Post Tensioned Concrete".
 - 7. Section 03 53 00 "Concrete Topping".

1.3 REFERENCES

- A. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
 - 1. American Concrete Institute (ACI):
 - a. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials
 - b. ACI 301 – Specifications for Structural Concrete for Buildings
 - c. ACI 318 – Building Code Requirements for Structural Concrete
 - d. ACI 347 – Guide to Formwork for Concrete
 - e. ACI SP-4 – Formwork for Concrete.

1.4 PERFORMANCE REQUIREMENTS

- A. Design and engineering of formwork, including shores, reshores, false work, bracing, and other temporary supports as well as determining when temporary supports and bracing can safely be removed after the specified curing time is the Contractor's responsibility.
- B. All components of the formwork shall be designed to support all loads imposed during construction including weight of construction equipment, live loads, and lateral loads due to wind and imbalance or discontinuity of building components.

- C. If any post tensioned members exist on the project, the formwork supporting those elements shall:
1. It is essential to take into account the stressing sequence of post-tensioned concrete in the design of the formwork. Any concrete element which is stressed can transfer its weight off the form work to the supporting concrete element in which case the forms for the supporting concrete element must be designed to support the entire load tributary of that element.
 2. Forms shall be designed and constructed to permit movement during stressing, both lifting and shortening of the concrete elements.
 3. Formwork supporting beams and girders shall be designed to support the weight of the beam or girder's entire tributary area.
 4. Formwork supporting post tensioned concrete elements shall not be removed until all concrete supported by the formwork has been fully stressed, but in no case shall the curing time before form removal be less than specified herein.
 5. Design, engineering, and production of shop drawings for the form work shall be performed under the supervision of a professional engineer.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork. Shop drawings for layout of pan type forms, if they exist on the project. Layout only - information and details about the support of these forms is not required, as it is the responsibility of the Contractor and his registered engineer
1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.
- C. Manufacturer's product data and installation instruction for propriety materials used in exposed concrete work including form liners, release agents, form systems, ties, and accessories.
- D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
1. Location of construction joints is subject to approval of the Architect.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver form materials in manufacturer's packaging with installation instructions.
- B. Store off ground in ventilated and protected area to prevent deterioration from moisture or damage.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician. An experienced installer who has completed work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in service performance.

- B. Testing Agency Qualifications: Refer to Section 01 45 23.
- C. Layout and measurement of concrete forms and embedment's, required for work, performed by a licensed surveyor employed by the contractor.
- D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specifications for Structural Concrete."
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- E. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
 - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Permanent Metal Forms for Slabs: Deck material, gauge and rib pattern shall be as noted on Drawings.
- E. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
 - 1. Pans shall be free of dents, irregularities, sag, rust or other deterioration.
 - 2. In areas permanently exposed to view, provide one piece units, manufactured to length between beams or ribs, or segmented units with reinforced butt-joint splices.
- F. Load-bearing Rigid Board Insulating Fill Under Slabs:
 - 1. Extruded Polystyrene Board Insulation: Comply with ASTM C 578, Type X, 15 psi minimum compressive strength, 1.30 lb./cu. ft. (21 kg/cu. m) .

- a. Owens Corning Insulating Systems, LLC, Toledo, OH 43659; www.owenscorning.com.
 - b. Thermal Resistance: (180-day real-time aging as mandated by ASTM C578, measured per ASTM C 518 at mean temperature of 75F): R-5.0 per inch of thickness, with 90% lifetime limited warranty on thermal resistance.
 - c. Blowing Agent Formulation: Zero ozone depleting.
 - d. Install according to manufacturer's recommended instructions.
2. Expanded Polystyrene Board Insulation: Un-faced Flat Board Stock: Rigid, closed cell, expanded polystyrene (EPS) boards, UL certified, complying with ASTM C 578 Type VIII, 15 psi minimum compressive strength .
 - a. Insulfoam, a Carlisle Company, which is located at: 6004 N. Westgate Blvd. Suite 120 ; Tacoma, WA 98406; Toll Free Tel: 800-248-5995; Tel: 253-572-5111; Email: request info (info@insulfoam.com); Web: www.insulfoam.com
 - b. Blowing Agent Formulation: Zero ozone depleting.
 - c. Install according to manufacturer's recommended instructions.
- G. Formwork Accessories
1. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
 2. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
 3. Expansion-Contraction Joint Filler Material: Bonded fabric of thickness indicated on Drawings composed of cellular fibers securely bonded together and uniformly saturated with asphalt complying with ASTM D 1751.
 4. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - a. Formulate form-release agent with rust inhibitor for steel form-facing materials.
 5. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - a. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - b. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
 - c. Furnish ties with integral water-barrier plates to walls indicated to receive damp proofing or waterproofing.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 1. Class A, 1/8 inch for smooth-formed finished surfaces.

2. Class B, 1/4 inch
 3. Class C, 1/2 inch
 4. Class D, 1 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
1. Install keyways, reglets, recesses, and the like, for easy removal.
 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts that are attached to the formwork.
1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 3. Install dovetail anchor slots in concrete structures as indicated.

4. Install accessories in accordance with manufacturer's instructions, level and plumb. Ensure items are not disturbed during concrete placement.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
 3. Determine compressive strength of in place concrete by testing representative field-cured test specimens according to ACI 301.
- B. Obtaining concrete compressive strength tests for the purposes of form removal shall be the responsibility of the Contractor.
- C. In the absence of cylinder tests, formwork shall remain in place until the concrete has cured at a temperature of at least 50 degrees Fahrenheit (10 degrees Celsius) for the minimum cumulative time periods given in ACI 347, Section 3.7.2.3. When the surrounding air temperature is below 50 degrees Fahrenheit (10 degrees Celsius), that time period shall be added to the minimum listed time period.
- D. Formwork for two-way conventionally reinforced slabs shall remain in place for at least the minimum cumulative time periods specified for one-way slabs of the same maximum span. Two-way conventionally reinforced slabs shall then be reshored until they attain the specified 28 day strength.
- E. Minimum cumulative curing times may be reduced by the use of high-early strength cement or forming systems that allow form removal without displacing shores. However, the Contractor must demonstrate, to the satisfaction of the Architect, that the early removal of forms will not result in excessive sag, distortion or damage to the concrete elements.
- F. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- G. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORES AND RESHORES

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

- B. The Contractor shall be solely responsible for proper shoring and reshoring. Locate and provide adequate reshoring to support construction without excessive stress or deflection.
- C. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement. Reshores shall be located in the same position on each floor. No construction loads shall be placed on the new construction until all supporting reshores have been installed.
 - 1. Extend shores or reshores from ground to top level in structure three stories or less in height, unless noted otherwise.
 - 2. In structures over three stories in height, extend shores or reshores at least three levels under the level being placed. Extend shores beyond the minimum number of levels if required to ensure proper distribution of loads throughout the structure.
 - 3. In crawl spaces or basement, shores or reshores shall extend to mud pads seated firmly on the soil or to on grade construction.
- D. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.
- E. Bottom tier of reshores shall remain in place until the supported concrete has attained at least 85 percent of the specified 28-day compressive strength and construction loads in excess of 20 psf have been removed but not less than 14 days.

3.5 REUSE OF FORMS

- A. Clean and repair surfaces of forms to be used in the Work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form release agent.
- B. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

5. Space vertical joints in walls as indicated. Otherwise, locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants are to be installed.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.7 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform

color and texture. Do not apply cement grout other than that created by the rubbing process.

- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
 - 1. Apply scratch finish to surfaces indicated or to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces indicated or to receive trowel finish or to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

3.9 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment

END OF SECTION 03 10 00

SECTION 03 10 01 – SPREAD FOOTINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Conditions of the Contract, Division 1 - General Requirements, and Drawings apply to Work of this Section.

1.02 RELATED WORK

- A. Section 01410: Quality Control
- B. Section 03300: Concrete

1.03 UNIT PRICE

- A. Elevations given are for bidding/estimating purposes only. Should field conditions require footings to be deeper or shallower, adjustment in Contract shall be made on a unit price basis.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Retarding Admixture: ASTM C494, Type B.

PART 3 - EXECUTION

3.01 EXCAVATION

- A. Establish bottoms of footings in stratum as indicated on Drawings. Elevations given are for bidding/estimating purposes only.
- B. Totally excavate soils encountered to size, depths, and elevations indicated on Drawings as necessary for construction of Work, including space for forms, bracing and shoring, waterproofing, and inspection.
- C. Protect excavations by shoring, bracing, sheet piling, underpinning, or other methods, as required to prevent cave-ins or loose dirt from falling into excavations.
- D. Grade around excavation to prevent surface water runoff into excavated area.
- E. Excavate bottom of footing level with 1/24 maximum slope.
- F. Protect bottom of excavations and soil around and beneath foundations from frost. Do not place concrete on frozen soil.
- G. Notify Architect of unexpected subsurface conditions and discontinue Work in area until Architect provides notification to resume Work.

- H. Drilling of spread footings:
1. As indicated on Drawings, drill footings in true alignment at locations as indicated on Drawings with maximum lateral variation not exceeding lesser of 3 inches or 4% of diameter.
 2. Drill footing plumb. Deviation more than lesser of 10% of diameter or 1% of full height, from vertical, will be cause for rejection.
 3. Drill footing using rotary rigs through overburden into bearing material as indicated on Drawings. Take top of bearing material at elevation as indicated on Drawings. Elevation is set for estimating purposes only and is not to be construed as elevation of top of bearing material throughout site. Actual elevation shall be verified by Geotechnical Consultant in field.

3.02 BEARING STRATA

- A. On-site inspection of foundation bearing strata shall be conducted during construction by Geotechnical Consultant.
- B. Soft areas of bearing strata or areas otherwise disturbed shall be repaired in accordance with recommendations of Geotechnical Consultant.

3.03 WATER REMOVAL

- A. Prior to concrete placement, remove all water from bottom of excavation.

3.04 PLACING OF FOOTING REINFORCEMENT

- A. Clean reinforcement of foreign materials which will destroy or reduce bond with concrete.
- B. Install reinforcement indicated on Drawings as follows:
 1. Support cage off bottom of excavation distance indicated on Drawings.
 2. Firmly secure cage in place, free of contact with sides of excavation, distance indicated on Drawings.
- C. Provide dowels or anchor bolts in footings as indicated on Drawings.

3.05 CONCRETE PLACEMENT

- A. Place concrete immediately after excavation has been inspected and bearing strata found acceptable by Geotechnical Engineer.
- B. Place concrete in footing by free fall, hopper, or tremie, as needed to prevent segregation or striking side of excavation or reinforcement.
- C. Place concrete continuously without construction joints for full depth of footing.
- D. Vibrate concrete for full depth of footing.
- E. During placement of concrete, and until concrete has set, provide protection around top of excavation to prevent entry of soil or other foreign matter.

- F. Placement should be controlled by qualified personnel through continuous observation.

3.06 FIELD QUALITY CONTROL

- A. Geotechnical Consultant shall provide qualified personnel at site to inspect footings as follows:
1. Before reinforcement and concrete is placed, inspect each footing as follows:
 - a. Inspect excavations to ensure seating in bearing strata which produces foundation capacities indicated on Drawings.
 - b. Inspect excavations to ensure that they are properly cleaned and dried.
 - c. Inspect dimensions of footing for conformance to Drawings, both size and location. Contractor is responsible for providing to Geotechnical Consultant, site elevations and top of footing center alignment survey.
 2. Inspect reinforcement as follows:
 - a. Prior to placement, inspect reinforcement for grade, quality of material, absence of foreign matter, and for suitable storage.
 - b. Provide continuous inspection of reinforcement during placement and immediately prior to concreting operations for: size, quantity, vertical and horizontal spacing and location, correctness of bends and splices, clearances, form tolerance, security of support and ties, and absence of foreign matter on reinforcement.
- B. Geotechnical Consultant shall submit inspection reports to Architect for each footing. Report shall include:
1. Elevation of top of bearing strata.
 2. Size of footing (or diameter and thickness).
 3. Statement describing whether or not footing reinforcement and reinforcement placement conformed to Drawings.
 4. Statement evaluating that footing seated in indicated bearing strata will produce foundation capacities indicated on Drawings.

END OF SECTION 02 03 80

SECTION 03 11 00 - CONCRETE FORMWORK

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION OF REQUIREMENTS

- A. Work Included: Perform all work necessary and required for the construction of the project as indicated. Such work includes but is not necessarily limited to the furnishing and installing of forms for all cast-in-place concrete work as shown and noted on the drawings and specified herein, including the removal of forms at completion of concrete work.
- B. Related Work in Other Sections: The following items of associated work are included in other sections of these specifications:
 - 1. Excavating, filling, backfilling, and other earthwork operations.
 - 2. Furnishing and placing of reinforcing steel.
 - 3. Cast-in-place concrete.
 - 4. Filling of tie rod, bolt holes, and defects. Curing of concrete.
 - 5. Furnishing of dovetail anchor slots for masonry adjacent to concrete.
 - 6. Furnishing of anchor bolts and miscellaneous metal items to be embedded in concrete.
 - 7. All other carpentry work.
 - 8. Furnishing of sheet metal reglets to be embedded in concrete.

1.2 CODES AND STANDARDS

- A. The American Concrete Institute's "Recommended Practice for Concrete Formwork", ACI 347, and Chapter 4, ACI 301 are hereby made a direct part of this specification, and all concrete formwork included in this contract shall conform with the applicable requirements therein except as specified otherwise herein.

1.3 SHOP DRAWINGS

- A. For exposed concrete submit fabricating drawings of forms showing the jointing of facing panels, the location of form ties, and any necessary alignment bracing.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Forms for exposed concrete at exterior of building: Unless otherwise shown or specified, construct all formwork for exposed concrete surfaces (this includes all surfaces to receive a painted finished coat) with plywood, metal-framed plywood-faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.
- B. Forms for exposed concrete at interior of building: Form concrete surfaces with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least two edges and one side for tight fit. Use either 6" or 8" wide lumber, nominal 1" thickness, or plywood as specified for exterior exposed concrete, at Contractor's option. Use "BB FIR" or "MDO" grade plywood for underside of parking decks.

- C. Form Ties and Spreaders: Standard metal form clamp assembly, of type acting as spreaders and leaving no metal within one inch (1") of concrete face. Inner tie rod shall be left in concrete when forms are removed. No wire ties or wood spreaders will be permitted.
- D. Form Anchors and Hangers: Anchors and hangers used for exposed concrete shall not leave exposed metal at surface. Hangers supporting forms from structural steel shall be symmetrically arranged on supporting members to minimize twisting or rotation of member. Penetration of structural steel members will not be permitted.
- E. Form Coatings: Form coating shall be a polymeric material and shall contain no wax or oil.

PART 3 - EXECUTION

3.1 CONSTRUCTION OF WORK

- A. The design layout, construction and removal of formwork shall be the sole responsibility of the Contractor.
- B. Earth Forms: If conditions warrant, and the approval of the Engineer is secured, earth trench forms for footings will be allowed. Where footings are placed on dry soil or pervious material, waterproof paper shall be laid over the earth surfaces to receive concrete. Soil may be thoroughly wetted to optimum moisture content prior to placing concrete in lieu of using waterproof paper.
- C. Formwork-General: Forms shall be constructed of sound material, shall be of the correct shape and dimensions, mortar tight, of sufficient strength, and so braced and tied together that the movement of men, equipment, materials, or placing and vibrating the concrete will not throw them out of line or position. Before reusing forms, or when using second-hand lumber for forms, same shall be cleaned and all nails removed therefrom. Forms shall be strong enough to maintain their exact shape under all imposed loads. Camber where necessary to assure level finished soffits. Forms shall be so constructed that they may be easily removed without damage to the concrete. Before concrete is placed in form, the horizontal and vertical position of the form shall be carefully verified, and all inaccuracies corrected. All welding and bracing shall be completed in advance of placing of concrete.
- D. Forms for Exterior Exposed Concrete (concrete to receive paint): Plywood panels shall be clean, smooth, uniform in size, and free from damaged edges and holes. Full size panels shall be used wherever possible. After construction, tape joints of plywood panels to prevent joint protrusions in concrete. Horizontal joints must be level and continuous. All edges of plywood must be backed to prevent separation. Use special care in the forming and stripping of the forms to protect the corners. Form inside corners with mitered boards so that no concrete is placed against form ends.
- E. Framing and Bracing: Framing, bracing, supporting members, and centering shall be of ample size and strength to safely carry, without deflection, all dead and live loads to which forms may be subjected, and shall be spaced sufficiently close to prevent any bulging or sagging of forms. Concrete out of line, level, or plumb will be cause for rejection of the whole work affected. Distribute bracing loads over base area on which bracing is erected. When placed on ground, protect against undermining or settlement.
- F. Tolerances:
 - 1. Variation from plumb in lines and surfaces of walls and arises shall not exceed 1/8 inch in 10 feet with maximum "in" and "out" variation occurring in not less than 20 feet.
 - 2. Variation in linear building lines from established position of columns, piers, or walls shall not exceed 1/4 inch in any bay of 20 feet or 1/2 inch in 40 feet or greater length.
 - 3. Variation in thickness of slabs and walls shall not exceed minus 1/4 inch or plus 1/2 inch.

4. Variation from the level or from the grades indicated on the drawings:
 - a. In slab soffits, ceilings, and in arises

In 10 feet.....1/4 inch.
In any bay or 20 feet max.....3/8 inch.
In 40 feet or more.....3/4 inch.
 - b. For exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines.

In any bay or 20 feet max.....1/4 inch.
In 40 feet or more.....1/2 inch.
5. Variation from level in floors or from the grade indicated: In any 10 feet.....1/4 inch.
6. Size and location of sleeves, pits, floor openings, etc., the location of bolts, inserts and fastenings: Plus or minus 1/4 inch.
7. Footings:
 - a. Variation in dimensions in plan:
minus.....1/2 inch, plus.....2 inch.
 - b. Misplacement or eccentricity: Two percent of the footing width in the direction of misplacement but not more than 2 inches. These tolerances for footings apply to the concrete only, and not to reinforcing bars or dowels.
- G. Chamfered Corners: As indicated, provide moldings in forms for all chamfering required. Moldings shall be 45-degree right triangle in profile of size required, milled from wood free from open defects.
- H. Form Ties: Form ties shall be of sufficient strength and used in sufficient quantities to prevent spreading of the forms. Ties shall be placed at least one inch away from the finished surface of the concrete. The use of ties consisting of twisted wire loops will not be permitted. Inner rods shall be left in concrete when forms are stripped. All form ties shall be spaced equidistant, and symmetrical, and shall line up both vertically and horizontally.
- I. Cleanouts and Access Panels: Provide removable cleanout sections or access panels at the bottom of all forms to permit inspection and effective cleaning of loose dirt, debris, and waste material. All forms and surfaces to receive concrete shall be cleaned of all chips, sawdust, and other debris and shall be thoroughly blown out with compressed air just before concrete is placed.
- J. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.
- K. Construction Joints: Construction joints shall be formed as specified in Section intitled "Cast-In-Place Concrete." Provide a surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints. Just prior to subsequent pour, remove strip and tighten forms to conceal shrinkage. Construction joints shall show no "overlapping" of concrete and shall, as closely as possible, present the same appearance as butted plywood joints. Joints in a continuous line shall be straight, true, and sharp.
- L. Embedded Items: Provisions shall be made for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, and other features. No wood other than necessary nailing blocks shall be embedded in concrete. Complete cooperation shall be extended suppliers of embedded items in their installation. Secure information for embedded items from other trades as required. All embedded items shall be securely anchored in correct location and alignment prior to placing concrete, electrical and telephone conduits shall be run in concrete only upon the written approval of the Engineer. Under NO circumstances will ALUMINUM CONDUIT be permitted in concrete. No

conduit larger than 3/4 inch in diameter and no plumbing pipes of any size will be permitted in concrete walls, columns, or slabs.

- M. Opening for Items Passing Through Concrete: Frame openings in concrete where indicated on architectural, structural, plumbing, mechanical, or electrical drawings. Contractor shall establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections. Contractor shall be held responsible for proper coordination of all work of this nature in order that there will be no unnecessary cutting and patching of concrete. Any cutting and repairing to concrete required as a result of failure to provide for such openings shall be paid for by the Contractor at no additional expense to the Owner.
- N. Screed: Contractor shall set screeds and establish levels for tops of concrete slabs and leveling for finish on slabs. Shape slabs to drain where required or as indicated on drawings. Before depositing concrete, all debris shall be removed from the space to be occupied by the concrete, and forms shall be thoroughly wetted. Reinforcement and inserts shall be secured in position. Free-standing water shall be removed.
- O. Screed Supports: Screed supports for concrete over waterproof membranes and/or vapor-barrier membranes shall be of a cradles, pad, or base type which will not puncture the membrane. Staking through the membrane will not be permitted.
- P. Shores and False Work: Contractor shall be fully responsible for the proper strength, safety, and adequacy of all falsework, supports, posts, footing, etc., used on and in connection with work. Falsework and supports shall be adequate in size and strength to resist the loads imposed upon them without deformation, deflection, or settlement. Wedges in pairs or jacks shall be used where required to bring forms, shoring, or falsework for beams, girders, slabs, and other parts of the structure to the exact elevations and uniform bearing before placing concrete. Single wedges will not be permitted. Vertical and lateral loads shall be carried to ground by form-work system or by completed structure, after it has attained adequate strength. Submit manufacturer's data for patented shores, shore splicing, and methods of shore support.
- Q. Reuse and Coating of Forms: Thoroughly clean forms and recoat with specified form coating before each reuse. Do not reuse any form for exposed work which cannot be reconditioned to "like new" condition. Apply form coating to all forms in accordance with the manufacturer's specifications. Apply form coatings before placing reinforcing steel.
- R. Inspection: Prior to placing of any concrete, and after placement of reinforcing steel in the forms, Contractor shall notify the Engineer so that proper inspection may be made. Such notification shall be made at least 72 hours in advance of placing concrete to permit proper arrangements to be made for inspection.
- S. Rejection of Defective Work Due to Improper Forms: Any movement or bellying of forms during construction or variations in excess of the tolerances specified will be considered just cause for the removal of such forms and, in addition, the concrete work so affected. Reconstruction of forms and new concrete shall be furnished at no additional cost to the Owner.

3.2 REMOVAL OF FORMS AND SHORES

- A. The supporting forms and shoring shall not be removed until the members have acquired sufficient strength to support their weight and the loads superimposed thereon safely. The contractor will be responsible for obtaining competent personnel to determine not only the method of forming, but the sequence of removal to assure that this requirement is met. All form work shall be removed without damage to the concrete.
- B. The Contractor shall be guided in the removal of forms by ACI publication 347. The removal of forms and shoring shall be determined by the method of forming and supports. The removal of

forms and shoring must be related to the strength of concrete as determined by tests of job-cured specimens in accordance with procedures outlined in ACI 347 and ACI 301 and test cylinders prepared in accordance with ASTM C31 with compression tests performed in accordance with ASTM C39.

- C. Shoring shall be adequate in strength and shall be so designed and placed that the load from successive parts of the structure will be transmitted directly through the falsework without creating bending or shearing stresses in the concrete. Do not remove shores until supporting members have attained sufficient strength to carry the imposed loads.
- D. During the period that forms are in place on the concrete work, said forms shall always be kept wet.
- E. In removing plywood forms, no metal pinch bars shall be used, and special care shall be taken in stripping. Start at top edge or vertical corner where it is possible to insert wooden wedges. Wedging shall be done gradually and shall be accompanied by light tapping on plywood panels to crack them loose. Do not remove forms with a single jerk after it has been started at one end.
- F. Forms shall be left in place as long as possible to permit shrinkage away from concrete, and plywood forms shall be left in place until all other forms around are stripped and until there is no danger of damaging the concrete due to other work in the vicinity.
- G. Nothing herein shall be construed as relieving the Contractor of any responsibility for the safety of the structure.
- H. After stripping, Contractor shall properly protect all concrete from damage.

END OF SECTION 03 11 00

SECTION 03 11 31 - VOID FORMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes corrugated paper void form material to create a temporary support for the placement of structural concrete slabs, grade beams, or walls over expansive soils.
- B. Related Sections:
 - 1. Section 01 45 23 "Testing and Inspection Services".
 - 2. Section 03 33 00 "Architectural Concrete".
 - 3. Section 03 30 00 "Cast In Place Concrete".
 - 4. Section 03 20 00 "Concrete Reinforcing".
 - 5. Section 03 47 13 "Tilt Up Concrete".
 - 6. Section 03 38 16 "Unbonded Post Tensioned Concrete".

1.3 PERFORMANCE REQUIREMENTS

- A. All components of the formwork shall be designed to support all loads imposed during construction including weight of construction equipment, live loads, and lateral loads due to wind and imbalance or discontinuity of building components.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated including manufacturer's written installation instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver form materials in manufacturer's packaging with installation instructions.
- B. Store off ground in ventilated and protected area to prevent deterioration from moisture or damage.

1.6 QUALITY ASSURANCE

- A. Design, place, and maintain void forms or carton forms for cast in place concrete work in compliance with ACI 347 "Guide to Form Work" unless otherwise shown or specified.
- B. Testing Agency Qualifications: Refer Section 01 45 23.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads, but not less than 800 pounds per square foot. Interior components shall be constructs as shown below:
1. Extra Fast Decomposition – Non wax impregnated, plain kraft paper and a water soluble adhesive.
 2. Fast Decomposition – Non wax impregnated, plain kraft paper and a moisture resistant adhesive.
 3. Moderate Decomposition – Plain kraft paper with a wax impregnated medium, but non wax impregnated liners and a moisture resistant adhesive.
 4. Slow Decomposition – Plain kraft paper with wax impregnated medium / liners and a moisture resistant adhesive.
 5. Extra Slow Decomposition – Wet strength paper with wax impregnated medium / liners and a moisture resistant adhesive.

2.2 VOID BOXES

- A. Slabs: Use “Slab Void” with interior cell sizes 8”x8” or smaller, capable of sustaining a working load 800 psf, for slabs 8 inches thick or less. For slabs between 8 inches thick and 12 inches thick, void box shall be capable of sustaining a working load of 1000 psf. For slabs greater than 12 inches thick, consult with the structural engineer. For interior piers, provide pre-manufactured curved end units against top of piers for tight fit.
- B. Grade beams and walls: Rectangular shape as shown on plans. Trapezoidal void boxes are not acceptable. Provide end caps at ends of forms and corners. Provide pre-manufactured curved end units against top of piers for tight fit. Cartons shall be capable of sustaining a working load of 200 psf times the height of the pour (in feet), without significant deformation.
- C. Design and maintain void forms to maintain all vertical and lateral loads that might be applied until such loads can be supported by the concrete structure. This includes, but is not limited to, live load, dead load, and weight of moving equipment, height of concrete drop, vibrator frequency, ambient temperature, soil pressures, and lateral stability.
- D. Form material shall be designed to lose it strength upon prolonged contact with the moisture that normally accumulates beneath slabs and beams on grade. Sufficient deterioration to cushion uplift forces shall take place within a maximum of 8 weeks after placement of concrete.

2.3 RELATED PRODUCTS

- A. Protection Board: Used over carton forms under slabs and under grade beam or walls wider than 12 inches. 1/4-inch minimum hardboard.
- B. Soil Retainers: High density, polyethylene (HDPE). “Sure Retainer” by Motzblock or 1/2 inch thick “Backfill Retainer” by Sure Void Products. Retainers shall be sized such that they extend a minimum of 4 inches above the void box and 4 inches below the void box.

PART 3 - EXECUTION

3.1 CARTON FORMS

- A. A void shall be constructed below all structural elements supported by piers to separate these elements from the soil. Where carton forms are used to construct this void the construction shall comply with the following:
1. Seal discontinuous ends of carton forms and tape all joints with waterproof tape so that concrete will not enter the void space during placement of concrete. Do not leave gaps between carton form sections.
 2. Pre-manufactured carton forms with circular edges shall be used around all drilled piers. Cutting of square carton forms is not acceptable.
 3. Do not allow any portion of carton forms to fall within the circumference of piers causing reduction in bearing area.
 4. Protect carton forms from water. Do not install carton forms during wet weather or on wet ground. Carton forms which become wet prior to placement of concrete shall be removed and replaced.
 5. Protect carton forms, from puncturing, collapsing, or crushing during construction. All damaged carton forms must be replaced prior to concrete placement.
 6. Exercise care in placement of concrete to avoid collapse of carton forms. If carton forms collapse, soil beneath the concrete shall be dug out and a proper void space shall be created and protected by installing the specified soil retainers.
 7. Carton forms wrapped in plastic to protect them from water, shall have the plastic ripped or punctured immediately prior to concrete placement.
- B. Carton Forms Under Slabs
1. Carton forms under slabs shall be protected on top by a protection board as specified with the specified vapor retarder on top of the protection board.
 2. Carton forms shall not be placed under soil supported slabs on grade.

END OF SECTION 03 11 31

SECTION 03 15 00 - CONCRETE ACCESSORIES

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Conditions of the Contract and the General Requirements are hereby made a part of this Section.

1.2 WORK INCLUDED

- A. The Work under this Section includes all material, labor, equipment and supervision to install anchor bolts, to install formwork and reinforcing steel for cast-in-place concrete and to epoxy coat exposed reinforcement as shown on the Drawings.

1.3 RELATED WORK

- A. The following work is related to this Section:

Demolition Section 02 41 16
Cast-in-Place Concrete Section 03 30 00

1.4 QUALITY ASSURANCE

- A. Materials and installed work may be reviewed by the Engineer at any time during the progress of the Work.

1.5 SUBMITTALS

- A. Contractor shall submit to the Engineer copies of the Manufacturers Specs. Data Sheets and Health and Safety Data Sheets for the following:

Reinforcement
Form Coating
Anchor Bolt Fastening System
Epoxy Coating
Permanent Compressible Joint Filler
Expansion Joint Assembly

1.6 DELIVERY, STORAGE AND HANDLING

- A. Store all materials clear of ground, protected, so as to preclude damage.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. Forms for Concrete Surfaces: APA exterior plyform BB or metal forms. Forms shall be clean and straight with mortar tight joints.

- B. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces to be cured with water or curing compound. Form oil shall be similar to that manufactured by Nox-Crete Company.

2.2 ANCHOR BOLT FASTENING SYSTEM

- A. Provide sizes indicated on the Drawings.

Provide one of the following embedded anchor systems:

1. "HILTI HIT Fastening System" By HILTI, Inc. Fastening Systems.
2. "HILTI HVA Adhesive Anchors" By HILTI, Inc. Fastening Systems.
3. "Molly Parabond Capsule Anchors" By Molly Fastener Group.
4. or Approved Equivalent.

2.3 REINFORCING MATERIALS

- A. Reinforcing Bars: ANSI/ASTM A615, grade 60 unless noted.
- B. Field Applied Epoxy Coating Materials for Existing Steel Reinforcement and Embedded Items.
- C. Provide one of the following epoxy coatings for existing steel reinforcement and miscellaneous metals that are to be embedded in concrete:
 1. "Sikagard 62 with Tan, Grey, Yellow or Green Pigment" by Sika Chemical Corp., Lyndhurst, N.J.
 2. or Approved Equivalent.

2.4 PERMANENT COMPRESSIBLE JOINT FILLER

- A. Joint filler in grout pockets and joints - as indicated on the Drawings. Acceptable products are:
 1. "Flexcell" by Celotex Corporation
 2. "Sonoflex F" by Sonneborn Building Products, Minneapolis, MN
 3. "Ceramar Flexible Foam E. J. Filler" by W.R. Meadows, Elgin, IL.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design: The design, engineering and proper construction of the formwork shall be the responsibility of the Contractor. Design formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces, the structure and adjacent materials. Formwork shall be braced properly to prevent displacement under vibration or sagging between supports.
- B. Edge Forms and Screed Strips for Overlay: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed compacting type screeds.
- C. Preparation of Form Surfaces: Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.
- D. Removal of Forms: Concrete formwork shall not be disturbed until the concrete has hardened to be able to support its own weight.

- E. Re-Use of Forms: Clean and repair surfaces of forms to be re-used in Work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.
 - 1. Do not use "patched" forms for exposed concrete surfaces.
- F. Tolerances: Comply with tolerances for formed surfaces as defined in ACI 301, Chapter 4, except as herein modified.

3.2 ANCHOR BOLT FASTENING SYSTEM

- A. Install anchor bolts according to manufacturer's recommendations.

3.3 EPOXY COATING FOR EXISTING REINFORCEMENT

- A. Preparation: Existing reinforcing and miscellaneous metal to remain shall be cleaned of rust and latency to Near White Metal.
- B. Installation: Existing reinforcing and miscellaneous metals that are to be embedded in concrete shall be epoxy coated in accordance with manufactures recommendations. Epoxy shall be cured prior to concrete placement.

3.4 SUPPLEMENTAL REINFORCEMENT

- A. Placing Reinforcement: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.
 - 1. Clean reinforcement of loose rust and mill scale, oil, earth and other materials which reduce bond with concrete.
 - 2. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations.
 - 3. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- B. Splices: Provide standard reinforcement splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements of ACI 318 for minimum lap of spliced bars.

END OF SECTION 03 15 00

SECTION 03 15 00 – CONCRETE ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes wheel stops.

1.3 SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For each type of exposed finish requiring color selection.
- C. Samples for Verification: For wheel stops, 6 inches (150 mm) long showing color and cross section; with fasteners.

PART 2 - PRODUCTS

2.1 PARKING BUMPERS

- A. Concrete Wheel Stops: Precast, steel-reinforced, air-entrained concrete, 4000-psi (27.6-MPa) minimum compressive strength, 6 inches (153 mm) high by 6 inches (153 mm) wide by 72 inches (1800 mm) long. Provide chamfered corners, transverse drainage slots on underside, and a minimum of two factory-formed or -drilled vertical holes through wheel stop for anchoring to substrate.
 - 1. Surface Appearance: Free of pockets, sand streaks, honeycombs, and other obvious defects. Corners shall be uniform, straight, and sharp.
 - 2. Mounting Hardware: As standard with wheel-stop manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WHEEL STOP INSTALLATION

- A. General: Install wheel stops according to manufacturer's written instructions unless otherwise indicated.
- B. Install wheel stops in bed of adhesive before anchoring.
- C. Securely anchor wheel stops to pavement with hardware in each preformed vertical hole in wheel stop as recommended in writing by manufacturer. Recess head of hardware beneath top of wheel stop.

END OF SECTION 03 15 00

SECTION 03 15 13 - WATERSTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Provision of waterstops embedded in concrete and spanning control, expansion, and/or construction joints to create a continuous diaphragm to prevent fluid migration.
- B. Non-metallic waterstops for use in concrete joints subjected to chlorinated water, sea water, and many waterborne chemicals.
- C. Non-metallic waterstops for use in concrete joints subjected to acids, bases, alcohols, oils, solvents, or other chemicals.

1.3 REFERENCES

- A. PVC WATERSTOP
 1. Corps of Engineers: CRD-C 572-74
 2. American Society for Testing Materials (ASTM)
 3. Bureau of Reclamation: C-902
 4. Canadian General Standards Board: 41-GP-35M Types 1 & 3
 5. ACI 350.2: Concrete Structures for Containment of Hazardous Materials
- B. HYDROPHILIC WATERSTOP
 1. American Society for Testing Materials (ASTM)

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store waterstops under tarps to protect from oil, dirt, sunlight, and premature exposure to water.

1.5 SUBMITTALS

- A. Submit shop drawings and fabrication drawings indicating placement of waterstops and shop fabrications.
- B. Submit manufacturer's test data for chemical resistance.

PART 2 - PRODUCTS

2.1 PVC WATERSTOPS FOR EXPANSION JOINTS

- A. Provide flexible PVC (polyvinyl chloride) waterstop as manufactured by Greenstreak or approved equal.

- B. The PVC waterstop shall be extruded from an elastomeric plastic material of which the basic resin is prime virgin polyvinyl chloride. The PVC compound shall not contain any scrapped or reclaimed material or pigment whatsoever.
- C. Profile: Ribbed with center bulb.
- D. Dimensions: 6 inches by 3/8 inch thick.
- E. Performance Requirements as follows:

Property	Test Method	Required Limits
Water absorption	ASTM D 570	0.15% max
Tear Resistance	ASTM D 624	200 lb/in (35 kN/m) min.
Ultimate Elongation	ASTM D 638	350% min.
Tensile Strength	ASTM D 638	2000 psi min.
Low Temperature Brittleness	ASTM D 746	No Failure @ -35o F
Stiffness in Flexure	ASTM D 747	600 psi min.
Specific Gravity	ASTM D 792	1.45 max.
Hardness, Shore A	ASTM D 2240	79 +3
Tensile Strength after accelerated extraction	CRD-C 572	1850 psi min.
Elongation after accelerated extraction	CRD-C 572	300% min.
Effect of Alkalis after 7 days: Weight Change Hardness Change	CRD-C 572	between -0.10% / +0.25% +/- 5 points

2.2 CHEMICALLY RESISTANT FLEXIBLE WATERSTOP

- A. Thermoplastic elastomeric rubber waterstops resistant to oil, solvents, and chemicals as manufactured by Westec or approved equal.
- B. Chemical resistance testing to be performed by independent ASTM certified laboratory.
- C. Profile: Ribbed with center bulb
- D. Dimensions: 6 inches by 3/8 inch thick.
- E. Performance requirements as follows:

Property	Test Method	Unexposed Value
Tensile Strength	ASTM D638	2000 psi
Ultimate Elongation	ASTM D638	450%
100% Modulus	ASTM D638	1000 psi
Shore A Hardness	ASTM D2240	85 units
Low Temp Brittleness	ASTM D746	No Failure @ -70 F

- F. Waterstop material should show less than +/- 30% change in material properties, including weight gain after 7-day exposure to selected chemicals, per ASTM D 471 testing.

2.3 HYDROPHILIC WATERSTOP FOR NON-MOVING CONTRACTION AND CONSTRUCTION JOINTS

- A. Provide hydrophilic rubber waterstop as supplied by Greenstreak, HYDROTITE profile style number (fill in profile style number).
- B. The waterstop shall be a combination of chloroprene rubber and chloroprene rubber modified to impart hydrophilic properties.
- C. The waterstop shall have a delay coating to inhibit initial expansion due to moisture present in fresh concrete.
- D. Performance Requirements as follows:

Chloroprene Rubber

Property	Test Method	Required Limits
Tensile Strength	ASTM D 412	1300 PSI min.
Ultimate Elongation	ASTM D 412	400% min.
Hardness (Shore A)	ASTM D 2240	50 +/- 5
Tear Resistance	ASTM D 624	100 lb/inch min.

Modified Chloroprene (Hydrophilic) Rubber

Property	Test Method	Required Limits
Tensile Strength	ASTM D 412	350 PSI min.
Ultimate Elongation	ASTM D 412	600% min.
Hardness (Shore A)	ASTM D 2240	52 +/- 5
Tear Resistance	ASTM D 624	50 lb/inch
Expansion Ratio	Volumetric Change - Distilled Water @ 70o F	3 to 1 min.

2.4 ACCESSORIES

- A. PVC and Chemically Resistant Waterstops
 - 1. Provide factory made waterstop fabrications for all changes of direction, intersections, and transitions leaving only straight butt joint splices for the field.
 - 2. Provide hog rings or grommets spaced at 12 inches on center along length of waterstop.
 - 3. Provide Teflon coated thermostatically controlled waterstop splicing irons for field butt splices.
 - 4. Splices to be free from defects.
- B. Hydrophilic Waterstops
 - 1. Provide Greenstreak 7300 two component epoxy gel to secure HYDROTITE to rough, wet (or dry) concrete.

2. Provide LEAKMASTER single component hydrophilic sealant to secure HYDROTITE to rough, dry concrete.
3. Provide cyanacrylate adhesive (super glue) for all splices.
4. Provide LEAKMASTER as addition to cyanacrylate adhesive at all splices for added insurance (Optional).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. PVC and Chemically Resistant Waterstops
1. Field butt splices shall be heat fused welded using a Teflon covered thermostatically controlled waterstop splicing iron at approximately 380 degrees F. Follow approved manufacturer recommendations.
 2. Lapping of waterstop, use of adhesives, or solvents shall not be allowed.
 3. Center waterstop in joint and secure waterstop in correct position using hog rings or grommets spaced at 12" on centers along the length of the waterstop and wire tie to adjacent reinforcing steel.
 4. Install in longest lengths practicable.
 5. Ensure steel reinforcing bars do not interfere with proper position of waterstop.
 6. Clean concrete joints of dirt and construction debris prior to second pour of concrete.
 7. Cut waterstop ends with miter guide and circular saw to ensure good, full contact at joints.
 8. At expansion joints, keep center bulb unembedded at joint centerline.
- B. Hydrophilic Waterstop
1. Cut coil ends square (or at proper angle for mitered corners) with shears or sharp blade to fit splices together without overlaps.
 2. Splices shall be sealed using cyanoacrylate adhesive (super glue) and LEAKMASTER (LEAKMASTER is optional).
 3. Seal watertight any exposed cells of HYDROTITE using LEAKMASTER.
 4. Follow approved manufacturer written recommendations.
 5. Install in longest length practicable.
- C. Hydrophilic and PVC Intersections
1. Maintain continuity of waterstops at all intersections and transitions.
 2. Joinery between PVC and HYDROTITE shall be sealed using LEAKMASTER.
 3. Follow approved manufacturer written recommendations.
- D. Retrofit Waterstop
1. Prepare existing concrete by grinding away irregularities. Clean concrete to ensure good epoxy bond.
 2. Apply continuous bed of epoxy to concrete 1/8 inch thick.
 3. Embed retrofit waterstop in uncured epoxy.
 4. Mechanically fasten waterstop to concrete using stainless steel batten bars and anchor bolts staggered 6 inches OC max. Use batten bars on top and bottom.
 5. Tool continuous layer of epoxy over batten bars and bolts to protect from corrosion.
 6. Use expansion joint filler at moving joints to minimize shear stresses.

- E. Concrete Placement at Waterstop
1. Carefully place concrete without displacing waterstop from proper position.
 2. Thoroughly and systematically vibrate concrete around waterstop to obtain impervious, void free concrete in vicinity of joint and to maximize intimate contact between concrete and waterstop.
 3. After first pour, clean un-embedded waterstop leg to ensure full contact of second pour concrete.

END OF SECTION 03 15 13

SECTION 03 20 00 - CONCRETE REINFORCEMENT

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION OF REQUIREMENTS

- A. Work Included: Perform all work necessary and required for the construction of the project as indicated. Such work includes but is not necessarily limited to the furnishing and installing of all reinforcing steel for the cast-in-place work and related items necessary to complete the work indicated on the drawings and described in the specifications.
- B. Related Work in Other Section: The following items of associated work are included in other sections of these specifications:
 - 1. Concrete Formwork
 - 2. Cast-In-Place Concrete
 - 3. Anchors and miscellaneous metal items and inserts to be embedded in concrete.
 - 4. Post-Tensioned Concrete

1.2 CODES AND STANDARDS

- A. Except as modified by the requirements specified herein and/or the details on the drawings, all work included in this section shall conform to the applicable provisions of the following codes and standards.
- B. Concrete Reinforcing Steel Institute (CRSI):
 - 1. "Reinforced Concrete - A Manual of Standard Practice"
 - 2. "Recommended Practice for Placing Reinforcing Bars"
 - 3. "Recommended Practice for Placing Bar Supports"
- C. American Concrete Institute (ACI):
 - 1. "Building Code Requirements for Reinforced Concrete", ACI 318
 - 2. "Manual of Standard Practice for Detailing Reinforced Concrete Structures", ACI 315
 - 3. "Specifications for Structural Concrete Buildings", ACI 301
- D. American Society for Testing and Materials (ASTM): The specifications and standards hereinafter referred to latest edition.
- E. Local Ordinances

1.3 SUBMITTALS

- A. Fully detailed shop drawings, including bending schedules and bending diagrams, shall be submitted to the Engineer for approval. Shop drawings shall show placing details and size and location of all reinforcing steel.
- B. Shop drawings shall be of such detail and completeness that all fabrication and placement at the site can be accomplished with the use of the shop drawings. Shop drawings shall include number of pieces, sizes, and markings of reinforcing steel, accessories, and any other information required for fabrication and placement.

- C. Complete shop and placing drawings for all reinforced concrete work shall be drawn to a scale of 1/8" = 1'-0" or larger. Detail wall reinforcement on 1/4" = 1'-0" scale elevations. If so, detailed on structural plans, detail the top and bottom reinforcement on separate plans, each showing all bars, details, accessories, etc., required for proper fabrication and placement of that portion of the reinforcement.
- D. Contractor shall check architectural, structural, mechanical, and electrical project or contract drawings for anchor bolt schedules and location, anchors, inserts, conduits, sleeves, and any other items which are required to be cast in concrete, and shall make necessary provisions as required so that reinforcing steel will not interfere with the placement of such embedded items.
- E. Reinforcing steel shall not be fabricated or placed before the shop drawings have been approved by the Engineer and returned to the Contractor. Approval of shop drawings by the Engineer will not relieve the Contractor of responsibility for errors or for failure in accuracy and complete placing of the work.
- F. Two copies of mill affidavits, stating the grades and physical and chemical properties of the reinforcing steel, shall be submitted to the Engineer before delivery of the steel to the job site.

1.4 PRODUCT HANDLING

- A. Steel reinforcement shall be transported to the building site, stored, and covered in a manner which will ensure that no damage shall occur to it from moisture, dirt, grease, or any other cause that might impair bond to concrete. A sufficient supply of approved reinforcing steel shall be stored on the building site at all times to ensure that there will be no delay of the work. Identification of steel shall be maintained after bundles are broken.

1.5 STORAGE AND PROTECTION

- A. Schedule reinforcement deliveries to minimize on site storage. Where such storage is unavoidable, place the reinforcement on blocks and cover.
- B. Mild steel reinforcement at the time of placement of concrete shall be clean and free of all loose dirt, form oil, and other coatings affecting bond.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Reinforcing bars shall be new, deformed billet steel bars, conforming to ASTM A615, Grade 60 (#3 bars may conform to ASTM A615, Grade 40).
- B. Welded wire fabric shall be new, rectangular welded steel wire fabric, conforming to ASTM A185.
- C. Anchoring hardware shall conform to the requirements set forth in the ACI 318 "Standard Building Code for Reinforced Concrete".
- D. Reinforcing steel shall be bundled and tagged with grades and suitable identification marks for checking, sorting, and placing. Tags and markings shall be waterproof and shall not be removed until steel is placed.
- E. Reinforcement accessories, consisting of spacers, chairs, ties, and similar items shall be provided as required for spacing, assembling and supporting reinforcement in place. All accessories shall be of plastic tipped galvanized steel, stainless steel or approved plastic conforming to the applicable requirements of the CRSI Standards hereinbefore specified.

- F. Tie wires for reinforcement shall be 16 gage or heavier, where noted or specified, black or galvanized steel wire conforming to ASTM A82.

2.2 FABRICATION

- A. Fabrication of steel reinforcement shall be in accordance with the details shown on the drawings and approved shop drawings. Where specific details are not shown or noted, comply with the applicable requirements of the "Codes and Standards" hereinbefore specified.
- B. Bars shall be accurately bent, cut, and placed as indicated on the drawings. Bars shall be bent cold; heating of bars will not be permitted. Bars shall not be bent or straightened in any manner that will injure the material.

PART 3 - EXECUTION

3.1 PLACING

- A. Reinforcing steel shall be placed in accordance with the drawings and approved shop drawings and the applicable requirements of the "Codes and Standards" hereinbefore specified. Install reinforcement accurately and secure against movement, particularly under the weight of workmen and the placement of concrete.
- B. Bars shall be supported on chairs or spacers on metal hangers, accurately placed and securely fastened to steel reinforcement in place. Additional bars shall be supplied whether specifically shown on the drawings or not where necessary to securely fasten reinforcement in place. Support legs of accessories in forms without embedding in form surface. Spacing of chairs and accessories shall conform with CRSI's "Recommended Practice for Placing Bar Supports." Hooping and stirrups shall be accurately spaced and wired to the reinforcing. No wood or clay brick will be permitted inside forms.
- C. All reinforcing shall be set in place, spaced, and rigidly and securely tied or wired at all splices and at all crossing points and intersections in the position shown, or as directed. Re-bending of bars on the job to fix existing conditions will not be permitted without the written approval of the Engineer. Point ends on wire ties away from forms.
- D. Minimum center to center distance between parallel bars shall be in accordance with the details on the drawings or, where not shown, the clear spacing shall be 1-1/2 times the bar diameter but in no case less than 1-1/2 inches nor less than 1-1/3 times the maximum size aggregate.
- E. Laps of splices, where shown or noted on drawings, shall be adequate to transfer stress by bond. Unless shown otherwise on drawings, lap bars a minimum of 32 diameters but in no case less than 12 inches. Whenever possible, splices of adjacent bars shall be staggered.
- F. Welded wire fabric shall be in as long lengths as practicable and shall be wired at all laps and splices. Laps shall be ten inches (10"). End laps shall be offset in adjacent widths. Fabric shall be supported at four-foot maximum intervals by chairs or concrete bricks.
- G. Dowels shall be tied securely in place before concrete is deposited. In the event there are no bars in position to which dowels may be tied, No. 3 minimum shall be added to provide proper support and anchorage. Bending of dowels after placement of concrete will not be permitted.
- H. Except where shown otherwise on the drawings, the minimum concrete coverage for steel reinforcement shall be as follows:
 - 1. Where concrete is placed against earth.....3 inches
 - 2. Over column ties.....1-1/2 inches

3. Formed walls.....1-1/2 inches for bars No. 5 and smaller, and 2 inches for bars over No. 5 in size.
4. Suspended slabs.....1 inch for #11 and smaller 1-1/2 inches for greater than #11.

3.2 NOTIFICATION

- A. Contractor shall notify the Engineer at least 72 hours ahead of each concrete pour, and no concrete shall be placed until all reinforcing steel has been installed by the Contractor and approved by the Engineer.

3.3 CORRECTION DURING CONCRETING

- A. Capable ironworkers shall be kept on the work at all times during the placing of concrete and shall properly reset any reinforcement displaced by runways, workmen or other causes.

3.4 DEFECTIVE WORK

- A. The following reinforcing steel work will be considered defective and may be ordered by the Engineer to be removed and replaced by the Contractor at no additional cost to the Owner.
 1. Bars with kinks or bends not shown on drawings.
 2. Bars injured due to bending or straightening.
 3. Bars heated for bending.
 4. Reinforcement not placed in accordance with the drawings and/or specifications.

END OF SECTION 03 20 00

SECTION 03 20 00 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cast-in-place concrete reinforcement, for the following:
1. Footings and/or piers.
 2. Foundation walls.
 3. Slabs-on-grade.
 4. Suspended slabs.
 5. Concrete toppings.
 6. Building frame members.
 7. Building walls.
- B. Related Sections:
1. Section 01 45 23 "Testing and Inspection Services".
 2. Section 03 10 00 "Concrete Forming and Accessories".
 3. Section 03 30 00 "Cast In Place Concrete".
 4. Section 03 47 13 "Tilt Up Concrete".
 5. Section 03 38 16 "Unbonded Post Tensioned Concrete".
 6. Section 04 22 00 "Concrete Unit Masonry".
 7. Section 31 20 00 "Earth Moving".
 8. Section 31 63 29 "Drilled Concrete Piers".

1.3 REFERENCES

- A. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
1. American Concrete Institute (ACI)
 - a. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials.
 - b. ACI 301 – Specifications for Structural Concrete for Buildings
 - c. ACI 315 – Details and Detailing of Concrete Reinforcement
 - d. SP-66 ACI Detailing Manual
 2. American Welding Society (AWS)
 - a. AWS D1.1 – Structural Welding Code
 3. Concrete Reinforcing Steel Institute (CRSI)
 - a. CRSI – Manual of Standard Practice
 - b. CRSI 63 – Recommended Practice for Placing Reinforcing Bars
 - c. CRSI 65 – Recommended Practice for Placing Bar Supports, Specifications and Nomenclature.
 4. American Society of Testing Materials (ASTM)

- a. ASTM-A185: Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete Reinforcement.
 - b. ASTM-A663: Standard Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties.
 - c. ASTM-A615: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - d. ASTM-A675: Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties.
 - e. ASTM-A706: Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
 - f. ASTM-A775: Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
 - g. ASTM-A884: Standard Specification for Epoxy-Coated Wire and Welded Wire Reinforcement.
- B. In the case of conflict between the Contract Documents and a reference standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement, according to ACI 315 "Details and Detailing of Concrete Reinforcement."
 1. Do not reproduce the structural drawings for use as shop drawings.
- C. Bar Supports: Submit manufacturer's product information for bolsters, chairs, spaces, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency, installer, and fabricator as indicated herein.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
 1. Steel reinforcement and accessories.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Refer Section 01 45 23.
- B. Installer Qualifications: An experienced installer who has completed reinforcing installation work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in service performance.

- C. Fabricator Qualifications: An experienced fabricator who has completed reinforcing fabrication work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in service performance.
- D. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4, "Structural Welding Code - Reinforcing Steel."
- E. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings, if any, on steel reinforcement.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Reinforcing Bars: ASTM A 615, Grade 60 or Grade 75 as indicated on Drawings, deformed.
- C. Low-Alloy-Steel Reinforcing Bars for bars to be welded: ASTM A 706, Grade 60 for #6 and smaller bars, Grade 75 for #7 and larger bars, deformed.
- D. Add the following paragraph below for stainless-steel reinforcement. Retain one of two options for reinforcement type.
- E. Stainless-Steel Reinforcing Bars: ASTM A 955, Grade 60, [Type 304] [Type 316L], deformed.
- F. Steel Bar Mats: ASTM A 184, fabricated from ASTM A 615, Grade 60 or ASTM A 706, deformed bars, assembled with clips.
- G. Plain-Steel Wire: ASTM A 82, as drawn.
- H. Deformed-Steel Wire: ASTM A 496.
- I. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.
- J. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

2.2 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar support contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 - 2. Use wire bar type supports complying with CRSI recommendations, unless otherwise indicated. Do not use wood, brick, or other unacceptable materials.

2.3 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice." Combined tolerances for formwork, reinforcing fabrication, and reinforcing placement shall not permit a reduction in specified concrete cover of reinforcing steel. In case of fabricating errors, do not bend or straighten reinforcement in a manner that will injure or weaken material. Bars used for concrete reinforcement shall meet following requirements for fabricating tolerances:
 - 1. Sheared length: Plus or minus 1 inch.
 - 2. Depth of truss bars: Plus 0, minus ½ inch.
 - 3. Overall dimensions of stirrups, ties, and spirals: Plus or minus ½ inch.
 - 4. Other bends: Plus or minus 1 inch.
- B. For bars with end bearing splice couplers, bar ends shall terminate in flat surfaces, within 1.5 degrees of a right angle to axis of bars and shall be fitted within 3 degrees of full bearing after assembly.

2.4 DOWEL BAR ANCHORS/SPLICERS

- A. Provide dowel bar anchors and threaded dowels designed to develop, both in tension and compression, 125% of the minimum ASTM specified yield strength of the dowel bars, as evidenced by published I.C.B.O. test reports. Unless otherwise indicated, anchors shall be furnished with ACI standard 90 degree hooks. Dowels shall be furnished by anchor supplier. The following dowel splicing systems are acceptable.
 - 1. Richmond Screw Anchor "Dowel Bar Splicer"
 - 2. Erico "Lenton Form Saver"
 - 3. Dayton Barsplice "Grip-Twist"

2.5 MECHANICAL SPLICES

- A. Provide mechanical splices designed to develop, both in tension and compression, 125% of minimum ASTM yield strength of the smaller bar being coupled, as evidenced by published I.C.B.O test reports. The following bar splicing systems are acceptable.
 - 1. Erico "Cadweld C-Series"
 - 2. Erico "Lenton"
 - 3. Dayton Barsplice "Bar Grip"

4. Dayton Barsplice "Grip Twist"

2.6 METAL ANCHORAGE AND EMBEDDED METAL ASSEMBLIES

- A. Steel Shapes and Plates: Conform to ASTM A36, "Specification for Structural Steel".
- B. Headed Stud Anchors: Headed studs welded by full fusion process, as furnished by TRW Nelson Stud Welding Division.
- C. Welding Electrodes: AWS 5.5, Series E70.
- D. Welded Deformed Bar Anchors: Welded by full fusion process, as furnished by TRW Nelson Stud Welding Division.
- E. All metal assemblies exposed to earth, weather, or moisture, including exposure to a crawl space environment, shall be hot dip galvanized.

2.7 FABRICATION OF METAL ACCESSORIES AND EMBEDDED METAL ASSEMBLIES

- A. Fabricate and assemble structural steel items in the shop. Shearing, flame cutting, and chipping shall be done carefully and accurately. Holes shall be cut, drilled, or punched at right angles to the surface of metal and shall not be made or enlarged by burning. Holes shall be clean-cut without torn or ragged edges. Welded construction shall conform to AISC "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings," and AWS D1.1. Welding shall be done by AWS certified welders.
- B. Welding of deformed bar anchors and headed stud anchors shall be done by full fusion process equal to that of TRW Nelson Stud Welding Division of KSM Welding Services Division, Omark, Ind. A minimum of two headed studs shall be tested at start of each production period for proper quality control. Studs shall be capable of being bent 45 degrees without weld failure.
- C. Welding of reinforcement shall be done in strict accordance with AWS requirements, using recommended preheat temperature and electrode for type of reinforcement being welded. Bars larger than No. 9 shall not be welded. Welding shall be performed subject to the observance and testing laboratory. Under no circumstances is ordinary reinforcing (ASTM A615) to be welded.
- D. Coatings, where required, shall be applied after fabrication and prior to casting concrete.

PART 3 - EXECUTION

3.1 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.2 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 1. Weld reinforcing bars according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Provide minimum concrete covering for reinforcement as shown in the Structural General Notes.
- G. Place bars to following tolerances:
 1. Clear distance to formed surfaces: Plus or minus 1/4 inch.
 2. Minimum spacing between bars: Minus 1/4 inch.
 3. Top bars in slabs and beams:
 - a. Members 8 inches deep or less: Plus or minus 1/4 inch.
 - b. Members between 8 and 24 inches deep: Plus or minus 1/2 inch.
 - c. Members more than 24 inches deep: Plus or minus 1 inch.
 4. Crosswise of members: Spaced evenly within 2 inches.
 5. Length of members: Plus or minus 2 inches.
- H. Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If moved more than one bar diameter, or enough to exceed above tolerances, resulting arrangement of bars subject to approval.
- I. Support reinforcement and fasten together to prevent displacement by construction loads or placing concrete beyond tolerances indicated.
- J. Unless permitted by Engineer, do not bend reinforcement after embedding in hardened concrete.

3.3 FIELD QUALITY CONTROL

- A. Testing and Inspecting: See Section 01 45 23.

- B. Inspections:
1. Steel reinforcement placement.
 2. Steel reinforcement welding.

END OF SECTION 03 20 00

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
1. Footings.
 2. Foundation walls.
 3. Slabs-on-grade.
 4. Suspended slabs.
 5. Concrete toppings.
 6. Building frame members.
 7. Building walls.
- B. Related Sections:
1. Section 01 45 23 "Structural Testing and Inspection Services".
 2. Section 03 20 00 "Concrete Forming and Accessories".
 3. Section 03 10 00 "Concrete Reinforcing".
 4. Section 03 11 31 "Void Forms".
 5. Section 03 15 13 "Waterstops".
 6. Section 03 05 80 "Under-slab Vapor Barrier – Retarder".
 7. Section 03 47 13 "Tilt Up Concrete".
 8. Section 31 63 29 "Drilled Concrete Piers and Shafts".

1.3 REFERENCES

- A. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
1. ACI 301 – Specification for Structural Concrete.
 2. ACI 302 – Guide for Concrete Floor Slab Construction.
 3. ACI 304 – Guide for Measuring, Mixing, Transporting and Placing Concrete.
 4. ACI 305 – Hot Weather Concreting.
 5. ACI 306 – Cold Weather Concreting.
 6. ACI 308 – Guide to Curing Concrete.
 7. ACI 309 – Guide for Consolidating Concrete.
 8. ACI 311 – ACI Manual for Concrete Inspection.
 9. ACI 318 – Building Code Requirements for Reinforced Concrete.
 10. ACI 347 – Guide to Concrete Formwork.
 11. ACI 207 – Mass Concrete.
 12. ACI 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.

13. ACI 211.2 – Standard Practice for Selecting Proportions for Structural Lightweight Concrete.
14. ACI 212.3 – Chemical Admixture for Concrete.
15. ACI 212.4 – Guide for the use of High Range Water Reducing Admixtures in Concrete.
16. ACI 214 – Evaluation of Strength Test Results of Concrete.
17. ACI 303 – Guide to Cast in Place Architectural Concrete Practice.
18. Concrete Reinforcing Steel Institute, “Manual of Standard Practice”.

- B. In the case of conflict between the Contract Documents and a referenced standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.4 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture include the following information. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
1. Each proposed mix design shall be accompanied by a complete standard deviation analysis based on at least 30 consecutive strength tests, or by three laboratory trial mixtures with confirmation tests.
 2. Proportions of cement, fine, and coarse aggregate, and water.
 3. Design strength.
 4. Maximum slump.
 5. Air Content.
 6. Maximum water / cement ratio.
 7. Maximum and minimum concrete temperature that is acceptable at time of placement for which the manufacturer can guarantee the strength of the concrete.
 8. Type cement and aggregates.
 9. Type and quantities of all admixtures.
 10. Air dry density and splitting tensile strength for lightweight concrete determined in accordance with ASTM 330.
 11. Type, color, and quantities of integral coloring compounds, where applicable.
 12. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Refer Section 03 20 00.
- D. Formwork Shop Drawings: Refer Section 03 10 00.
- E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
1. Location of construction joints is subject to approval of the Architect.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Fiber reinforcement.
 - 4. Curing compounds.
 - 5. Floor and slab treatments.
 - 6. Bonding agents.
 - 7. Adhesives.
 - 8. Semi rigid joint filler.
 - 9. Joint-filler strips.
 - 10. Repair materials.
- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- F. Field quality-control reports.
- G. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: See Section 01 45 23.
 - 1. Contractor's responsibility to testing laboratory.
 - a. Furnish all labor and materials as required to assist testing agency in obtaining, making and handling samples at the jobsite.
 - b. Advise the Owner's Testing Laboratory sufficiently in advance of operations to allow adequate time for the assignment of testing personnel.
 - c. Furnish and maintain adequate facilities for proper curing of concrete test specimens on the project site in accordance with ASTM C31.

- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code - Reinforcing Steel."
- F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specifications for Structural Concrete."
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- G. Mockups: Cast concrete slab-on-grade and formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.
 - 1. Build panel approximately 200 sq. ft. for slab-on-grade and 100 sq. ft. for formed surface in the location indicated or, if not indicated, as directed by Architect.
- H. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings, if any, on steel reinforcement.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. See Section 03 10 00.

2.2 STEEL REINFORCEMENT

- A. See Section 03 20 00.

2.3 REINFORCEMENT ACCESSORIES

- A. See Section 03 20 00.

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I or Type I/II, gray. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F or C. Carbon content shall not exceed 3 percent by volume.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years of satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 - 1. Maximum Coarse-Aggregate Size: 1-1/2 inches, 1 inch, or 3/4 inch nominal as indicated on Drawings for specific uses.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Lightweight Aggregate: ASTM C 330, 3/4-inch nominal maximum aggregate size.
- D. Water: ASTM C 94 and potable.

2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that contain not more than 0.05 percent water soluble chloride ions. Do not use calcium chloride or admixtures containing calcium chloride (except the chemical admixture Xypex).
 - 1. Water-Reducing Admixture: ASTM C 494, Type A.
 - 2. Retarding Admixture: ASTM C 494, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.
 - 7. Waterproofing Admixture: Xypex Admix C-1000
- C. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ChemMasters.
 - b. Davis Colors.
 - c. Dayton Superior Corporation.
 - d. Hoover Color Corporation.
 - e. Lambert Corporation.
 - f. QC Construction Products.
 - g. Rockwood Pigments NA, Inc.
 - h. Scofield, L. M. Company.

- i. Solomon Colors, Inc.
2. Color: As selected by Architect from manufacturer's full range.

2.6 FIBER REINFORCEMENT

- A. Synthetic Macro-Fiber: Polyolefin macro-fibers engineered and designed for use in concrete, complying with ASTM C 1116, Type III, 1 to 2-1/4 inches long.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. 3M; Scotchcast Polyolefin Fibers 2".
 - b. Euclid Chemical Company (The), an RPM company; Tuf-Strand SF.
 - c. FORTA Corporation; FORTA FERRO.
 - d. Grace Construction Products, W. R. Grace & Co.; Strux 90/40.
 - e. Nycon, Inc.; XL.
 - f. Propex Concrete Systems Corp.; Fibermesh 650.
 - g. Sika Corporation; Sika Fiber MS or MS10.

2.7 CONCRETE MIX DESIGNS

- A. Selection of Proportions: Proportions of ingredients for concrete mixes shall be determined by a qualified concrete supplier in accordance with the requirements of ACI 301.
- B. Required average strength above specified strength: Determination of required average strength above specified strength shall be based on the standard deviation record of the production facility in accordance with ACI 301. Calculation of standard deviation of compressive strength results shall be made in accordance with ACI 214. If a suitable record of strength tests is not available, proportions shall be selected on the basis of laboratory trial batches to produce an average strength greater than the strength f'_c by the amount defined in ACI 301.

2.8 VAPOR RETARDERS

- A. See Section 03 05 80.

2.9 FLOOR AND SLAB TREATMENTS

- A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, non-glazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100 percent passing No. 8 sieve.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Anti-Hydro International, Inc.; Emery.
 - b. Dayton Superior Corporation; Emery Tuff Non-Slip.
 - c. Lambert Corporation; EMAG-20.
 - d. L&M Construction Chemicals, Inc.; Grip It.
 - e. Metalcrete Industries; Metco Anti-Skid Aggregate.
- B. Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Anti-Hydro International, Inc.; A-H Alox.
 - b. L&M Construction Chemicals, Inc.; Grip It AO.

- c. Master Builders Solutions; MasterTop 120SR (Pre-2014: Frictex NS)

2.10 LIQUID FLOOR TREATMENTS

- A. VOC Content: Liquid floor treatments shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ChemMasters; Chemisil Plus.
 - b. ChemTec Int'l; ChemTec One.
 - c. Conspec by Dayton Superior; Intraseal.
 - d. Curecrete Distribution Inc.; Ashford Formula.
 - e. Dayton Superior Corporation; Day-Chem Sure Hard (J-17).
 - f. Edoco by Dayton Superior; Titan Hard.
 - g. Euclid Chemical Company (The), an RPM company; Euco Diamond Hard.
 - h. Kaufman Products, Inc.; SureHard.
 - i. L&M Construction Chemicals, Inc.; Seal Hard.
 - j. Meadows, W. R., Inc.; LIQUI-HARD.
 - k. Metalcrete Industries; Floorsaver.
 - l. Nox-Crete Products Group; Duro-Nox.
 - m. Symons by Dayton Superior; Buff Hard.
 - n. US SPEC, Division of US Mix Products Company; US SPEC Industraseal.
 - o. Vexcon Chemicals, Inc.; Vexcon StarSeal PS Clear.
- C. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Advanced Floor Products; Retro-Plate 99.
 - b. L&M Construction Chemicals, Inc.; FGS Hardener Plus.
 - c. QuestMark, a division of CentiMark Corporation; DiamondQuest Densifying Impregnator Application.

2.11 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
 - b. ChemMasters; SprayFilm.
 - c. Conspec by Dayton Superior; Aquafilm.
 - d. Dayton Superior Corporation; Sure Film (J-74).
 - e. Edoco by Dayton Superior; BurkeFilm.
 - f. Euclid Chemical Company (The), an RPM company; Eucobar.
 - g. Kaufman Products, Inc.; Vapor-Aid.
 - h. Lambert Corporation; LAMBCO Skin.

- i. L&M Construction Chemicals, Inc.; E-CON.
 - j. Master Builders Solutions; MasterKure ER 50 (Pre-2014: Conflim).
 - k. Meadows, W. R., Inc.; EVAPRE.
 - l. Metalcrete Industries; Waterhold.
 - m. Nox-Crete Products Group; MONOFILM.
 - n. Sika Corporation; SikaFilm.
 - o. SpecChem, LLC; Spec Film.
 - p. Symons by Dayton Superior; Finishing Aid.
 - q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
 - r. Unitex; PRO-FILM.
 - s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
 - b. ChemMasters; Safe-Cure Clear.
 - c. Conspec by Dayton Superior; W.B. Resin Cure.
 - d. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
 - e. Edoco by Dayton Superior; Res X Cure WB.
 - f. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
 - g. Kaufman Products, Inc.; Thinfilm 420.
 - h. Lambert Corporation; AQUA KURE - CLEAR.
 - i. L&M Construction Chemicals, Inc.; L&M Cure R.
 - j. Meadows, W. R., Inc.; 1100-CLEAR.
 - k. Nox-Crete Products Group; Resin Cure E.
 - l. Right Pointe; Clear Water Resin.
 - m. SpecChem, LLC; Spec Rez Clear.
 - n. Symons by Dayton Superior; Resi-Chem Clear.
 - o. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
 - p. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.
- F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ChemMasters; Polyseal WB.
 - b. Conspec by Dayton Superior; Sealcure 1315 WB.
 - c. Edoco by Dayton Superior; Cureseal 1315 WB.
 - d. Euclid Chemical Company (The), an RPM company; Super Diamond Clear VOX; LusterSeal WB 300.
 - e. Kaufman Products, Inc.; Sure Cure 25 Emulsion.

- f. Lambert Corporation; UV Safe Seal.
 - g. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
 - h. Master Builders Solutions; MasterKure CC 1315WB (Pre 2014: Kure1315).
 - i. Meadows, W. R., Inc.; Vocomp-30.
 - j. Metalcrete Industries; Metcure 30.
 - k. Right Pointe; Right Sheen WB30.
 - l. Symons by Dayton Superior; Cure & Seal 31 Percent E.
 - m. Vexcon Chemicals, Inc.; Vexcon Starseal 1315.
2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.12 RELATED MATERIALS

- A. Expansion and Isolation Joint Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
- B. Semi-rigid Joint Filler: Two-component, semi-rigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.13 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109.

- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109.

2.14 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of Portland cement, which would otherwise be used, as indicated in Structural General Notes.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 - 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
- E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.15 NON-SHRINK GROUT

- A. Grout shall be prepackaged, non metallic, and non gaseous. It shall be non-shrink when tested in accordance with ASTM-C1107 Grade B or C at a fluid consistency (flow cone) of 20 to 30 seconds. Thirty-minute-old grout shall flow through the flow cone after slight agitation, in temperatures of 40 degrees to 90 degrees Fahrenheit. Grout shall be bleed free and attain 7,500 psi compressive strength in 28 days at fluid consistency. Certified independent test data required. Approved products include the following:
 - 1. "Euco NS" by Euclid Chemical Company
 - 2. "Masterflow 713" by Master Builders.

2.16 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Proportion normal-weight concrete mixture as indicated in Structural General Notes:

2.17 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.18 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.
1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. See Section 03 10 00.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 2. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

- A. See Section 03 10 00.

3.4 SHORES AND RESHORES

- A. See Section 03 10 00.

3.5 VAPOR RETARDERS/BARRIERS

- A. See Section 03 05 80.

3.6 STEEL REINFORCEMENT

- A. See Section 03 20 00

3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 - 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants are specified or otherwise indicated.
 - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Do not permit concrete to drop freely any distance greater than 10'-0" for concrete containing a high range water reducing admixture or 5'-0" for other concrete. Provide chute or tremie to place concrete where longer drops are necessary. Do not place concrete into excavations with standing water. If place of deposit cannot be pumped dry, pour concrete through a tremie with its outlet near the bottom of the place of deposit.
- F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Scream slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleed water appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- G. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- H. Hot-Weather Placement: Comply with ACI 305 and as follows:
1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.9 FINISHING FORMED SURFACES

- A. See Section 03 10 00.

3.10 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
1. Apply scratch finish to surfaces indicated and/or to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
1. Apply float finish to surfaces indicated and/or to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Apply a trowel finish to surfaces indicated and/or exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 2. Finish surfaces according to ASTM E 1155, for a randomly trafficked floor surface.

- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated or where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
 - 1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
- G. Slip-Resistive Finish: Before final floating, apply slip-resistive finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:
 - 1. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive granules over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
 - 2. After broadcasting and tamping, apply float finish.
 - 3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive granules.

3.11 CONCRETE FLOOR FINISH TOLERANCES

- A. Interior Finish Floor surfaces to the following tolerances, measured within 24 hours according to ASTM E 1155, "Standard Test Method for Determining Floor Flatness and Levelness Using the F-Number System." The following values apply before removal of shores. Levelness values F(L) do not apply to intentionally sloped or cambered areas, nor to slabs poured on metal deck or precast concrete.
 - 1. Exposed, vinyl tiled, or thin-set tiled floors: Specified overall values of flatness, Ff =35; and levelness, FI =25; with minimum local values of flatness, Ff =24; and levelness, FI =17.
 - 2. Carpeted floors, floors under concrete toppings, thickset tile and terrazzo: Specified overall values of flatness, Ff =25; and levelness, FI = 20; with minimum local values of flatness, Ff =17; and levelness, FI =15.
- B. Floor Elevation Tolerance Envelope:
 - 1. The acceptable tolerance envelope for absolute elevation of any point on the slab surface, with respect to the elevation shown on the Drawings, is as follows:
 - a. Slab-on-Grade, or Slab-on-Void Construction: +/- 3/4"
 - b. Top surfaces of formed slabs measured prior to removal of supporting shores: +/- 3/4"
 - c. Top surfaces of all other slabs: +/- 3/4"
 - d. Slabs specified to slope shall have a tolerance from the specified slope of 3/8" in 10'-0" at any point, up to 3/4" from theoretical elevation at any point.

3.12 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-

place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.13 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.

- b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
- a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 2. Do not apply to concrete that is less than 28 days' old.
 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
- B. Polished Concrete Floor Treatment: Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.
1. Machine grind floor surfaces to receive polished finishes level and smooth and to depth required to reveal aggregate to match approved mockup.
 2. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
 3. Continue polishing with progressively finer grit diamond polishing pads to gloss level to match approved mockup.
 4. Control and dispose of waste products produced by grinding and polishing operations.
 5. Neutralize and clean polished floor surfaces.
- C. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.15 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least six month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semi-rigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.16 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written

instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.17 FIELD QUALITY CONTROL

- A. Testing and Inspecting: See Section 01 45 23.
1. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 2. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.18 PROTECTION OF LIQUID FLOOR TREATMENTS

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 03 30 00

SECTION 03 31 00 STRUCTURAL CONCRETE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Refer to Harris County Engineering Department (HCED) Specifications, dated October 10, 2023 or City of Humble specifications when working in public right of way.
- C. This section contains HCED items:
 - 1. 421 – Hydraulic Cement Concrete
 - 2. 800 – Hydraulic Cement
 - 3. 801 – Fly Ash

ITEM 421

HYDRAULIC CEMENT CONCRETE

421.1 DESCRIPTION.

This Item shall govern for hydraulic cement concrete to be used for concrete pavement, concrete structures, precast/prestressed concrete members, and other incidental concrete construction.

421.2 REFERENCES.

- A.** ACI 211.1 “Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete”
- B.** ACI 211.4R “Guide for Selecting Proportions for High-Strength Concrete Using Portland Cement & Other Cementitious Material”
- C.** ASTM C31 “Standard Practice for Making and Curing Concrete Test Specimens in the Field”
- D.** ASTM C33 “Standard Specification for Concrete Aggregates”
- E.** ASTM C39 “Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens”
- F.** ASTM C94 “Standard Specification for Ready-Mixed Concrete”
- G.** ASTM C131 “Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine”
- H.** ASTM C138 “Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete”
- I.** ASTM C143 “Standard Test Method for Slump of Hydraulic-Cement Concrete”
- J.** ASTM C172 “Standard Practice for Sampling Freshly Mixed Concrete”
- K.** ASTM C173 “Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method”

- L.** ASTM C231 “Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method”
- M.** ASTM C232 “Standard Test Method for Bleeding of Concrete”
- N.** ASTM C260 “Standard Specification for Air-Entraining Admixtures for Concrete”
- O.** ASTM C494 “Standard Specification for Chemical Admixtures for Concrete”
- P.** ASTM C618 “Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete”
- Q.** ASTM C685 “Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing”
- R.** ASTM C989 “Standard Specification for Slag Cement for Use in Concrete and Mortars”
- S.** ASTM C1064 “Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete”
- T.** ASTM C1240 “Standard Specification for Silica Fume Used in Cementitious Mixtures”
- U.** ASTM C1602 “Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete”
- V.** ASTM C1610 “Standard Test Method for Static Segregation of Self-Consolidating Concrete Using Column Technique”
- W.** ASTM C1611 “Standard Test Method for Slump Flow of Self-Consolidating Concrete”
- X.** ASTM C1621 “Standard Test Method for Passing Ability of Self-Consolidating Concrete by J-Ring”
- Y.** ASTM C1758 “Standard Practice for Fabricating Test Specimens with Self-Consolidating Concrete”
- Z.** ASTM D75 “Standard Practice for Sampling Aggregates”
- AA.** TxDOT “Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges” 2014 Edition

1. Item 421 “Hydraulic Cement Concrete”

BB. TxDOT Test Procedure:

1. Tex-203-F “Sand Equivalent Test”
2. Tex-401-A “Sieve Analysis of Fine and Coarse Aggregate”
3. Tex-402-A “Fineness Modulus of Fine Aggregate”
4. Tex-406-A “Material Finer than 75 μm (No. 200) Sieve in Mineral Aggregates (Decantation Test For Concrete Aggregates)”
5. Tex-408-A “Organic Impurities in Fine Aggregate for Concrete”
6. Tex-411-A “Soundness of Aggregate Using Sodium Sulfate or Magnesium Sulfate”
7. Tex-413-A “Determining Deleterious Material in Mineral Aggregate”

421.3 MATERIALS.

Hydraulic cement concrete shall be composed of cementitious materials, water, coarse and fine aggregate, and chemical admixtures.

Cementitious Materials. Cementitious materials are the cement and supplementary cementing materials used in concrete and shall conform to the following specifications. Cementitious materials shall be from a prequalified producer/supplier listed on TxDOT’s Material Producer List (MPL).

- A. Portland cement shall conform to the requirements of Item 800 “Hydraulic Cement.”

Supplementary Cementing Materials (SCM):

- B. Fly ash shall conform to the requirements of Item 801 “Fly Ash.”
- C. Slag cement shall conform to the requirements of ASTM C989.
- D. Silica fume shall conform to the requirements of ASTM C1240, Table 1 and Table 2.

- E. Metakaolin shall conform to the requirements of ASTM C618, Class N.

Mixing Water. Mixing water for concrete shall conform to the requirements of ASTM C1602.

Aggregates. Coarse and fine aggregates shall be from a producer/supplier listed on TxDOT's Material Producer List (MPL). Aggregate test requirements and gradation reports (Tables 1, 2, 3, and 4) shall be the responsibility of the Contractor. Test reports shall be provided at the discretion of HCED.

- A. **Coarse Aggregate.** Coarse aggregate shall consist of durable particles of gravel, crushed stone, or combinations thereof; free from frozen material or injurious amounts of salt, alkali, vegetable matter, or other objectionable material. Coarse aggregate shall meet the requirements in Table 1 unless otherwise shown on the Contract Documents.

TABLE 1

COARSE AGGREGATE REQUIREMENTS

DESCRIPTION	TEST METHOD	LIMIT
Weight of Clay Lumps, % Max.	Tex-413-A	0.25
Weight of Shale, % Max.		1.0
Weight of Laminate and Friable Particle, % Max.		5.0
L.A. Abrasion Wear, % Max.	ASTM C131	40
5-Cycle Magnesium Sulfate Soundness, non air-entrained concrete, % Max.	Tex-411-A	25
5-Cycle Magnesium Sulfate Soundness, air-entrained concrete, % Max.		18
Loss by Decantation, % Max.	Tex-406-A	1.5 ¹

1. Loss by decantation limit may be increased to 3.0% for all classes of concrete and 5.0% for Class A concrete if the material finer than the No. 200 sieve is determined to be at least 85% calcium carbonate in accordance with Tex-406-A, Part III, in the case of aggregates made primarily from crushing stone unless otherwise shown on the Contract Documents. Test results shall be provided upon request.

Coarse aggregate shall conform to the gradation requirements shown in Table 2 when tested in accordance with Tex-401-A unless otherwise specified.

TABLE 2
COARSE AGGREGATE GRADATION

GRADE NO. ¹	NOM. SIZE	PERCENT PASSING, BY WEIGHT ON SIEVE							
		2"	1-1/2"	1"	3/4"	1/2"	3/8"	No.4	No.8
2	1-1/2"	100	95-100		35-70		10-30	0-10	
3	1-1/2"	100	95-100		60-90	25-60		0-10	
4 (57)	1"		100	95-100		25-60		0-10	0-5
5 (67)	3/4"			100	90-100		20-55	0-10	0-5
8	3/8"					100	95-100	20-65	0-10

1. Corresponding ASTM C33 gradation shown in parentheses.

- B. Fine Aggregate.** Fine aggregate shall consist of clean, hard, durable and uncoated particles of natural or manufactured sand or a combination thereof. It shall be free from frozen material or injurious amounts of salt, alkali, vegetable matter or other objectionable material. Fine aggregates shall meet the requirements in Table 3 unless otherwise shown on the Contract Documents.

TABLE 3
FINE AGGREGATE REQUIREMENTS

DESCRIPTION	TEST METHOD	LIMIT
Weight of Clay Lumps, % Max.	Tex-413-A	0.50
Organic Impurities	Tex-408-A	Color not darker than standard
Sand Equivalent	Tex-203-F	80
Fineness Modulus	Tex-402-A	2.3 to 3.1

Fine aggregate shall conform to the gradation requirements shown in Table 4 when tested in accordance with Tex-401-A unless otherwise specified.

TABLE 4
FINE AGGREGATE GRADATION

SIEVE SIZE	PERCENT PASSING, BY WEIGHT
3/8"	100
No. 4	95 – 100
No. 8	80 – 100
No. 16	50 – 85
No. 30	25 – 65
No. 50	10 – 35 ¹
No. 100	0 – 10
No. 200	0 – 3 ²

1. 6 – 35 when sand equivalent value is greater than 85.
2. 0 – 6 for manufactured sand.

Chemical Admixtures. Chemical admixtures shall conform to the following requirements:

- A.** Air-entraining admixtures shall conform to the requirements of ASTM C260.
- B.** Chemical admixtures shall conform to the requirements of ASTM C494.

Admixtures containing calcium chloride are prohibited in any type of structural concrete.

Chemical admixture Type C, Type E, Type F, and Type G are prohibited in Class S bridge slab concrete.

Storage of Materials. Cement shall be stored in well ventilated weathertight buildings, bins, or silos which shall exclude moisture and contaminants.

Aggregate stockpiles shall be arranged and used in such a manner as to avoid contamination, with other materials or with other sizes of like aggregates. To ensure that this condition is met, any test for determining conformance to requirements for cleanliness and grading shall be performed on samples secured in accordance with ASTM D75. Sprinkle aggregate stockpiles to maintain uniform moisture content and temperature as necessary.

Chemical admixtures shall be stored in accordance with the manufacturer's recommendations. Liquid admixtures shall be protected from freezing and from temperature changes which would adversely affect their characteristics.

421.4 EQUIPMENT.

Excluding volumetric mixers, stationary and truck mixers shall be capable of combining all materials of the concrete into a thoroughly mixed and uniform mass and capable of discharging the concrete so at least 5 of the 6 requirements of ASTM C94, Annex A1 "Concrete Uniformity Requirements" are attained. Volumetric mixers shall conform to the requirements of ASTM C685.

All scales shall conform to the requirements of Item 520 "Weighing and Measuring Equipment."

421.5 CONSTRUCTION.

Concrete Classifications. Hydraulic cement concrete shall be classified as shown in Table 5.

**TABLE 5
 CONCRETE CLASSIFICATIONS**

CLASS	DESIGN STRENGTH¹ MIN. f'c (psi)	MAX. W/CM RATIO	COARSE AGGR. GRADE²	CEMENT TYPES	MIX DESIGN OPTIONS³	EXCEPTIONS TO MIX DESIGN OPTIONS	GENERAL USAGE⁴
A	3,000	0.60	2 - 4, 8	I, II, I/II, IL, IP, IS, IT, V	1, 2, 4, & 7	When the cementitious material content does not exceed 520 lb./cu. yd., any fly ash listed in the MPL may be used at a cement replacement of 20% to 50%.	Curb, curb & gutter, sidewalks, driveways, concrete medians, directional islands, riprap

CLASS	DESIGN STRENGTH ¹ MIN. f'c (psi)	MAX. W/CM RATIO	COARSE AGGR. GRADE ²	CEMENT TYPES	MIX DESIGN OPTIONS ³	EXCEPTIONS TO MIX DESIGN OPTIONS	GENERAL USAGE ⁴
C ⁵	3,600	0.45	2 - 5	I, II, I/II, IL, IP, IS, IT, V	1 - 8		Bridge substructure, bridge railing, headwalls, wingwalls, box culverts, inlets, manholes, concrete collars, traffic signal supports
E	3,000	0.50	2 - 5 ⁶	I, II, I/II, IL, IP, IS, IT, V	1 - 8	When the cementitious material content does not exceed 520 lb./cu. yd., any fly ash listed in the MPL may be used at a cement replacement of 20% to 50%.	Concrete pavement, concrete seal slabs
H ⁵	Note ⁷	0.45	3 - 5	I, II, I/II, III, IL, IP, IS, IT, V	1 - 4, 8	Mix design options 1-8 allowed for cast-in-place concrete and the following precast elements unless otherwise stated in the plans: <ul style="list-style-type: none"> ■ Traffic Rail, ■ Traffic Barrier, and ■ precast concrete products included in Items 462, 464, 465, and 466. Do not use Type III cement in mass placement concrete. Up to 20% of blended cement may be replaced with listed SCMs when Option 4 is used for precast concrete. Options 6, & 7 allowed for cast-in-place Class H concrete.	Precast concrete, prestressed concrete, post-tension members

CLASS	DESIGN STRENGTH ¹ MIN. f'c (psi)	MAX. W/CM RATIO	COARSE AGGR. GRADE ²	CEMENT TYPES	MIX DESIGN OPTIONS ³	EXCEPTIONS TO MIX DESIGN OPTIONS	GENERAL USAGE ⁴
P	4,000	0.50	2 - 3	I, II, I/II, IL, IP, IS, IT, V	1 - 8	When the cementitious material content does not exceed 520 lb./cu. yd., any fly ash listed in the MPL may be used at a cement replacement of 20% to 50%.	Concrete pavement
S ⁵	4,000	0.45	2 - 5	I, II, I/II, IL, IP, IS, IT, V	1 - 8		Drilled shafts, bridge slabs, approach slabs, top slabs of direct traffic culverts
T	4,500	0.50	2 - 3	I, II, I/II, IL, IP, IS, IT, V	1 - 8	When the cementitious material content does not exceed 520 lb./cu. yd., any fly ash listed in the MPL may be used at a cement replacement of 20% to 50%.	Concrete pavement
K ⁵	Note ⁷	0.40	Note ⁷	I, II, I/II, III, IL, IP, IS, IT, V	1 - 8		Note ⁷
HES ⁸	Note ⁷	0.45	Note ⁷	I, II, I/II, III, IL		Mix design options do not apply. 700 lbs. of cementitious material per cubic yard limit does not apply.	Concrete pavement, concrete pavement repair
"X" (HPC) 5,9,10	Note ¹¹	0.45	Note ¹¹	I, II, I/II, III, IL, IP, IS, IT, V	1 - 4, & 8	Maximum fly ash replacement for Option 3 may be increased to 50%. Up to 20% of blended cement may be replaced with listed SCMs for Option 4. Do not use Option 8 for precast concrete.	

CLASS	DESIGN STRENGTH ¹ MIN. f'c (psi)	MAX. W/CM RATIO	COARSE AGGR. GRADE ²	CEMENT TYPES	MIX DESIGN OPTIONS ³	EXCEPTIONS TO MIX DESIGN OPTIONS	GENERAL USAGE ⁴
"X" (SRC) 5,9,12	Note ¹¹	0.45	Note ¹¹	I/II, II, IL, IP, IS, IT, V	1 - 4, & 7	When using fly ash, only use fly ashes allowed for SRC as listed in the Fly Ash MPL. Type III-MS may be used where allowed. Type I and Type III cements may be use when fly ashes allowed for SRC as listed in the Fly Ash MPL are used, and with a maximum w/cm of 0.40. Up to 20% of blended cement may be replaced with listed SCMs when Option 4 is used for precast concrete. Use Option 7 for precast concrete where allowed.	

1. Design strength must be attained within 28-days.
2. Other grades of coarse aggregate maybe used in non-structural concrete classes when approved by HCED.
3. Option 6 and 8 are permissible for concrete mix designs as specified in Subsection A. "Mix Design Options."
4. For information only.
5. Structural concrete classes.
6. Use Grade 2 - 3 coarse aggregate in concrete pavement.
7. As shown on the Contract Documents or specified.
8. HES: High Early Strength.
9. "X" denotes class of concrete shown on the Contract Documents or specified.
10. (HPC): High Performance Concrete.
11. Same as class of concrete shown on the Contract Documents.
12. (SRC): Sulfate Resistant Concrete.

Mix Design Proportioning. Proportioning of concrete mix designs shall conform to ACI 211.1 or ACI 211.4R.

A. Mix Design Options. Concrete mix designs shall conform to one of the Mix Design Options (Option 1 through 5, or 7) as specified in TxDOT Item 421 "Hydraulic Cement Concrete." Mix Design Option 6 and 8 shall be permissible only for concrete mix designs previously

approved by TxDOT. If the Contractor elects at his/her expense to use Mix Design Option 6 or 8, he/she shall provide a certified test report signed and sealed by a licensed Professional Engineer that the proposed concrete mixture conforms to the requirements of the pertinent Mix Design Option.

- B. Cementitious Materials.** Cementitious materials shall not exceed 700 lbs. per cubic yard of concrete unless otherwise specified or approved by HCED.

The same cement type and same source shall be use for monolithic concrete placement.

Do not use Class C fly ash in sulfate-resistant concrete.

- C. Air Entrainment.** An air-entraining admixture shall be used when air-entrained concrete is specified, or when an air-entraining admixture is used at the Contractor's option, and shall not exceed the manufacturer's recommended dosage. Entrained air content shall be a minimum of 3.0 percent and maximum of 5.0 percent for all concrete when air-entrained concrete is specified, during trial batch, or when providing previous field data. Determine air content of air-entrained concrete in accordance with ASTM C173 or ASTM C231.
- D. Self-Consolidating Concrete (SCC).** Self-consolidating concrete shall be permissible only for use in precast/prestressed concrete and conform to the requirements of Table 6.

TABLE 6

MIX DESIGN REQUIREMENTS FOR SCC

TESTS	TEST METHOD	ACCEPTABLE LIMITS
Slump Flow, in.	ASTM C1611	22 to 27
T ₅₀ , sec.	ASTM C1611	2 to 7
VSI Rating	ASTM C1611	0 or 1
Passing Ability, in.	ASTM C1621	≤ 2
Segregation Column, %	ASTM C1610	≤ 10
Bleeding, %	ASTM C232	≤ 2.5

Concrete Characteristics. Concrete shall be capable of providing the following characteristics:

- A. Workability and consistency to permit concrete to be worked readily into forms and around reinforcement under conditions of placement without excessive segregation or bleeding.
- B. Meet the specified concrete classification design strength requirements in accordance with Table 5.
- C. Resistance to special exposure as required by HCED and as specified in the Contract Documents and in any Special Provisions.

Determine slump of concrete in accordance with ASTM C143. The concrete placement slump shall conform to the requirements of Table 7.

TABLE 7
CONCRETE PLACEMENT SLUMP

GENERAL USAGE ¹	SLUMP RANGE ² , INCHES
Walls (over 9 in. thick), caps, columns, piers, approach slabs, concrete overlays	3 to 5
Bridge slabs, top slabs of direct traffic culverts	3 to 5-1/2
Inlets, manholes, walls (less than 9 in. thick), bridge railing, culverts, concrete pavement	4 to 5-1/2
Concrete pavement (slip form paver)	1 to 3-1/2
Drilled shafts	5-1/2 to 7-1/2
Slurry displacement drilled shafts	7 to 9
Precast concrete, prestressed concrete	4 to 9
Curb, curb and gutter, sidewalk, driveways	2 to 4

- 1. For information only.
- 2. For fiber reinforced concrete, perform slump before addition of fibers.

Concrete Mix Design Evaluation and Acceptance. The concrete producer/supplier shall perform concrete trial batch testing and provide the following documentation verifying the concrete mix conforms to the specification requirements.

- A. Concrete Mix Design
- B. Material Sources

- C.** Proportions
- D.** TxDOT Mix Design Option
- E.** Concrete Trial Batch Test Results

Concrete Trial Batch Testing shall be completed by personnel with proper ACI certification. Sample freshly mixed concrete for testing in accordance with ASTM C172 and perform the following tests.

- A.** Ambient Temperature
- B.** Slump in accordance with ASTM C143
- C.** Concrete Temperature in accordance with ASTM C1064
- D.** Concrete Density (Unit Weight) in accordance with ASTM C138
- E.** Air Content in accordance with ASTM C173 or ASTM C231
- F.** If the trial batch is a self-consolidating concrete (SCC) mix, the entire set of mix design requirements listed in Table 6 shall be performed.
- G.** Concrete Test Specimens

Concrete test specimens for compressive strength testing shall be molded and laboratory cured in accordance with ASTM C31. For a self-consolidating concrete (SCC) mix the filling procedure shall be in accordance with ASTM C1758 and the finishing and curing procedure in accordance with ASTM C31. A set of six concrete test specimens, consisting of 2 specimens for 7-day, 28-day, and one additional age unless otherwise directed. Specimens shall be tested in accordance with ASTM C39.

The concrete mix design shall be considered satisfactory, if one of the following requirements is met:

- A.** The average of two concrete test specimens results is equal or exceeds the specified concrete design strength.
- B.** A previously satisfactory concrete mix design test results and documentation are submitted to HCED indicating the proposed mix design conforms to the specification requirements.

Once a concrete trial batch is considered satisfactory or a previous satisfactory concrete mix design is verified to meet the specification

requirements, the material sources, proportions and mixing methods used shall become the "Concrete Mix Design of Record."

A change in any material source such as cement, SCM's, coarse or fine aggregates in a satisfactory concrete mix design shall require a re-evaluation of the mix design. Trail batch testing results and documentation shall be submitted for conformance to the specification requirements.

Concrete Production and Delivery. Mixers and agitators shall be operated within the limits of the rated capacity and speed for mixing and agitation as designated by the manufacturer of the equipment. Provide concrete in a thoroughly mixed and uniform mass meeting the concrete uniformity requirements of ASTM C94, Annex A1. The concrete mix design water-to-cementitious material ratio shall not be exceeded. The concrete shall be mixed in the quantities required for immediate use and any concrete which has developed initial set shall not be used.

Ready-mixed concrete shall be batched, mixed, and transported in accordance with ASTM C94. Ready-mix concrete trucks shall depart the ready-mixed concrete plant and arrive to the project site with a full water tank.

Before unloading concrete for placement, Harris County Form 421A "Concrete Batch Ticket" shall be completed and furnished to HCED or designated representative. HCED or representative shall verify all information is provided on the delivery ticket. The Contractor may provide an equivalent document to Harris County Form 421A with prior approval from HCED. Failure to furnish Harris County Form 421A or approved equivalent document may result in rejection of the concrete.

HCED or representative shall verify the concrete mix design water-to-cementitious material ratio is not exceeded.

When concrete arrives at the project site with a slump below that suitable for placing, water may be added only if the concrete mix design water-to-cementitious material ratio and maximum slump is not exceeded.

Discharge time for concrete placement shall meet the requirements of Table 8.

TABLE 8
CONCRETE DISCHARGE TIMES

FRESH CONCRETE TEMPERATURE	MAXIMUM TIME AFTER BATCHING FOR CONCRETE NOT CONTAINING TYPE B OR D ADMIXTURES	MAXIMUM TIME AFTER BATCHING FOR CONCRETE CONTAINING TYPE B OR D ADMIXTURES¹
90°F and above	45 minutes	75 minutes
75°F ≤ T < 90°F	60 minutes	90 minutes
T < 75°F	90 minutes	120 minutes

1. Concrete must contain at least the minimum manufacturer's recommended dosage of Type B or D admixture.

Job-Control Testing. Concrete materials and operations shall be tested and inspected as the work progresses by the Testing Laboratory's representative. Failure to detect any defective work or material shall not in any way prevent later rejection when such defect is discovered nor shall it obligate HCED for final acceptance.

Fresh concrete shall be sampled in accordance with ASTM C172 and tested for the properties listed in Table 9.

TABLE 9
FRESH CONCRETE TESTS

TEST	TEST METHOD
Slump	ASTM C143
Temperature	ASTM C1064
Air Content	ASTM C173 or ASTM C231
Concrete Density (Unit Weight)	ASTM C138
Concrete Test Specimens	ASTM C31 & ASTM C1758 ¹

1. Required for the filling procedure of a self-consolidating concrete (SCC) mix.

Concrete with a slump lower than the minimum placement slump in Table 7 and at the water-to-cementitious material ratio of the concrete mix design shall be rejected by HCED.

Concrete with a slump higher than the maximum placement slump in Table 7 shall be immediately re-sampled and re-tested. After the re-test, if the

concrete exceeds the slump range and is used at the Contractor's option; concrete test specimens shall be made, cured, and tested.

Fresh concrete exhibiting excessive segregation and bleeding shall be rejected by HCED.

Fresh concrete testing frequency shall meet the requirements of Table 10.

TABLE 10
TESTING FREQUENCIES

CONCRETE PLACEMENT TYPES	FREQUENCY
Bridge Slabs	Test ¹ the first 2 loads, then every 60 cu. yds. or fraction thereof ² per day.
All other Structural Class Concrete Class C, H, S, K, (HPC), & (SRC)	One test ¹ every 60 cu. yds. or fraction thereof ² per class per day.
Non-Structural Class Concrete Class A, E, P, T, HES, (HPC), & (SRC)	One test ¹ every 150 cu. yds. or fraction thereof ² per class.

1. The word "test" is defined as being the entire set of tests listed in Table 9.
2. Testing of fractional quantities of concrete shall be at the discretion of HCED.

Concrete test specimens shall be molded and standard cured for acceptance testing as specified in ASTM C31. Concrete test specimens shall be transported to curing facilities within 24 to 48 hours after molding or as approved by HCED.

When the concrete is a self-consolidating concrete (SCC) mix, the tests and test frequencies shall conform to the requirements of Item 424 "Precast Concrete Members (Fabrication)."

421.6 QUALITY ASSURANCE AND ACCEPTANCE.

The Testing Laboratory's representative shall sample and test the fresh concrete mixture for quality and acceptance. All hydraulic cement concrete test results shall be reported to HCED, Contractor, and concrete producer/supplier. Any concrete that fails to meet the minimum required design strength, the concrete producer/supplier shall investigate the quality of materials, the concrete production operation, and other possible problem areas to determine the cause. HCED may suspend all concrete operations until the problem is identified, documented, and corrected. Concrete

operations shall resume only after obtaining proposed corrective actions and approval from HCED.

The compressive strength for 6" by 12" concrete test specimens shall be determined by averaging the results of two specimens for the test age designated.

Structural Class of Concrete. For concrete classes identified as structural concrete in Table 5, the Testing Laboratory's representative shall mold six 6" by 12" concrete test specimens from each batch sampled. The concrete test specimens shall be tested in accordance with ASTM C39 for 7-day, 28-day and one additional age. Acceptance shall be based on attaining the design strength in accordance with Table 5.

For structural concrete used in prestressed concrete structures, the manufacturer shall supply cylinder molds to the Testing Laboratory's representative to mold release-of-tension concrete test specimens. The concrete test specimens shall be molded and cured alongside the precast/prestressed member. The concrete test specimens shall be tested in accordance with ASTM C39 by the manufacturer and witnessed by the Testing Laboratory's representative to ensure that the concrete meets the minimum release-of-tension strength prior to stress transfer. The Testing Laboratory's representative shall mold four 6" by 12" concrete test specimens for each lot of precast concrete. The concrete test specimens shall be tested in accordance with ASTM C39 for 7-day and 28-day. Acceptance shall be based on attaining the design strength in accordance with Table 5.

Class HES Concrete. For HES concrete, the Testing Laboratory's representative shall mold six 6" by 12" concrete test specimens from each batch sampled. The concrete test specimens shall be tested in accordance with ASTM C39 for the specified early time, 7-day, and 28-day. Acceptance of Class HES concrete shall be based on attaining the design strength in accordance with Item 360 "Concrete Pavement," Item 361 "Repair of Concrete Pavement," or as indicated on the Contract Documents.

All Other Classes of Concrete. For all other classes of concrete, the Testing Laboratory's representative shall mold four 6" by 12" concrete test specimens from each batch sampled. The concrete test specimens shall be tested in accordance with ASTM C39 for 7-day and 28-day. Acceptance shall be based on attaining the design strength in accordance with Table 5.

421.7 CONTRACTOR RESPONSIBILITY AND DUTIES.

The Contractor shall:

- A. Provide additional testing services the Contractor deems needed or required at his/her own expense.
- B. Facilitate testing and inspection, by furnishing any necessary labor to assist the designated Testing Laboratory in obtaining and handling samples or other sources of materials at the project site.
- C. Notify the Harris County representative a minimum 24 hours before concrete placement operations begin to allow for the assignment of personnel and for completion of quality assurance testing.

421.8 SUBMITTAL.

Concrete Trial Batch Testing. The Contractor shall submit the items listed in 421.5, Section "Concrete Mix Design Evaluation and Acceptance" for approval by HCED.

Documentation. The Contractor shall submit the following documents to HCED or designated representative.

- A. Harris County Form(s) 421A "Concrete Batch Ticket" or HCED approved equivalent document
- B. Copy of material test reports or certifications for shipments of cement, supplementary cementing materials (SCM), coarse and fine aggregates, and chemical admixtures may be required at the discretion of HCED

421.9 MEASUREMENT AND PAYMENT.

No direct measurement or compensation shall be made for this Item. The work performed, materials furnished, equipment, labor, tools, and incidentals necessary to complete the work shall be subsidiary to pertinent Items.

Material Procurement. If hydraulic cement concrete is utilized for material procurement, in which concrete is not already a requirement of another Item, measurement and payment shall be by the cubic yard of concrete determined from Harris County Form 421A "Concrete Batch Ticket" or HCED approved equivalent document at the unit price bid for "Hydraulic Cement Concrete" of the concrete class specified.

Where the bid sheet specifies FOB the plant, the hydraulic cement concrete material shall be loaded on Harris County vehicles.

Where the bid sheet specifies FOB the job, the hydraulic cement concrete material shall be transported to the job site specified on the bid sheet.

There are item code(s), description(s), and unit(s) for this Item.

NOTE: This Item requires other Standard Specifications

Item 360 "Concrete Pavement"
Item 361 "Repair of Concrete Pavement"
Item 424 "Precast Concrete Members (Fabrication)"
Item 520 "Weighing and Measuring Equipment"
Item 800 "Hydraulic Cement"
Item 801 "Fly Ash"

END OF ITEM 421

ITEM 800

HYDRAULIC CEMENT

800.1 DESCRIPTION.

This Item shall govern for the requirements of hydraulic cement. Hydraulic cement shall be cement that sets and hardens by chemical interaction with water and that is capable of doing so under water.

800.2 REFERENCES.

- A. ASTM C150 "Standard Specification for Portland Cement"
- B. ASTM C465 "Standard Specification for Processing Additions for Use in the Manufacture of Hydraulic Cements"
- C. ASTM C595 "Standard Specification for Blended Hydraulic Cements"
- D. ASTM C1567 "Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)"
- E. ASTM C1260 "Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)"

800.3 MATERIALS.

All cement types shall meet the requirements of ASTM C150 or ASTM C595, with the following additions and exceptions.

Additions to ASTM C150. ASTM C465 shall be required when.

- A. Adding 1% to 5% of an inorganic processing addition or an inorganic processing addition, such as fly ash or ground-granulated blast furnace slag. The control cement should be composed of either.
 - 1. Clinker + organic grinding aid (with prior passing ASTM C465) + gypsum, or
 - 2. Clinker + organic grinding aid (with prior passing ASTM C465) + gypsum + limestone (with prior ASTM C465 full or mortar/paste only – fineness tolerances not required)

- B. Adding 1% to 5% inorganic processing addition AND 1% to 5% limestone addition. The control cement should be composed of clinker + organic grinding aid (with prior passing ASTM C465) + gypsum.

A modified ASTM C465 including the mortar/paste testing only (fineness tolerances not required) shall be required when adding 1 to 5 percent limestone to a cement already containing an inorganic processing addition (with prior passing ASTM C465). The control cement should be composed of either.

- A. Clinker + organic grinding aid (with prior passing ASTM C465) + gypsum, or
- B. Clinker + organic grinding aid (with prior passing ASTM C465) + gypsum + inorganic processing addition (with prior passing ASTM C465 submitted prior to the effective date of this Specification)

For cements with limestone additions, report a corrected percent limestone to accurately reflect the total amount of limestone added. Report the difference between background/baseline loss on ignition (pre-limestone addition) and the total loss on ignition (after limestone addition) as the corrected percent limestone.

Additions to ASTM C595.

- A. **Type IP.** Type IP Portland-pozzolan cements must be blended with at least the minimum percentage of fly ash listed in the Fly Ash MPL. Use of lower percentages of fly ash will be allowed if ASTM C1567 test data is provided showing the proposed percentage of fly ash will limit the expansion to a <0.10% when tested using a fine aggregates with an ASTM C1260 $\geq 0.30\%$.
- B. **Type IIIP.** Type IIIP Portland-pozzolan cements must meet all the requirements of a Type IP, and the strength requirements listed in Table 1.

TABLE 1

COMPRESSIVE STRENGTH TYPE IIIP CEMENTS

ITEM	LIMIT
1 day Compressive Strength, minimum psi	1,890
3 day Compressive Strength, minimum psi	3,780

- C. Type IS.** Type IS Portland blast-furnace slag cements must be Type IS (>35).
- D. Type IT.** Type IT ternary blended cements must contain 35% to 50% supplementary cementing materials, and no more than 35% may be fly ash, and no more than 10% may be silica fume. Type IT cements containing less than 35% supplementary cementing materials, or contained limestone as one of the constituents, must provide ASTM C1567 test data showing the proposed Type IT cement will limit the expansion to a <0.10% when tested using a fine aggregates with an ASTM C1260 $\geq 0.30\%$.

Note: When performing ASTM C1567 using Type IP or Type IT cements, use the proposed blended cement, and do not replace any of the proposed blended cement with additional supplementary materials.

800.4 MEASUREMENT AND PAYMENT.

No direct measurement or compensation shall be made for this Item. The work performed, materials furnished, equipment, labor, tools, and incidentals shall be subsidiary to pertinent Items.

There are no item code(s), description(s), or unit(s) for this Item.

END OF ITEM 800

ITEM 801

FLY ASH

801.1 DESCRIPTION.

This Item shall govern for the requirements of non-blended and blended fly ash, modified fly ash (MFA), and ground bottom ash (GBA) used in concrete products. Non-blended fly ash is the finely divided residue or ash that results from the burning of finely pulverized coal at high temperatures. Blended fly ash is fly ash blended by interblending or intergrinding with other supplementary cementing materials including other fly ash, slag cement, natural pozzolans, etc. MFA is a non-blended or blended fly ash produced by intergrinding with or without additional additives. GBA is the coarse residue or ash that remains after burning finely pulverized coal at high temperature and is ground to finer material.

801.2 REFERENCES.

- A.** ASTM C114 "Standard Test Methods for Chemical Analysis of Hydraulic Cement"
- B.** ASTM C188 "Standard Test Method for Density of Hydraulic Cement"
- C.** ASTM C311 "Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete"
- D.** ASTM C989 "Standard Specification for Slag Cement for Use in Concrete and Mortars"
- E.** ASTM C1038 "Standard Test Method for Expansion of Hydraulic Cement Mortar Bars Stored in Water"
- F.** ASTM C1260 "Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)"
- G.** ASTM C1567 "Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)"

801.3 MATERIALS.

Non-Blended and Blended Fly Ash, and GBA. Non-blended and blended fly ash, and GBA shall meet all the physical and chemical requirements of

Table 1. Sources with average Calcium Oxide contents from the last ten samples $\geq 18.0\%$ will not be allowed for use in sulfate resistant concrete.

TABLE 1
FLY ASH SPECIFICATION REQUIREMENTS

ITEM	LIMIT	TEST METHOD
Chemical Composition: Average CaO content of the last ten samples, %	Report Only	ASTM C114
Sulfur Trioxide (SO ₃), maximum, %	5.0	ASTM C114
Magnesium Oxide (MgO), %	Report Only	ASTM C114
Total Alkali Content, expressed as NaO _{2,eq} , %	Report Only	ASTM C114
Strength Activity Index ¹ : <ul style="list-style-type: none"> • 7-day, minimum, % of control • 28-day, minimum, % of control 	75 75	ASTM C311
Fineness: Amount retained when wet-sieved on 45- μ m sieve, maximum, %	34	ASTM C311
Uniformity of Fineness: % points from average of last 10 test results or by all preceding tests if the number is less than ten	Report Only	
Water requirement, maximum % of control	105	ASTM C311
Moisture content, maximum, %	2.0	ASTM C311
Loss of ignition, maximum, %	6.0	ASTM C311
Density Uniformity of Density: maximum variation from average of last 10 test results or by all preceding tests if the number is less than ten, %	Report Only 5	ASTM C188
Autoclave Soundness, maximum, %	0.8	ASTM C311
Effectiveness in Controlling Alkali-Silica Reaction ² : 14 day maximum expansion limit, %, when tested using a fine aggregate with a ASTM C1260 expansion $\geq 0.30\%$,	0.10	ASTM C1567

1. Meeting either the 7-day or 28-day is acceptable.
2. Material producers will not have to report this on the material certificates.

The following will be provided on the Material Producer’s List:

- the minimum dosage needed to control alkali-silica reaction for each fly ash having a Calcium Oxide Content <18.0%,
- sources that must use Item 421 Option 8 to determine minimum dosage needed to effectively control alkali-silica reaction, and
- sources not allowed to be used when sulfate resistant concrete specified on the plans.

Modified Fly Ash. Modified fly ash shall meet the requirements of Table 1, with the exceptions and additions listed in Table 2.

TABLE 2

ADDITIONAL SPECIFICATION REQUIREMENTS FOR MFA

ITEM	LIMIT	TEST METHOD
Strength Activity Index <ul style="list-style-type: none"> • 28-day, minimum, % of control 	95	ASTM C989
Fineness: Amount retained when wet-sieved on 45-µm sieve, maximum, % Uniformity of Fineness: maximum variation, % points from average of last 10 test results or by all preceding tests if the number is less than ten	10 3	ASTM C311
Effectiveness in Controlling Alkali-Silica Reaction ¹ : 14 day maximum expansion limit, %, when tested using a fine aggregate with a ASTM C1260 expansion ≥0.30%,	0.10	ASTM C1567
Expansion of Mortar Bars with 50% replacement, max %	0.02	ASTM C1038

1. Material producers will not have to report this on the material certificates.

801.4 MEASUREMENT AND PAYMENT.

No direct measurement or compensation shall be made for this Item. The work performed, materials furnished, equipment, labor, tools, and incidentals shall be subsidiary to pertinent Items.

There are no item code(s), description(s), or unit(s) for this Item.

END OF ITEM 801

END OF SECTION 03 31 00

SECTION 03 35 19 - CONCRETE FLOOR STAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Water-based reactive stained concrete floor finish and sealer.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's technical data sheets and installation instructions for each product specified.
- B. Samples for Initial Selection: Manufacturer's color charts showing full range of available colors.
- C. Qualification Data: Provide lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer of stain and sealer products shall have minimum 10 years experience in the production of chemical stains.
- B. Installer Qualifications: Stain manufacturers approved applicator with minimum 5 years experience in staining applications who has successfully completed not less than 5 projects comparable in scale and complexity.
- C. Regulatory Requirements:
 - 1. Products shall comply with the United States Clean Air Act for maximum Volatile Organic Compound (VOC) content as specified in PART 2 of this section.
- D. Source Limitations: Obtain each specified material from same source and maintain high degree of consistency in workmanship throughout Project.
- E. Mockups:
 - 1. Prepare temporary concrete slab for application of mock-up at location selected by Architect. Prepare mockup 4 feet by 4 feet for review and approval by Architect and Owner.
 - 2. Construct mockup using processes and techniques intended for use on permanent work, including curing procedures. Include samples of control, construction, and expansion joints in mockup panels.
 - 3. Mockup shall be stained and sealed by the individual workers who will actually be performing the work for the Project.
 - 4. Obtain written approval of the mockup from Architect before start of work.
 - 5. Retain approved mockup through completion of the Work for use as a quality standard for finished work.
 - 6. Mock-up will not be allowed to be incorporated into final Work. Do not remove mock-up from site until after receiving final acceptance of Work by Architect at end of Project and when directed by Architect.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver the specified products in original, unopened containers with legible manufacturer's identification and information.
- B. Store specified products in conditions recommended by the manufacturer.

1.6 PROJECT CONDITIONS

- A. Environmental Conditions: Maintain an ambient temperature of between 50° and 90°F during application and at least 48 hours after application.
- B. Protection: Precautions shall be taken to avoid damage or contamination of any surfaces near the work zone. Protect completed stain work from moisture or contamination.

1.7 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 00 – Project Management and Coordination

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS (SC-1)

- A. Basis of Design: L.M. Scofield Company, a Sika Brand, Douglasville, Georgia (800) 800-9900; or comparable product approved by Architect.

2.2 MATERIALS

- A. Exterior Concrete Stain: Scofield® Lithochrome Tintura Stain.
 - 1. Color: Color to match stain at plaza near Turner.
 - 2. Finish: Broom.
- B. Sealer: Cementone Clear Concrete Sealer or as instructed by manufacturer.
- C. Sealants: Scofield® Cureseal.
 - 1. Color: To selected by Architect from manufacturer's full range of colors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Examine areas and conditions under which work will be performed and identify conditions detrimental to proper and timely completion of work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. New Concrete:
 - 1. Newly placed concrete shall be sufficiently cured to allow concrete to become reactive, minimum 28 days. Prepare concrete as instructed by stain manufacturer.
 - 2. Do not use liquid curing materials. Cure concrete flatwork with new, unwrinkled, non-staining, high quality curing paper. Do not overlap curing paper.
 - 3. Immediately prior to chemically staining, thoroughly clean the concrete. Sweep surfaces, then pressure wash or scrub using a rotary floor machine. Use suitable, high-quality commercial detergents to facilitate cleaning. Rinse

surfaces after cleaning until rinse water is completely clean. Allow floor to dry completely prior to application of floor stain.

4. Concrete surfaces shall be uniformly slip-resistant and profiled to meet a Concrete Surface Preparation (CSP) profile of 1-2 per ICRI guidelines.
5. As required and instructed by manufacturer, abrade concrete to allow sufficient penetration of stain materials.

- B. Scoring: Score decorative jointing in concrete surfaces 1/8-inch deep with diamond blades. Rinse until water is completely clean.

3.3 APPLICATION OF WATER-BASED REACTIVE STAIN

- A. Concrete surfaces shall be dry and properly prepared as described above. Protect surrounding areas from over-spray, run-off and tracking. Divide surfaces into small work sections using wall, joint lines, or other stationary breaks as natural stopping points.
- B. Apply stain full strength (undiluted) at the coverage rate instructed by the manufacturer and use application equipment described in the manufacturer's printed technical literature. The color of the liquid chemical stain has no resemblance to the final color produced on the concrete substrate.
- C. Reaction time depends on wind conditions, temperatures, and humidity levels.
- D. Final dried color shall match the approved mock-up panel.

3.4 APPLICATION OF SEALER

- A. Concrete substrate shall be completely dry.
- B. After the final stain application has dried sufficiently, remove all contaminants from the surface by dry mopping if required.
- C. Apply sealer according to manufacturer's written instructions. Two coats are required.
- D. Maintain a wet edge at all times.
- E. Allow sealer to completely dry before applying additional coats.
- F. Apply second coat of sealer at 90 degrees to the direction of the first coat using the same application method and rates.
- G. Seal horizontal joints in areas subject to pedestrian or vehicular traffic.

3.5 PROTECTION

- A. Protect floor from traffic for at least 72 hours after final application of sealer.

3.6 MAINTENANCE

- A. Provide Owner with manufacturers written maintenance information.

END OF SECTION 03 35 19

SECTION 03 52 16 - LIGHTWEIGHT INSULATING CONCRETE DECK SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. It is the intent of this Section,
 - 1. to include the lightweight insulating concrete, and EPS roof insulation for all areas of existing roof construction, and
 - 2. that all Work be performed by the lightweight insulating concrete Sub-contractor.

1.2 RELATED WORK

- A. All Sections of Work pertinent to the roofing system, including mechanical, plumbing and electrical items penetrating metal deck, lightweight insulating concrete, rough carpentry, roof insulation, subsequent roofing and sheet metal flashing and trim.

1.3 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications, instructions and other data needed for proper placement of the lightweight insulating concrete roof insulation system.
 - 2. Manufacturer's installation instructions.
- B. Mix Design: Indicate materials and proportions of proposed mix.
- C. Applicator's Qualifications: Submit a letter from the proposed lightweight insulating concrete system supplier confirming that the Contractor is approved to install the proposed lightweight insulating concrete system. Refer also to Paragraph 1.5, A.
- D. Certifications:
 - 1. Manufacturer's affidavit that materials used in Project contain no asbestos.
 - 2. On completion of installation, furnish Architect with Certificate signed by a representative of the manufacturer and by the applicator stating that insulating concrete was prepared and applied in accordance with manufacturer's recommendations.
 - 3. Manufacturer's certification that system meets or exceeds UL-90 wind up-lift and UL Class A fire rating.
 - 4. Manufacturer's certification that system meets or exceeds Factory Mutual Research Corp. FM I-90 wind up-lift rating.
- E. Warranty:
 - 1. Submit a sample copy of the warranty covering the proposed lightweight insulating concrete system.
 - 2. Submit a sample copy of the roof system warranty covering the proposed lightweight insulating concrete system and roof membrane system.
 - 3. Refer to the roofing system specification section and coordinate the lightweight insulating concrete system warranty with the roof system warranty.

1.4 REFERENCES

- A. Comply with all applicable recommendations of the referenced standards. In any conflict between referenced standards, the more stringent requirements shall govern.
 - 1. American National Standards Institute/Underwriters' Laboratories, Inc. (ANSI/UL)

2. American Society for Testing and Material (ASTM)
 - a. A525, Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
 - b. C150, Standard Specification for Portland Cement
 - c. C177, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
 - d. C332, Standard Specification for Lightweight Aggregates for Lightweight Concrete
 - e. C495, Standard Test Method for Compressive Strength of Lightweight Insulating Concrete
 - f. E119, Standard Test Methods for Fire Tests of Building Construction and Materials
3. National Roofing Contractors Association (NRCA)
4. Occupational Safety and Health Administration (OSHA)
5. Underwriters' Laboratories, Inc. (UL)
 - a. Wind Uplift Class 90 - UL-90
 - b. Fire Ratings - Class A
6. Vermiculite Association (VA)

1.5 QUALITY ASSURANCE

- A. Applicator:
 1. A firm regularly engaged in and properly equipped for the installation of lightweight fill, and acceptable to the fill manufacturer, which has installed at least five (5) million square feet in the last five (5) years.
 2. Key Person Requirement: A thoroughly trained and experienced employee of the Installer, who is acceptable to the Roofing Consultant, shall be present at all times during the execution of work specified in this Section, and direct that work.
 3. Approved in writing by manufacturer to install the roof lightweight insulating concrete deck system.
 4. Responsible for ensuring positive drainage.
 5. **No ponding** water will be acceptable.
 6. Perform water test prior to application of roof system. Architect will be present, provide 48 hours' notice in advance of water testing.
- B. Agency Approvals: Provide products, execution, and material thickness to conform to the applicable code requirements for the required fire resistance ratings, wind uplift classifications, insulation values, and diaphragm values.
- C. Diaphragm Construction: Incorporate metal decking thickness, welding pattern, and minimum compressive strength of the lightweight insulating concrete to achieve diaphragm design values for edge and field conditions as specified to meet applicable code requirements.
- D. Fire Resistance Classifications: Provide a lightweight insulating concrete system meeting the following fire resistance standards:
 1. Tested by UL in accordance with the procedures of ASTM E119 and listed in the UL "Fire Resistance Directory".
 2. Approval Rating: Class A
- E. Wind Uplift Classifications: Provide a lightweight insulating concrete system meeting the following wind uplift standards:
 1. Tested by UL in accordance and listed in the UL "Roofing Materials Directory" for wind uplift resistance.
 2. Approval Rating: UL-90
 3. Tested and approved by Factory Mutual Research Corp. for wind up-lift rating of I-90.

- F. Inspection and Testing Laboratory Services:
 - 1. Test results shall meet or exceed established Standards. Refer to Section 01115, Inspection and Testing Laboratory Services.
 - 2. The Owner will select the Inspection and Testing Laboratory and pay for the cost of tests to determine the dry density and compressive strength.
 - 3. Compressive strength shall be determined in accordance with ASTM C495.
 - 4. Wet and dry density range shall be in accordance with ASTM C495.
 - 5. Polystyrene (EPS) density shall be in accordance with ASTM C578.
- G. Building / Construction Components: Meet or exceed established standards.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original unopened packaging fully identified as to manufacturer, brand or other identifying data as approved in submittal documents.
- B. Store materials under cover, and in a dry location until ready for installation. Roofing insulation must always be covered or stored in a dry area when not being used.
- C. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day. Any exception must be in written form. Do not place materials or equipment in such a manner as to overload the structure.
- D. Familiarize every member of the installation crew with the manufacturer's material safety data sheets and with fire and safety regulations recommended by OSHA, NRCA, and as required by governing codes of authorities having jurisdiction.

1.7 PROJECT / SITE CONDITIONS

- A. When air temperatures of 40 degrees F or above are predicted to occur within the first 24 hours after placement, normal application procedures may be used.
- B. When air temperatures of 32 degrees F - 40 degrees F are predicted to occur within the first 24 hours after placement, warm water not exceeding 90 degrees F may be used.
- C. Do not place the lightweight insulating concrete system when air temperatures are below 40 degrees F, including wind chill.
- D. Insulating Lightweight Concrete Fill Installer shall be responsible for protecting the new insulating lightweight concrete deck from all adverse conditions until roofing begins.

1.8 SEQUENCING AND SCHEDULING

- A. Sequence and coordinate application of lightweight insulating concrete roof insulation with work in other sections so as not to interfere with efficient roof insulation application.

1.9 WARRANTY

- A. Manufacturer's Warranty: Warrant the decking and associated Work in conjunction with the roofing manufacturer from the project date of Substantial Completion as follows:
 - 1. The warranty shall be a NDL "No Dollar Limit" / no penal sum type, with total replacement cost. Refer to roof system specification section for length of warranty period.
 - 2. The warranty shall provide manufacturer's maximum extended wind rated coverage (up to Hurricane force winds) as defined by the Beaufort Scale.

3. The warranty shall guarantee the entire roof system and associated work against defective materials and workmanship of installation, with NO exclusion for ponding water.
 4. The full system warranty including lightweight insulating concrete deck, roofing insulation, flashing, metal work, labor, and material shall be guaranteed against failure of workmanship and materials. Repair of the system, including materials and labor, shall be done at no cost to the Owner.
- B. Contractor Warranty: Jointly with any subcontractors employed by him, shall guarantee the work required and performed under this contract will be free from defects in workmanship and materials, and that the lightweight insulating concrete deck will be and remain in good condition for a five (5) year warranty period, after the Architect accepts the work as substantially complete. The warranty shall be in approved notarized written form, to obligate the Contractor, and subcontractors, to make good the requirements of the warranty.
- C. Make arrangements with the roofing manufacturer to provide the required warranty. Final warranty shall be submitted to Owner at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

- A. Products and manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.
1. Elastizell Corp. of America
 2. Siplast, Inc.
 3. Vermiculite Products Inc.
 4. Celcore, Inc.
 5. Mearlcrete

2.2 MATERIALS

- A. Metal Deck: Refer to Section 05 31 00. Corrugated steel decking incorporating a pre-applied galvanized coating conforming to ASTM A653, minimum Class G-90 and having slots in flutes equal to a minimum of 0.75 percent of the deck area. Refer to Structural Drawings for size, type and section modulus of metal deck and for welding pattern of deck.
- B. Insulation Board:
1. Type: Expanded polystyrene (EPS) insulation board Type I by ASTM C578 and containing approximately three (3) percent open area.
 2. Thickness: 6 inches thick minimum, unless shown otherwise.
 3. Approved Products / Manufacturers:
 - a. "Insulperm" manufactured by Siplast, Irving, Texas (800) 922-8800.
 - b. "Starrfoam-HB" manufactured by Starrfoam Manufacturing, Inc., Fort Worth, Texas (817) 654-4688.
 - c. "Vermaperm" manufactured by Vermiculite Products Inc., Houston, Texas (713) 869-6663.
 - d. "Holey Board" manufactured by Houston Foam Plastics, Houston, Texas, (713) 224-3612.
 - e. PowerFoam, manufactured by PowerFoam, Midolathian Texas 972-299-5556

- C. Water: Potable water that is clean and free of deleterious amounts of acid, alkali, and organic materials – (Drinkable).
- D. Cement: Portland type, conforming to ASTM C150, Type I or III.
- E. Foam Concentrate: Protein based foam concentrate conforming to ASTM C 869 and ASTM C 796.
- F. Vermiculite Aggregate: Any one (1) of the following products from a single manufacturer is approved for use on this Project:
 - 1. Vermiculite: Comply with ASTM C332, produced by a current member of VA. Mix shall be 1:6 with 300 (min) psi at 28 days compressive strength; 48 to 60 pcf wet density, and 25 to 32 pcf dry density.
 - 2. Cellular: Mix shall be 1:3 with minimum compressive strength of 300 psi, cast density of 34-42 pcf, manufactured by Elastizell Corporation of America, Ann Arbor, MI (734) 761-6900\
- G. Admixtures: Air entraining types and superplasticizer (water reducer) types as recommended by insulating concrete material manufacturer. Admixtures may be injected into material at the plant. The use of calcium chloride is not permitted.
- H. Expansion Joint Material: One (1) inch thick of type recommended by insulating concrete material supplier for expansion joints in structural system.
- I. Reinforcing: 3/4 inch long, polypropylene fiber, Fibermix as manufactured by Fibermesh Co. for cellular concrete only.
- J. Nailers: (Refer to Section 06 10 00, Rough Carpentry) As shown on drawings. Install required thickness of wood to align with specified thickness of lightweight insulating concrete.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Prior to placing reinforcing and insulating concrete, inspect to ensure all piping, curbs, wood nailers, etc., have been raised to the proper height and the substrate is free of any foreign materials.
- B. Ensure perimeter edge and penetrations are sealed in a watertight fashion.
- C. Ensure temporary roof is installed as specified in Section 07 52 19.

3.2 PREPARATION

- A. Notify other trades of dates of pouring in ample time for each to install his work.
- B. Review required finishes and allowable tolerances for surface defects.
- C. Set screeds so various deck thicknesses are maintained uniformly in place with all slopes as shown and detailed on drawings.
- D. Verify with the appropriate type instrument that all roof areas have positive drainage. Areas lacking positive drainage are unacceptable and shall be removed and re-poured at Contractor's expense.

3.3 INSTALLATION

- A. Metal Deck: Place sheets with corrugation edges upon the perpendicular to supports with end laps centered over supports. Attach to supports with plug welds through welding washers. Refer to Structural Drawings for additional requirements.
- B. Expansion Joint Material: Install at the following locations.
 - 1. Perimeter of deck.
 - 2. Changes in direction of roof deck.
 - 3. Structural roof penetrations and expansion joints
- C. Provide equipment and installation procedures conforming to the materials manufacturer's installation instructions.
- D. Mix Portland cement and aggregate in a mix ratio design with water in accordance with manufacturer's instructions to achieve the specified wet density, minimum dry density, and minimum compressive strength.
- E. Install slurry coat of lightweight insulating concrete over metal deck to minimum thickness of 1/4 inch over top of flutes of metal decking.
- F. Place insulation boards into slurry within 30 minutes of applying lightweight insulating concrete in accordance with manufacturer's instructions.
- G. Place insulation board with joints staggered in a brick-like running bond pattern.
- H. Hold board back two (2) inches from the perimeter of the roof areas and all roof top units.
- I. Butt boards together and place so as to provide full contact of slurry with board, causing insulating concrete fill to enter the locking/keying openings in the insulation board.
- J. Walk insulation board into slurry to ensure proper embedding of insulation boards into lightweight insulating concrete and keying with insulation holes.
- K. Fill holes in the insulation boards and place a two (2) inch minimum thickness of lightweight insulating concrete over top of the insulation boards within four (4) hours after installation of insulation boards.
- L. Build all crickets and saddles shown with lightweight insulating concrete sloped to drain as indicated on drawings.
- M. Deposit insulating concrete fill and screed (without troweling, rodding, tamping, or vibrating) immediately after mixing. Place on surfaces clean and free of loose material. Place no concrete when temperature is 40 degrees F or falling.
- N. All wood blocking for deck penetrations support and low roof deck to rise wall blocking shall be installed one (1) inch higher than designed lightweight fill thickness. Install fill in a two (2) foot tapered edge condition.
- O. Allow insulating concrete fill to dry as thoroughly as possible before application of roofing, and not less than the minimum time recommended by the manufacturer. Begin roofing when the insulating concrete fill can withstand construction traffic (usually two (2) to three (3) days after placement), verify / confirm with manufacturer's recommendations. Do not leave insulating concrete fill deck surface exposed for longer than ten (10) days. Install no more insulating concrete fill than can be roofed within the ten (10) day time limit. Maximum unroofed insulating concrete deck shall be 5,000 square feet; no exceptions.

- P. Where material is to be pumped, equipment shall be in good condition and well maintained to avoid equipment failure and delays.
- Q. Install and cure lightweight insulating concrete in accordance with manufacturer's instructions.
- R. Avoid roof-top traffic over the lightweight insulating concrete deck system until 24 hours have elapsed after last placement of lightweight insulating concrete.
- S. Allow lightweight insulating concrete to dry as thoroughly as possible before application of roofing. Testing Laboratory may perform tests to determine moisture content of lightweight insulating concrete.
- T. Add two (2) pounds of fiber reinforcing per cubic yard of lightweight insulating concrete if cellular concrete is used.

3.4 FIELD QUALITY ASSURANCE

- A. The Owner will select the independent inspection and testing laboratory and pay for the cost of tests in accordance with Division 1.
- B. The independent inspection and testing laboratory will randomly sample and verify the following:
 - 1. Thermal insulation value in accordance with ASTM C177.
 - 2. Mix design compressive strength in accordance with ASTM C495.
 - 3. Mix design wet and dry density range in accordance with ASTM C495.
 - 4. Polystyrene insulation density in accordance with ASTM C578.
- C. Contractor shall provide base ply fastener pull tests prior to installation of roofing system, following the installation of the lightweight insulating concrete to ensure a minimum withdrawal resistance of 40 pounds per fastener.
- D. Results of all tests will be made available to all concerned parties.
- E. Water Test: Run water on the finished deck for the Architect's observation. The lightweight insulating concrete shall slope to drain and no ponding of water will be accepted. No slopes less than 1/4 inch per foot will be allowed.
- F. Certification: On completion of installation, furnish Architect with certificate signed by a representative of the manufacturer and by the applicator stating that insulating concrete was prepared and applied in accordance with manufacturer's recommendations.

3.5 ADJUSTING AND CLEANING

- A. Remove ridges, surface depressions and other surface irregularities which are unacceptable to the roofing contractor and Architect.
- B. Completely remove all insulating concrete fill from any surface on which it is not intended to be placed.
- C. Perform all patching and repairing of insulating concrete using Zono-Patch or other materials approved by the lightweight insulating concrete supplier.

3.6 PATCHING AND REPAIRING

- A. Perform all patching and repairing of lightweight insulating concrete using the same materials specified in this Section or materials approved by the system manufacturer.
- B. The party responsible for damage will be charged for repairs.

3.7 PROTECTION

- A. Lightweight insulating concrete installer shall be responsible for protecting newly applied decks from all adverse conditions until Roofing Contractor begins installation of specified roof system.
- B. General Contractor shall be responsible for protection of roof deck from other trades until it has been approved for traffic by installer.

END OF SECTION

SECTION 04 20 00 - UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Concrete masonry units (CMU)
- B. Face brick, including solids.
- C. Calcium Silicate Masonry Units.

1.3 RELATED WORK

- A. Section 01 45 23 - Testing and Inspecting Services
- B. Section 05 50 00 – Metal Fabrications. Steel masonry lintels.
- C. Section 07 11 00 – Bituminous Dampproofing
- D. Section 07 21 00 – Thermal Insulation
- E. Section 07 92 00 – Joint Sealants
- F. Section 09 90 00 – Paintings and Coatings
- G. All Sections of Work built-in, adjacent to, or applied to unit masonry work.

1.4 REFERENCES

- A. ASTM International (ASTM)
 - 1. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron & Steel Hardware
 - 2. A307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
 - 3. A615, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 - 4. A706, Standard Specification for Low-Alloy Steel Deformed Bars for Concrete
 - 5. C67, Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
 - 6. C140, Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units
 - 7. C144, Standard Specification for Aggregate for Masonry Mortar
 - 8. C150, Standard Specification for Portland Cement
 - 9. C207, Standard Specification for Hydrated Lime for Masonry Purposes
 - 10. C216, Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)
 - 11. C270, Standard Specification for Mortar for Unit Masonry
 - 12. C331, Standard Specification for Lightweight Aggregates for Concrete Masonry Units
 - 13. C332, Standard Specification for Lightweight Aggregates for Insulating Concrete
 - 14. C404, Standard Specification for Aggregates for Masonry Grout
 - 15. C476, Standard Specification for Grout for Masonry
 - 16. C578, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation

17. C652, Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale)
18. C780, Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
19. C979, Standard Specification for Pigments for Integrally Colored Concrete
20. D226, Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
21. D1751, Standard Specification for Prefomed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
22. E119, Standard Test Methods for Fire Tests of Building Construction and Materials

B. Underwriters' Laboratories, Inc. (UL)

1.4 QUALITY ASSURANCE

- A. Where requirements of this Section are in conflict with requirements noted on the Structural Drawings, the Structural Drawings shall take precedence. Refer to Structural Drawings for information on load-bearing CMU walls.
- B. Fire Performance Characteristics: Where indicated or required, provide materials and construction which are identical to assemblies whose fire endurance has been determined by testing in compliance with ASTM E119 by U.L. or other recognized testing and inspection organization or by other means, acceptable to authority having jurisdiction.
- C. Masonry Cleaning: Workers shall have minimum 5 years of masonry cleaning experience, and shall be approved by cleaner manufacturer prior to application of cleaning material, and shall meet with cleaner manufacturer for demonstration and instructions for use of product prior to application.
- D. Single Source Responsibility:
 1. For Masonry Units: Obtain masonry units of uniform texture and color, or a uniform blend within the accepted ranges for those characteristics, from one (1) manufacturer for each different product required for each continuous surface or visually related surfaces.
 2. For Mortar and Grout Materials: Brands of cementitious materials and admixtures, and the source of supply of sand and aggregates shall remain the same throughout the Work where exposed to view and where not scheduled to receive a subsequently applied finish, i.e. parging, painting, etc., unless directed otherwise in writing by the Architect.
 3. Contractor's Responsibility: Contractor performing Work of this Section shall be responsible for coordinating with others performing work which is built-in or adjacent to unit masonry work.

1.5 SUBMITTALS

- A. Product Data: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.
- B. Samples: Two (2) sets of color chips representing manufacturer's full range of available colors and textures of each face brick for Architect's selection and approval.
- C. Sample Panel(s):
 1. Do not start masonry until Architect has approved samples.
 2. Sample panel shall be 6 feet long by 8 feet high showing selected color range and texture, bonding, joint shape, and quality of workmanship. Include a brick and expansion joint, and any specialty details, such as reveals, soldier courses, etc. Include mock-up of installation of thru-wall flashing at foundation sill and lintel above openings, window jambs and sills.
 3. A separate panel for each type of masonry used is required.

Sample panel(s) shall remain at the jobsite until all masonry is completed.
Installed materials shall be visible and integrated into adjacent materials.

4. Brace and support as required to withstand structural wind loads.

- D. Certification: Submit manufacturer's affidavit that materials used in Project contain no asbestos.
- E. Mortar and Grout Mix Designs: Submit two (2) copies of proposed mortar and grout mix designs to Owner's testing laboratory.

1.6 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 00 – Project Management and Coordination

1.7 TESTS AND INSPECTIONS

- A. Materials and installation of masonry shall be subject to testing and inspection by an independent testing laboratory. Such tests and inspections shall not relieve Contractor of responsibilities for providing materials and procedures which comply with Contract Documents. Promptly remove and replace materials which do not comply.
- B. Owner will select Inspection and Testing Laboratory and will pay for all Work required by Inspection and Testing Laboratory.

1.8 DELIVERY, STORAGE AND PROTECTION

- A. Deliver and store materials in dry protected areas off ground. Keep free of stain or other damage before, during and after installation. Replace any damaged material at no cost to Owner.
- B. During freezing weather, protect masonry units with tarpaulins or other suitable material. Keep free of stain or other damage before, during and after installation. Replace damaged material at no cost to Owner.
- C. Protect reinforcement and accessories from elements.

1.9 SITE CONDITIONS

- A. Cold Weather Protection:
 1. No masonry shall be laid when the temperature of the outside air is below 40 degrees F, unless protection measures are employed and pre-approved by the Architect.
 2. Protection measures for cold weather erection include maintaining space and masonry unit temperatures of at least 40 degrees F for 48 hours prior to and after erection.
- B. Hot Weather Protection:
 1. When the mean daily temperature exceeds 100 degrees F or exceeds 90 degrees F with a wind velocity greater than 8 mph, fog spray all newly constructed masonry until damp, at least three (3) times a day until the masonry is three (3) days old.

1.10 BRACING OF MASONRY DURING ERECTION

- A. All masonry shall be adequately braced at all times during erection.

1.11 COORDINATION

- A. Openings and chases for heating, plumbing, electrical ducts, pipes, and conduits shall be built into masonry walls as required. Provide for installation of bolts, toggles, flashings, beams,

anchors, hangers, nailing strips, wall plugs, and frames as required. Consult other trades in advance and make provisions for installation of their work to avoid cutting and patching. Coordinate installation of steel reinforcement for reinforced masonry. Coordinate placement of concrete in masonry beams, lintels, soffits, and pilasters.

- B. Contractor performing Work of this Section shall be responsible for and coordinate with work of Section 07 11 00, Dampproofing Above Grade and all Sections of Work built-in, adjacent to, or applied to unit masonry work.

1.12 WARRANTY

- A. Warrant the Work specified herein for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
- B. Defects shall include, but not be limited to, the following:
 - 1. Noticeable deterioration of unit or mortar finish.
 - 2. Chalking or dusting excessively.
 - 3. Changing color in irregular fashion.
 - 4. Cracking or spalling.
 - 5. Releasing from substrate.
 - 6. Staining or discoloring, including efflorescence.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

- A. Specifications are based on products of manufacturers named within the specifications. Other manufacturers must have a minimum of five (5) years experience manufacturing products equal to those specified and comply with requirements of Division 1 regarding substitutions to be considered.
 - 1. Face Brick Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - a. Interstate Brick.
 - b. Cloud Ceramics.
 - c. Kansas Brick & Tile.
 - 2. Concrete Masonry Units (CMU/Block) Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - a. Best Block Construction Materials
 - b. Revels Block & Brick Co., Inc.
 - c. Upchurch Kimbrough Co. CMU
 - 3. Calcium Silicate Masonry Units:
 - a. Arriscraft International provided by Upchurch Kimbrough
 - b. Equivalent product approved by Architect.

2.2 MATERIALS

- A. Concrete Masonry Units (CMU/Block):
 - 1. Type/Sizes:
 - a. Concealed cavity block and interior block, unless otherwise noted: Regular smooth face units with 8 inch by 16 inch face dimensions as shown on drawings or required, 4 inch, 6 inch, and 8 inch depths as indicated on drawings.
 - 1) Color: Standard.

- b. Interior block, unless otherwise noted: Regular smooth face units with 8 inch x 16 inch face dimensions as shown on drawings or required, 4 inch, 6 inch, and 8 inch depths as indicated on drawings.
 2. Integral Water Repellant (In exterior exposed CMU): "Dry-Block Block Admixture" integral water repellant admixture as manufacturer by W.R. Grace & Co., or equal.
 3. Specification: Comply with ASTM C90 (Class D-2 (2 hour) and Class B-4 (4 hour)) block at rated walls)
 - a. Grade: Type N, highest standard for typical cavity block and interior use. Type S, for exterior exposed masonry walls.
 - b. Aggregate: Lightweight in accordance with ASTM C331
 4. Curing: Rotary kiln process.
 5. Provide special shape bullnose units at corners of interior CMU wall.
 6. Provide bond beams, control joints, jambs, lintels, soaps, cap blocks, and fillers to match and compliment block units as shown or required.
- B. Face Brick: King Size face brick complying with the requirements of ASTM C216, Grade SW, Type FBX as selected by Architect. Brick size to match existing brick types.
 1. Basis of Designs:
 - a. B-1 - Field: Cloud Grey by Cloud Ceramics.
 - b. B-2 - Accent: 500 Cocoa by Kansas Brick & Tile.
 2. Provide solid, uncured face brick in locations where cores would be exposed in finish work.
 3. Provide special shapes at corners that are not 90 Degrees and where otherwise indicated.
 4. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3350 psi (23.10 MPa).
 5. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested according to ASTM C 67.
 6. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated not effloresced.
 7. Sizes: 2-3/4" width x 2-5/8" height x 9-5/8" length.
 8. Colors: Architect to select from manufacturers full range.
- C. Calcium Silicate Masonry Units (Arriscraft)
 1. Calcium Silicate Stone Units: ASTM C73, Grade SW; solid units pressure formed and autoclaved; 3-5/8" bed depth;
 2. Size: 3-5/8" depth x 11-5/8" high x 23-5/8" long as coursing allows.
 3. Pattern: Running Bond
 4. Color: Smooth Oak Ridge.
 5. Special shapes: Provide special shapes where indicated or required for lintels, jambs, control joints, headers, bonding or other special conditions.
- D. Cement Backer Board: Cementitious, water durable, board; surfaced with fiberglass reinforcing mesh on front and back; long edges wrapped; and complying with ANSI A118.9 and ASTM C 1325 (PermaBase BRAND Cement Board).
 1. Thickness: 1/2 in., 5/8 in.
 2. Width: 2 ft. 8 in., 3 ft., or 4 ft.
 3. Length: 4 ft., 5 ft., 6 ft., or 8 ft.
 4. Edges: Tapered.
 5. Compressive Strength: Not less than 2250 lbs. per sq. in. when tested in accordance with ASTM D 2394.
 6. Water Absorption: Not greater than 8 percent when tested for 24 hours in accordance with ASTM C 473.
- E. Fasteners:

1. Screws: Hi-Lo thread screws (No. 8) wafer head, corrosion-resistant, 1-5/8 in length , and complying with ASTM C 1002
2. Use above for wood and 22 ga. or lighter steel framing. Use below for 20 ga. or heavier steel framing.
3. Screws: Drill point screws (No. 8) wafer head, corrosion-resistant 1-5/8 in length and complying with ASTM C 1002.

F. Joint Treatment:

1. Tape: Alkali-resistant fiberglass mesh tape intended for use with cement board.

G. Adhered Masonry Veneer Installation System:

1. Basis of Design: Laticrete or approved manufacturer approved by Architect.
 - a. Laticrete MVIS Thin Brick Mortar (Skim Coat).
 - b. Laticrete MVIS Air and Water Barrier Membrane.
 - c. Laticrete MVIS Thin Brick Mortar (for Adhesion).
 - d. Laticrete MVIS Masonry Pointing Mortar.

H. Mortar:

1. Materials: (Unless stated otherwise on Structural Drawings)
 - a. Portland Cement: ASTM C150, Type 1.
 - b. Hydrated Lime: ASTM C207, TYPE "N", typical. Use TYPE "S" for load-bearing masonry.
 - c. Aggregate: Sand conforming to ASTM C144
 - d. Water: Clean and potable
 - e. Admixtures For Mortar:
 - 1) General: Do not use calcium chloride
 - 2) Concrete Masonry Units: Spectrum Mortar Color or Architect approved equal.
 - 3) Face Brick: Spectrum Mortar Color or Architect approved equal.
 - 4) Integral Water Repellant (In mortar of exterior exposed CMU): "Dry- Block Mortar Admixture" integral water repellant admixture as manufacturer by W.R.Grace & Co., or equal. Note: Water repellent block admixture and mortar admixture are not interchangeable.
2. Mix Design: (Proportions by volume) (Unless stated otherwise on Structural Drawings)
 - a. Typical, Non-load bearing masonry
 - 1) Type: ASTM C270, Type "N"
 - 2) Proportions: 1 part cement, 1 part hydrated lime and 6 parts sand to provide a compressive strength of 750 psi in 28 days. Do not use calcium chloride.
 - b. Load bearing structural masonry
 - 1) Type: ASTM C270, Type "S"
 - 2) Proportions: 1 part cement, 1/2 part hydrated lime and 4-1/2 parts sand to provide a compressive strength of 1800 psi in 28 days. Do not use calcium chloride.

I. Grout:

1. Materials: (Unless stated otherwise on Structural Drawings)
 - a. Hydrated Lime: ASTM C207, TYPE "S"
 - b. Portland Cement: ASTM C150, Type 1.
 - c. Water: Clean and potable
 - d. Aggregates:
 - 1) Course aggregate shall conform to ASTM C404.
 - 2) Fine aggregate shall conform to ASTM C144.
2. Mix Design: (Unless stated otherwise on Structural Drawings)
 - a. Comply with ASTM C476 to provide a compressive strength of 2,500 psi in 28 days, unless noted otherwise. Do not use calcium chloride.

- 1) Fine Grout: Fine grout conforming to ASTM C476 and consisting of 1 part Portland cement, 0 to 1/10 part lime and 2-1/4 to 3 parts sand by volume.
 - 2) Course Grout Mix: Course grout conforming to ASTM C476 and consisting of 1 part Portland cement, 0 to 1/10 part lime and 2-1/4 to 3 parts sand, and 1 to 2 parts course aggregate.
- B. Reinforcement, Anchors and Tie Systems:
1. General: Reinforcement used in all wythes shall be galvanized after fabrication in accordance with ASTM A153, Class B-2.
 2. Approved Manufacturers include the following:
 - a. Dur-O-Wal
 - b. Heckmann Building Products
 - c. Hohmann & Barnard, Inc
 - d. Wire-Bond
 3. At solid multiple wythe masonry walls and single wythe masonry walls, (Interior partitions) use #9 gauge truss type reinforcing. Pre-fab corners and tees shall be used at all wall corners and intersections; width shall be two (2) inches less than nominal thickness of walls. Dur-O-Wal "Truss" at single wythe; "Trirod" at multiple, or Architect approved equal.
 4. At Double Wythe Cavity Walls with Insulation Board: Use Hot-dipped galvanized, #9 gauge truss type with 3/16 inch adjustable pintle wall ties. Width of truss reinforcement shall be 2 inches less than the nominal thickness of wall. 3/16 inch wall tie double eye sections welded at 16 inches o.c. extended as required for insulation thickness. Pre fab corners and tees shall be used at all wall corners and intersections. Dur-O-Wal "Dur-O-Eye", or Architect approved equal.
 5. At Masonry Anchored to Steel Spandrel Beam and Columns: Hot-dipped galvanized, No. 315 Anchor and No. 316 Pintle Tie manufactured by Heckmann Building Products, Inc., or Architect approved equal. Anchors detailed on Structural Drawings supersede.
 6. At Veneer Brick Anchored to Light Gauge Steel Framing: Hot-dipped galvanized, No. 75HE Pos-i-Tie System utilizing self-tapping screw for steel studs with 5/8 inch barrel length, and 4 inch triangle wire tie for 2 inch cavity manufactured by Heckmann Building Products, Inc., or Architect approved equal. Anchors detailed on structural drawings supersede. Attachment screws shall be corrosion resistant type as recommended by manufacturer to suit application. Adjust wire tie size as required to conform with cavity depth if other than 2 inch.
 7. Control Joint Anchor: Equal to Heckmann Building Products, Inc. No. 351 Anchor.
 8. Corrugated Wall Tiles: Not acceptable under any circumstances.
- C. Precast Concrete U-Lintels (Contractors Option to site built masonry lintels)
1. Concrete Materials:
 - a. Portland Cement: ASTM C150 Type I or III, gray color
 - b. Aggregates: ASTM C33
 - c. Water: potable
 - d. Admixtures: Shall not contain calcium chloride or chloride ions
 2. Reinforcing:
 - a. Deformed Reinforcement: ASTM A615 Grade 40 or 60
 - b. Prestressing Strand: ASTM A416 270 ksi LL
 3. Fabrication:
 - a. Unless specified otherwise, conform to PCI MNL-116
 - b. U-lintel units 14 feet in overall length and shorter shall be made of concrete with a minimum strength of 3500 psi at 28 days.
 - c. U-lintel units exceeding 14 feet in overall length shall be made of concrete with a minimum strength of 6000 psi at 28 days and shall be prestressed concrete.
 - d. Units shall be sand block finish except prestressed, 6 inch wide, and 12 inch wide U-lintels shall be smooth form finished.
 - e. Tolerances shall be per PCI MNL-116

- f. Minor patching in plant is acceptable provided structural adequacy of units is not impaired
 4. Acceptable Product/Manufacturer: Cast-Crete High Strength Precast Concrete U-lintels as manufactured by Cast-Crete, Tampa, FL (800) 999-4641, and locally distributed by Headwaters, (713) 365-9077.
- D. Miscellaneous Materials: (As shown or required)
1. Reinforcing Steel: ASTM A615, Grade 60.
 2. Forms: Form grade plywood with wood studs and wales as required.
 3. Shores: Patented shores of design and manufacture sufficient to safely support imposed loads.
 4. Premolded Filler: Fibrous mastic strips containing 35 percent to 50 percent asphaltic impregnation, ASTM D1751.
 5. Flashing Cement: "Nervaplast" cold setting mastic manufactured by Nervastral, Inc., or Architect approved equal.
 6. Building Felt: No. 15 asphalt saturated felt, ASTM D226.
 7. Dovetail Anchors: 16 gauge galvanized dovetail corrugated masonry anchor, 1 inch x 3-1/2 inch manufactured by AA Wire Products Co., Heckman Building Products, Inc., Dur-O-Wal, Inc., Hohmann & Barnard, Inc., Masonry Reinforcing Corporation of America, or Architect approved equal.
 8. Steel Shapes and Plates: As shown on drawings and specified in Section 05 50 00, Miscellaneous Metals.
 9. Headed Stud Anchor: Welded by full-fusion process as furnished by TRW Nelson Stud Welding Division, or Architect approved equal.
 10. Bolts: ASTM A307. Furnish with carbon steel washers.
 11. Deformed Bar Anchors: Welded by full-fusion process as furnished by TRW Nelson Stud Welding Division, or Architect approved equal.
 12. Reinforcing Bars to be Welded: ASTM A706.
 13. Cavity Drainage Protection: 2 inch thick by 10 inch high by 5 feet long recycled polyester/polyethylene mesh, trapezoidal-shaped, continuous at foundation, at heads above openings, and shelf angles as indicated on drawings. Provide Mortar Net™ manufactured by Mortar Net USA, Ltd., Gary, IN; (800) 664-6638, or Architect approved equal.
 14. Masonry Color: Iron oxide pigment conforming to ASTM C979 in color(s) selected by Architect, shall be inert, stable to atmospheric conditions, sunfast, weather resistant, alkali resistant, water insoluble, and free of fillers and extenders, as manufactured by ChemSystems, Inc., Davis Colors, Solomon Grind-Chem Service, Inc., or Architect approved equal.
 15. Weep Hole Vents: Injection molded vent made from flexible polyvinyl chloride in an offset "T" shape, inserted in head joints, the slotted leg of the vent allows air to pass in and out allows water to weep out and prevents water from penetrating in manufactured by Williams- Goodco, Phone: 800-521-9594 or 248-643-6400 or Email: Wilpro@williamsproducts.net. Weep hole vents shall be sized to match masonry (may require custom sizing).

2.2 MASONRY STRENGTH

- A. Ultimate compressive strength of masonry as required by design and determined by prism tests shall not be less than 1,800 psi, unless stated otherwise in Structural Drawings.

2.3 MASONRY CLEANING MATERIALS

- A. Water: Clean, potable, and free of oils, acids, alkalis, salts, and organic matter. Use to rinse masonry surfaces and dilute concentrated cleaners.
- B. Cleaner: "Deox" chemical cleaner manufactured by National Chemsearch, or "Sure Klean" manufactured by ProSoCo, Inc., or Tex Clean Plus" manufactured by AHI Supply, L.P.; or Architect approved equal. Verify product use based on masonry color being cleaned as instructed by

manufacturer.

- C. Muriatic acid is not permitted.
- D. The following products based on Prosoco Sure Klean® products are intended as a guide only and does not preclude the contractors use of equal products by listed manufacturers. Consult manufacturer prior to application for any questions or inconsistencies.

Substrate	Color/Type	Cleaning Solution
Brick	Red	Sure Klean® 600 Detergent
	Light	Sure Klean® Vana Trof®
	Dark	Sure Klean® Vana Trof®
	Pavers	Sure Klean® 600 Detergent
CMU	Split Face	Sure Klean® Custom Masonry Cleaner
	Burnished/Ground Face	Sure Klean® Burnished Custom Masonry Cleaner
Architectural Concrete	Natural Color/Smooth	Sure Klean® Light Duty Concrete Cleaner
	Textured	Sure Klean® Custom Masonry Cleaner
Stone Construction	Cast Stone	Sure Klean® Light Duty Concrete Cleaner
	Arriscraft	Light Staining - Sure Klean® Burnished Custom Masonry Cleaner Heavy Staining - Sure Klean® Vana Trof®
	Limestone (Unpolished)	Sure Klean® Vana Trof®

2.4 MASONRY STAINING

- A. Basis of Design: NawKaw or comparable product approved by Architect.
- B. Composition: Mineral stain uses silicate as a binding agent, water-based, non-flammable, zero VOC, solvent free, vapor-premeable, water washup, nonhazardous content.
- C. Finish: Flat.
- D. Abrasion Resistance: Excellent.
- E. UV & Water Resistant.
- F. Color: Architect to select from manufacturer’s full range of colors.

PART 3 - EXECUTION

3.1 FORMS AND SHORES

- A. Provide forms and shores sufficiently strong and rigid as required to support soffits, beams, and lintels during construction.

- B. Build forms to conform to shape, line, and dimension of masonry members as detailed, substantial and sufficiently tight to prevent leakage of mortar, grout or concrete. Properly brace or tie together so as to maintain position and shape.

3.2 PREPARATION OF MATERIALS

- A. Concrete Masonry Units:
 - 1. Where cutting is required, masonry shall be cut with a sharp masonry saw.
 - 2. Ensure concrete masonry units to receive sand fill are ready for filling and cutouts are protected from material spillage.
- B. Brickwork: Dampen brick before laying in a manner consistent with the nature of the brick, the mortar, and the weather conditions.
- C. Mortar and Grout:
 - 1. Use suitable containers for material measurement. Measuring sand by the shovel is not acceptable.
 - 2. Thoroughly machine mix a minimum of five (5) minutes after all materials are in mixer.
 - 3. Consistency will completely fill all spaces intended to receive grout.
 - 4. Use within 2-1/2 hours of initial mixing.
 - 5. Mortar or grout shall not be used if curing has progressed to yield a stiff consistency.
- D. Reinforcement:
 - 1. Reinforcement shall be free from loose rust and other coatings that would reduce the bond.
 - 2. Cut accurately to length and bend by such methods as will prevent injury to the material.
 - 3. Straighten out kinks or bends.
- E. Flashing:
 - 1. Locations: Install in exterior walls to divert moisture within walls to exterior surfaces.
 - 2. Bed Joints: Coordinate work with Division 4, Masonry. Install flashings between two (2) thin layers of masonry mortar without increasing thickness of mortar joint. Keep outer edge of flashing material back from face of masonry.
 - 3. Adjacent Work: Protect work by masking, covering, or other precautionary methods. Remove protection when no longer necessary.
 - 4. Separate copper flashing from dissimilar materials.
 - 5. Protect membrane flashing from overexposure to direct sunlight.

3.3 INSTALLATION

- A. General:
 - 1. Do not use chipped or cracked concrete masonry units (CMU) and face brick, where exposed to view.
 - 2. Use masonry saws to cut and fit exposed units.
 - 3. Exposed masonry at exterior corners shall be solid units.
 - 4. Clean surface of masonry smooth and free from projections which might puncture or otherwise damage flashing material.
 - 5. Place through-wall flashing as follows:
 - a. Place on bed of mortar and cover with mortar.
 - b. Provide at steel columns and beams in exterior masonry walls and elsewhere as indicated on the drawings or required.
 - c. Install asphalt laminated copper membrane as base flashing at all exterior cavity walls below weep holes.
 - d. Install at material transitions inside exterior cavity walls, roof edge/ exterior wall transitions, masonry joints (control/expansion) inside exterior cavity walls, exterior wall sill/weep conditions, exterior door and window frame perimeters, roof deck/ exterior wall transitions, exterior wall penetrations (i.e. pipe, conduit, ducts, etc.). Provide

membrane at all joints, holes, gaps or openings to ensure a continuously sealed building envelope.

6. Lay masonry units plumb, true to line, and with level courses accurately spaced within allowable tolerances.
7. Do not furrow bed joints.
8. Stop off horizontal run by racking back in each course; tothing is not permitted.
9. Adjust units to final position while mortar is soft and plastic.
10. If units are displaced after mortar has stiffened, remove, clean joints and units and re-lay with fresh mortar.

11. When joining fresh masonry to set or partially set masonry:
 - a. Remove loose masonry units and mortar
 - b. Clean and lightly wet exposed surface of set masonry prior to laying fresh mortar.

- B. Metal Door Frames: Fill jamb frames solid with mortar. Build in anchors.

- C. Lintels and Bond Beams: Provide reinforced unit type, except where steel lintels are shown. Use reinforcing bars as shown on the drawings. Completely fill in lintel block and bond beams with grout. Provide 8 inch bearing at end of lintels.

- D. Corners: Connect corners with No. 9 galvanized wire tie using one tie for each 4 inches of nominal wall thickness.

- E. Partition Tops: Allow space at top of horizontal spanning walls for compressible joint back-up and sealant as specified in Sealant section. Anchor top of walls to deck or structure.

- F. Mortar Beds:
 1. Place mortar in a manner which will result in the development of adequate bond between the masonry and the reinforcement.
 2. Lay units with full mortar coverage on horizontal and vertical joints in all courses.
 3. Provide sufficient mortar on ends of masonry unit to fill head joints.
 4. Rock closures into place with head joints thrown against two adjacent masonry units in place.
 5. Do not pound corners or jambs to fit stretcher units after setting in place.
 6. Where adjustment to corners or jambs must be made after mortar has started to set, remove mortar and replace with fresh mortar.

- G. Mortar Joints and Patterns:
 1. Lay CMU in running one-half (1/2) bond pattern, unless noted otherwise.
 2. Lay brick in running one-third (1/3) bond pattern, unless noted otherwise on drawings. Refer to drawings for accent coursing.
 3. Provide flush joints where concealed from view and where dampproofing is scheduled.
 4. Provide standard concave tooled joint where masonry is exposed to view for brick and CMU, typically.
 5. All mortar joints to be of consistent size.
 6. Provide soldier courses where indicated, refer to the elevations.
 7. All horizontal joints shall be concave tooled joint at face of units, unless noted otherwise.
 8. Provide raked joints at all exposed burnished cmu locations.

- H. Reinforcement, Anchor and Tie Systems:
 1. General:
 - a. Completely embedded in mortar or grout.
 - b. All reinforcement consisting of bars or wire 1/4 inch or less in diameter embedded in the horizontal mortar joints shall have no less than 5/8 inch mortar coverage from the exposed face.
 - c. Where modular brick is used with brick coursing at 16 inches on center, provide

ladder reinforcing within each wythe at 16 inches o.c. vertically for exterior wythe and back-up wythe, whether detailed or not. For other than modular brick, refer to Paragraph h. below.

- d. Veneer anchors at exterior sheathed covered metal stud exterior walls shall be attached on outside face of sheathing using cadmium plated sheet metal screws. Spacing shall be same as stud spacing o.c. horizontally and 16 inches o.c. vertically.
 - e. Veneer anchors at Interior brick walls with metal stud back-up shall be the same as Paragraph "d" above, except anchors shall be attached directly to metal stud with recommended corrosion resistant fasteners in accordance with manufacturer's recommendations.
 - f. At intersection of all perpendicular masonry walls provide two (2) vertical rows of ladder type reinforcing at 16 inches o.c. vertically.
 - g. Weld veneer anchors to structural steel in accordance with manufacturer's recommendations. Touch-up steel shop paint and galvanized coating on anchor with proper touch-up paint to match damaged coating in accordance with manufacturer's recommendations.
 - h. In cavity walls with CMU back-up, embed truss type horizontal reinforcement with integral adjustable pintle wall ties every 16 inches o.c. vertically.
 - i. Splices in reinforcement: Splices may be made only at such points and in such manner that the structural strength of the member will not be reduced. Lapped splices shall be eight (8) inches. Welded or mechanical connection shall develop the strength of the reinforcement.
 - j. Corrugated strap ties shall not be used as veneer anchors at exterior or where subject to moisture. Their use in interior, dry conditions are acceptable.
 - k. Place joint reinforcement in the first two (2) bed joints above and the first two (2) bed joints below masonry openings. Extend extra reinforcing two (2) feet beyond jambs.
 - l. Provide masonry ties at floor and roof decks as indicated.
- I. Flashing:
1. Follow manufacturer's instructions for mechanically fastened installation with a termination bar.
 2. Application Guidelines - Install flashing at the following locations:
 - a. Membrane Flashing: material transitions inside exterior cavity walls, roof edge/exterior wall transitions, masonry joints (control/expansion) inside exterior cavity walls, exterior door and window frame perimeters, roof deck/exterior wall transitions, exterior wall penetrations (i.e. pipe, conduit, ducts, etc.). Provide membrane at all joints, holes, gaps, or openings to ensure a continuously sealed building envelope. Utilize primer on substrates as instructed by manufacturer.
 - b. Copper Flashing: At all horizontal wall flashing, including (but not limited to) exterior wall sill/weep conditions, exterior door and window head/weep conditions, masonry wall cap flashing and masonry wall base flashing.
 3. Apply substrate primer as instructed by membrane manufacturer to suit condition.
 4. Provide drip edge flashing at weep conditions with membrane flashing. Cut membrane flush with outside edge of brick over top of drip edge flashing to alleviate exposure to UV degradation and deterioration of asphalt membrane.
 5. On Horizontal Surfaces: The flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. The flashing shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall, turned up where possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of six (6) inches. Flashing will then be secured in back wall with termination bar.
 6. On Vertical Surfaces: Surfaces receiving the flashing shall be sufficiently spotted with asphalt mastic to hold in place until masonry is set. Secure in back wall with termination bar.

7. Foundation Sill Dampproofing: The flashing for foundation sills shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. The flashing shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be sloped across the cavity and turned up the wall a minimum of ten (10) inches and secured to back wall with termination bar. Where sill and column meet, flashing shall be brought up a minimum of ten (10) inches up the column.
 8. Thru-Wall Flashing: Shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Carry flashing through the wall, turned up where possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of six (6) inches, unless noted otherwise, and secure in back wall with termination bar.
 9. Cavity Wall: Flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and upward across the cavity a minimum of six (6) inches, unless noted otherwise, and secured in the back wall with termination bar. Vertical membrane joints shall be secured with termination bar as instructed by membrane manufacturer.
 10. Heads and Sills: Flashing for heads and sills shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and upward across the cavity a minimum of six (6) inches, unless noted otherwise. Head flashing shall be carried six (6) inches beyond both end of the steel lintel. Both head and sill flashing shall be turned up at the sides to form a pan. All corners shall be folded, NOT CUT. Install weepholes. Spandrels: Spandrel flashing shall start from the outside toe of the shelf angle, go up the face of the beam and then through the wall, turned up on the inside not less than two (2) inches. Install weepholes.
 11. Parapet or Coping: Flashing for parapets or coping sills shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Weepholes shall be installed immediately on top of the flashing.
 12. Lengths: Install flashings without longitudinal joints within walls, if possible. If required materials are not available in a single width, join by lapping material minimum two (2) inches and seal joint throughout its length with adhesive.
 13. End Joints: Avoid end joints in flashing. When end joints are necessary, lap flashing minimum six (6) inches and seal joint continuously with adhesive.
 14. Penetrations: Where anchors, pipes, and inserts penetrate flashing, make opening in flashing snug and seal with adhesive.
 15. Reglet Termination: Insert wedge into place and seal carefully with adhesive
 16. Termination Bar: Install flashing with termination bars in accordance with manufacturer's instructions. Provide 3 coursing at all termination bars, typical.
 17. Top Coat: After flashing material is in place (except in masonry joints where bond and mortar is required) trowel full 1/8 inch protective coating or mastic on all flashing faces.
- J. Laying Masonry: Lay units plumb, level, and true to line with full head and bed joints. Butter ends of masonry with sufficient mortar to fill head joints. Do not furrow bed joints. Slope top of bed joint toward center of wall to minimize amount of mortar forced into grout space. Remove mortar, protruding from joints into grout space, before pouring grout.
- K. Reinforcing Bars:
1. Hold vertical bars in position at top and bottom and at intervals not exceeding eight (8) feet-0 inches with a minimum clearance of 1/4 inch from masonry and not less than one (1) bar diameter between bars.
 2. When a foundation dowel is not in alignment with a vertical block cell or pilaster, slope it not more than one (1) horizontal in six (6) vertical to bring it into proper alignment before grouting.
 3. Place horizontal reinforcing bars in continuous masonry courses, consisting of bond- beam or trough block units, and solidly grout in place.
 4. Use straight reinforcing bars except for bends around corners and where bends or hooks

- are detailed on plans.
5. Lap reinforcing steel 40 bar diameters minimum where spliced and wire together.
- L. Grouting: Where detailed place grout in reinforced masonry beams, walls, columns, and pilasters. All cells and spaces containing reinforcing bars shall be filled with grout. Wherever possible grouting shall be done from inside face of masonry. Exercise extreme care to prevent grout from staining face of masonry. Immediately remove any spilled grout from face and top of masonry.
1. Prior to grouting clean space so that all spaces to be filled with grout do not contain mortar projections greater than 1/2 inch, mortar droppings or other foreign material. Grout shall be placed so all spaces designated to be grouted shall be filled with grout and grout shall be confined to those specific spaces.
 2. Grout materials and water content shall be controlled to provide adequate fluidity for placement, without segregation of constituents and shall be mixed thoroughly.
 3. Between grout pours a horizontal construction joint shall be formed by stopping all wythes at the same elevation and with grout stopping a minimum of 1-1/2 inches below a mortar joint, except at top of wall. Where bond beams occur, stop grout pour a minimum of 1/2 inch below top of masonry.
 4. Reinforcement shall be placed prior to grouting. Bolts shall be accurately set with templates or by approved equivalent means and held in place to prevent movement. Segregation of grout materials and damage to masonry shall be avoided during the grouting process. Adequately brace masonry to prevent displacement or cracking during grouting operations.
 5. Grout shall be consolidated by mechanical vibrator during placing, before loss of plasticity, in a manner to fill grout space. Grout pours greater than 12 inches shall be reconsolidated by mechanical vibration to minimize voids due to water loss. Grout pours 12 inches or less in height shall be mechanically vibrated, or puddled.
 6. Grout shall not be handled nor pumped utilizing aluminum equipment.
 7. Size and height limitations of grout space or cell shall be as follows:

GROUT TYPE	GROUT POUR MAX. HEIGHT (FEET)	LEAST CLEAR DIMENSIONS		CLEANOUTS REQUIRED
		Width of Grout Space (In.)	CMU Cell Dim. Dims. (In. x In.)	
Fine	1	3/4	1-1/2 x 2	No
Fine	5	1-1/2	1-1/2 x 2	No
Fine	8	1-1/2	1-1/2 x 3	Yes
Coarse	1	1-1/2	1-1/2 x 3	No
Coarse	5	2	2-1/2 x 3	No
Coarse	8	2	3 x 3	Yes

- a. Clear dimension is the cell or grout space width less mortar projections.
 - b. Grout space width shall be increased by the horizontal projection of the diameters of horizontal bars within the cross section of the grout space.
8. Place grout in lifts not exceeding 8 feet-0 inches.
- M. Concreting: Supervise placing of concrete in cores of masonry beams and lintels and over masonry soffits where structural concrete is detailed. Report discrepancies or procedures which may adversely affect performance of masonry work.
- N. Brick Weep holes:
1. Provide weep holes above all thru-wall flashings where weep holes occur at the base of the wall. The mason shall coordinate the location of the thru-wall flashings with the location of the sidewalks on the civil engineering drawings. All weep holes shall be at least one course below finished floor or at the first course of brick above the sidewalks. Pay particular attention to areas near exterior doors.
 2. Ensure cavity drainage protection is properly installed.

3. Leave head joint free and clean of mortar.
 4. Spacing: 20 inches on center maximum for king sized brick, and 24 inches on center for modular brick and block, unless shown otherwise.
 5. Keep weep holes and area above flashing free of mortar droppings.
 6. Coordinate weep holes to be located above sidewalks and paving.
- O. Sealant Joints:
1. Allow for sealant joints around outside perimeters of exterior doors, window frames and other wall openings.
 2. Uniform depth: 3/4 inch.
 3. Uniform width: As shown on the drawings but not less than 1/4 inch.
 4. Provide sample for Architect's approval.
 5. Refers to drawing for locations and details of accent joints.
- P. Movement Joints (Expansion Joints and Control Joints):
1. Locate expansion and control joints as shown on drawings, or if not shown, comply with the following:
 - a. General:
 - 1) Vertical expansion joints shall be placed in the brick wythe and control joints shall be placed in the concrete masonry wythe, although they do not necessarily have to be aligned.
 - 2) Mortar and joint reinforcement shall not bridge brick movement joints.
 - 3) Mortar joints which stop at the expansion joint cavity shall be struck flush with the masonry unit, producing a continuous flat surface for the sealant to adhere to.
 - b. Vertical Expansion Joints:
 - 1) Locate expansion joints on long straight walls without openings maximum 25 feet-0 inches.
 - 2) Locate expansion joints at the corner of walls perpendicular to one another. In instances, where the joint is not desired at the corner, the expansion joint shall be located within 10 feet-0 inches of the corner in either wall, but not necessarily both. The spacing of expansion joints around a corner shall not exceed the spacing of expansion joints in a straight wall. For example, if the spacing between expansion joints on a straight wall is 25 feet-0 inches, then the spacing of expansion joints around a corner could be 10 feet-0 inches on one side of the corner and 15 feet-0 inches on the other side. Joint reinforcement may be added around wall corners to provide added tensile strength to the corner, but joint reinforcement shall not bridge the expansion joint.
 - c. Offsets and Setbacks:
 - 1) Locate expansion joints at 10 feet-0 inches maximum on one side of the offset or setback. The spacing of expansion joints around an offset or setback shall not exceed the spacing of expansion joints in a straight wall. See expansion joints at corners of perpendicular walls to one another above for example of spacing.
 - d. Openings (Doors and Windows):
 - 1) Locate vertical expansion joints along the edge or jamb of the opening of windows and doors. Single opening windows and doors under 6 feet-0 inches in width shall have expansion joint on one (1) side of the edge or jamb of the opening as determined by the Architect, unless shown otherwise on drawings. Windows and doors 6 feet-0 inches and over in width shall have expansion joints on both sides of the edge or jamb of the opening.
 - 2) Where masonry above an opening is supported by shelf angles attached

to the structure, a vertical expansion joint shall be located alongside the opening, continuing through the horizontal support.

3) Where masonry above the opening is supported by loose lintels (unattached to the structure), special detailing and construction is required. If the expansion joint runs along side the opening, the loose steel lintel shall be allowed to expand independently of the masonry. To accomplish this, form a slip plane with flashing located above and below the angle. A backer rod and sealant shall be installed in front of the toe of the angle, and space shall be left at the end of the angle. Thus, a pocket will be formed which will allow movement of the steel angle within the brickwork. If the joint cannot be built in this manner, then the vertical expansion joint shall not be located alongside the opening, but rather, with Architect's prior approval, the joint shall be located halfway between the openings.

e. Intersections and Junctions:

- 1) Locate expansion joints at intersections of masonry walls and walls which serve different functions. If the masonry is not required to be bonded at the intersection, an expansion joint shall be incorporated. Walls which intersect at other than right angles are also vulnerable to cracking at the intersection.
- 2) Locate expansion joint to separate adjacent walls of different heights to avoid differential movement, especially if the difference is very large.

f. Parapets:

- 1) All vertical expansion joints shall be carried through the parapets.
- 2) Additional expansion joints shall be halfway between those running full height, unless the parapet is reinforced. These additional expansion joints shall continue down to a horizontal expansion joint, or continue to the base of the wall.

g. Horizontal Expansion Joints:

- 1) Locate horizontal expansion joints at shelf angles supporting brick masonry.

h. Control Joints:

- 1) Locate CMU control joints directly over concrete slab control joints.
- 2) Whenever possible, lay out CMU so that control joint will coincide with CMU module (25 feet-0 inch maximum spacing between control joints), unless noted otherwise on drawings.
- 3) Locate control joints at structural columns to isolate movement from continuing or intersecting walls and columns.
- 4) Install backer rod and sealant in accordance with manufacturer's instructions.

i. Use vandal resistant metal cover at interior expansion joints. At exterior expansion joints, silicone coated compressible expansion joint materials are acceptable.

j. At interior and exterior control joints, use paintable silicone or polyurethane sealant with vandal resistant characteristics.

3.4 ALLOWABLE TOLERANCES

A. Maximum Variation from Plumb:

1. In lines and surfaces of columns, walls and at rises:
 - a. 1/4 inch in 10 feet (1:480)
 - b. 3/8 inch in 20 feet (maximum)
 - c. 1/2 inch in 40 feet (1:960)

2. For external corners, expansion joints and other conspicuous lines:
 - a. 1/4 inch in 20 feet (maximum)
 - b. 1/2 inch in 40 feet (1:960)
- B. Maximum variation from level:
 1. 1/4 inch in any bay or 20 feet
 2. 1/2 inch in 40 feet (1:960)

3.5 REMOVAL OF FORMS AND SHORES

- A. Do not remove shores and forms under reinforced masonry beams, lintels, and soffits until members have hardened sufficiently to carry their own weight and other super imposed loads. Providing that sufficient curing has taken place, leave forms and shores in place as follows:
 1. Beam and lintels: Minimum ten (10) days.
- B. Allow 16 hours to elapse after completion of masonry columns and walls before placing floor or roof construction loads on them. Allow an additional 48 hours before applying concentrated loads such as trusses, girders, and beams.

3.6 REPAIRING, POINTING AND CLEANING

- A. All holes in exposed masonry shall be pointed, and defective joints shall be cut out and re-pointed with mortar.
- B. Before applying any cleaning agent to the entire wall, it shall be applied to a sample wall area of approximately 20 square feet, in a location approved by Architect. No further cleaning work may proceed until the sample area has been approved by Architect, after which, the same cleaning materials and method shall be used on remaining wall area. Sash, metal lintels and other corrodible parts shall be thoroughly protected.
Clean all exposed surfaces of new masonry of excess mortar, efflorescence, stains, and job dirt, using materials specified.
 1. Clean from bottom up; prevent cleaning materials and rinse water from contacting non-cementitious materials.
 2. Clean in accordance with manufacturer's instructions and recommendations, product data, and container label instructions.
 3. Mix materials in strict accordance with manufacturers instructions; do not dilute unless permitted by manufacturer.
 4. Prevent overspray, wind drift, and splash onto surfaces not to be treated.
 5. No high pressure washers are permitted.
 6. Low pressure spray for wetting and rinsing is permitted. Pressure should be in the range of 400-1000 psi. Equipment should produce 6-8 gallons of water per minute using a 15- 40 degree fan tip (no fan tip less than a 15 degree is allowed).
 7. No metal tools or wire brushes are allowed for cleaning of masonry. Use a waste piece of same masonry material for scraping of installed material.

3.7 REPAIR OR REPLACEMENT OF DAMAGED WORK

- A. Imperfect or damaged work, or any material damaged or determined to be defective before final completion and acceptance of the entire job, shall be satisfactorily replaced at Contractor's expense and in conformity with all requirements of drawings and specifications. Removal and replacement of masonry work shall be performed in such a manner as not to impair the appearance or strength of the structure in any way.

3.8 CLEAN-UP AND PROTECTION

- A. Clean up all debris caused by work of this Section, keeping the area clean and neat at all times.
- B. Cover all unfinished work at night against the elements with plastic sheeting, building paper, heavy

canvas or other material approved by Architect to prevent water from entering cavities.

- C. Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure unit masonry is without damage and deterioration at time of Substantial Completion.

3.9 FIELD QUALITY CONTROL AND TESTING

- A. Inspection and Testing Laboratory services shall be in accordance with Section 01 45 23, Testing and Inspecting Services.

END OF SECTION 04 20 00

SECTION 04 22 00 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Concrete masonry units.
 - 2. Mortar and grout.
 - 3. Steel reinforcing bars.
 - 4. Masonry joint reinforcement.
 - 5. Ties and anchors.
 - 6. Embedded flashing.
 - 7. Miscellaneous masonry accessories.

1.3 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
 - 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

1.5 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
 - 1. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.
 - 2. Mortar Test (Property Specification): For each mix required, according to ASTM C 109 for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
 - 3. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For the following:
 - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 - 2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.
 - 3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples for Initial Selection:
 - 1. Decorative CMUs, in the form of small-scale units.
 - 2. Pre-faced CMUs.
 - 3. Colored mortar.
 - 4. Weep holes/vents.
- D. Samples for Verification: For each type and color of the following:
 - 1. CMUs.
 - 2. Accessories embedded in masonry.

1.7 INFORMATIONAL SUBMITTALS

- A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
 - 1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.
- B. Qualification Data: For testing agency.
- C. Material Certificates: For each type and size of the following:
 - 1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements.
 - b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
 - 2. Cementitious materials. Include brand, type, and name of manufacturer.
 - 3. Pre-blended, dry mortar mixes. Include description of type and proportions of ingredients.
 - 4. Grout mixes. Include description of type and proportions of ingredients.
 - 5. Reinforcing bars.
 - 6. Joint reinforcement.
 - 7. Anchors, ties, and metal accessories.
- D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109 for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
 2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
- F. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.
- B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
- E. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.
1. Build sample panels for each type of unit masonry construction in sizes approximately 48 inches long by 48 inches high by full thickness.
 2. Where masonry is to match existing, erect panels adjacent and parallel to existing surface.
 3. Protect approved sample panels from the elements with weather-resistant membrane.
 4. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
 - a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by Architect in writing.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination."

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver pre-blended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store pre-blended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.10 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
- B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
- B. Integral Water Repellent: Provide units made with integral water repellent for exposed units and where indicated.
 - 1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514 as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.
- C. CMUs: ASTM C 90.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.
 - 2. Density Classification: Normal weight unless otherwise indicated.
 - 3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
 - 4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.
 - 5. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

2.3 CONCRETE AND MASONRY LINTELS

- A. General: Provide one of the following:
- B. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than CMUs.

- C. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.4 MORTAR AND GROUT MATERIALS

- A. Regional Materials: Aggregate for mortar and grout shall be extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
- B. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Portland Cement-Lime Mix: Packaged blend of Portland cement and hydrated lime containing no other ingredients.
- E. Masonry Cement: ASTM C 91.
- F. Mortar Cement: ASTM C 1329.
- G. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.
- H. Aggregate for Mortar: ASTM C 144.
 - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 - 2. For joints, less than 1/4-inch-thick, use aggregate graded with 100 percent passing the No. 16 sieve.
 - 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
 - 4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- I. Aggregate for Grout: ASTM C 404.
- J. Cold-Weather Admixture: Non-chloride, noncorrosive, accelerating admixture complying with ASTM C 494, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
- K. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs, containing integral water repellent by same manufacturer.
- L. Water: Potable.

2.5 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615 or ASTM A 996, Grade 60.
- B. Masonry Joint Reinforcement, General: ASTM A 951.

1. Interior Walls: Mill- galvanized, carbon steel.
 2. Exterior Walls: Hot-dip galvanized, carbon steel.
 3. Wire Size for Side Rods: 0.148-inch diameter or as indicated on Drawings.
 4. Wire Size for Cross Rods: 0.148-inch diameter or as indicated on Drawings.
 5. Wire Size for Veneer Ties: 0.148-inch diameter or as indicated on Drawings.
 6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
 7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units].
- C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

2.6 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153, Class B-2 coating.
 2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008, Commercial Steel, with ASTM A 153, Class B coating.
 3. Steel Plates, Shapes, and Bars: ASTM A 36.
- B. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- diameter, hot-dip galvanized steel wire.
 2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.187-inch diameter, hot-dip galvanized steel.
- C. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch- thick, steel sheet, galvanized after fabrication.
 2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.187-inch-diameter, hot-dip galvanized steel.
 3. Corrugated Metal Ties: Metal strips not less than 7/8-inch-wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch made from 0.075-inch-thick, steel sheet, galvanized after fabrication with dovetail tabs for inserting into dovetail slots in concrete and sized to extend to within 1 inch of masonry face.
- D. Partition Top anchors: 0.105-inch- thick metal plate with 3/8-inch-diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
- E. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4-inch-thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.
1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153] [Epoxy coating 0.020 inch thick.

2.7 MISCELLANEOUS ANCHORS

- A. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of dimensions indicated.
- B. Post-installed Anchors: Torque-controlled expansion anchors or chemical/adhesive anchors unless otherwise indicated on Drawings.
 - 1. Load Capacity: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 - 2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 unless otherwise indicated.

2.8 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with Section 076200 "Sheet Metal Flashing and Trim" and as indicated on Drawings. Include accessories, adhesives, primers, and seam tapes as applicable.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Pre-molded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812, or D/A 817.
 - b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
 - c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
 - d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2.10 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. For reinforced masonry, use Portland cement-lime mortar.

3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Pre-blended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a pre-blended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
1. For masonry below grade or in contact with earth, use Type M.
 2. For reinforced masonry, use Type S.
 3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
 4. For interior non-load-bearing partitions, Type O may be used instead of Type N.
- D. Grout for Unit Masonry: Comply with ASTM C 476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 2. Proportion grout in accordance with ASTM C 476, Table 1 or] paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi except where indicated on Drawings.
 3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 2. Verify that foundations are within tolerances specified.
 3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Build chases and recesses to accommodate items specified in this and other Sections.
- B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

- C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 TOLERANCES

- A. Dimensions and Locations of Elements:
 - 1. For dimensions in cross section or elevation do not vary by more than plus 1/2-inch or minus 1/4-inch.
 - 2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2-inch.
 - 3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4-inch in a story height or 1/2-inch total.
- B. Lines and Levels:
 - 1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4-inch in 10 feet, or 1/2-inch maximum.
 - 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8-inch in 10 feet, 1/4-inch in 20 feet, or 1/2-inch maximum.
 - 3. For vertical lines and surfaces do not vary from plumb by more than 1/4-inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
 - 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8-inch in 10 feet, 1/4-inch in 20 feet, or 1/2-inch maximum.
 - 5. For lines and surfaces do not vary from straight by more than 1/4-inch in 10 feet, 3/8-inch in 20 feet, or 1/2-inch maximum.
 - 6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4-inch in 10 feet, or 1/2-inch maximum.
- C. Joints:
 - 1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8-inch, with a maximum thickness limited to 1/2-inch.
 - 2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8-inch.
 - 3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8-inch or minus 1/4-inch.
 - 4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8-inch.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond, unless otherwise indicated on Drawings; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
 - 1. Install compressible filler in joint between top of partition and underside of structure above.
 - 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches or less on center unless otherwise indicated.
 - 3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
 - 4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078446 "Fire-Resistive Joint Systems."

3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
 - 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 - 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
 - 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 - 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
 - 1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
 - 2. Allow cleaned surfaces to dry before setting.
 - 3. Wet joint surfaces thoroughly before applying mortar.
- D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.6 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8-inch on exterior side of walls, 1/2-inch elsewhere. Lap reinforcement a minimum of 6 inches.
 - 1. Space reinforcement not more than 16 inches o.c.
 - 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
 - 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:
 - 1. Provide an open space not less than inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 - 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
 - 3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.8 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry as follows:
 - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
 - 2. Install preformed control-joint gaskets designed to fit standard sash block.
 - 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
 - 4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

3.9 LINTELS

- A. Provide masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.
- B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.10 FLASHING

- A. General: Install embedded flashing in masonry at lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
 - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
 - 2. At lintels, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
 - 3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 07 92 00 "Joint Sealants" for application indicated.
 - 4. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 07 92 00 "Joint Sealants" for application indicated.
 - 5. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2-inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.

6. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2-inch back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
 7. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.
- D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

3.11 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 2. Limit height of vertical grout pours to not more than 60 inches.

3.12 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
- B. Inspections: Level 1 special inspections according to the "International Building Code."
1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.

- D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- F. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.
- G. Prism Test: For each type of construction provided, according to ASTM C 1314 at 28 days.

3.13 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.14 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
 - 1. Crush masonry waste to less than 4 inches in each dimension.
 - 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 31 20 00 "Earth Moving."
 - 3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 22 00

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Structural steel.
 - 2. Prefabricated building columns.
- B. Related Sections:
 - 1. Section 01 45 23 "Testing and Inspection Services".
 - 2. Section 05 12 13 "Architecturally Exposed Structural Steel Framing".
 - 3. Section 05 31 00 "Steel Decking".
 - 4. Section 13 34 19 "Metal Building Systems".

1.3 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
- C. Heavy Sections: Rolled and built-up sections as follows:
 - 1. Shapes included in ASTM A 6 with flanges thicker than 1 1/2 inches.
 - 2. Welded built-up members with plates thicker than 2 inches.
 - 3. Column base plates thicker than 2 inches.
- D. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.
- E. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.4 REFERENCES

- A. Comply with applicable provisions of the following specifications and documents: The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
 - 1. AISC "Code of Standard Practice for Steel Buildings and Bridges".
 - 2. AISC "Specification for Structural Steel Buildings," including the "Commentary" and the Supplements thereto, as issued.
 - 3. AISC "Specification for Architecturally Exposed Structural Steel".
 - 4. AISC's "Seismic Provisions for Structural Steel Buildings".
 - 5. ASTM A 6 "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use".

6. AWS D1.1 Structural Welding Code.
7. Research Council on Structural Connections' (RCSC) "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts".
8. Research Council on Structural Connections' (RCSC) "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts".
9. SSPC (Steel Structures Painting Council), Painting Manuals, Volumes 1 and 2.
10. UL Fire Resistance Directory.

- B. In the case of conflict between the Contract Documents and a reference standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.5 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.
1. Select and complete connections using schematic details indicated and AISC 360.
- B. Moment Connections: Type FR, fully restrained.
- C. Construction: System as indicated on Drawings.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.
1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 2. Include embedment drawings.
 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
 5. Identify members and connections of the seismic-load-resisting system.
 6. Indicate locations and dimensions of protected zones.
 7. Identify demand critical welds.
 8. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. At full penetration welds, Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:
1. Power source (constant current or constant voltage).
 2. Electrode manufacturer and trade name, for demand critical welds.

1.7 INFORMATIONAL SUBMITTALS

- A. Submit the following informational submittals:
1. Qualification Data: For qualified installer, fabricator, and testing agency.
 2. Welding certificates.
 3. Mill test reports for structural steel, including chemical and physical properties.

4. Product Test Reports: For the following:
 - a. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - b. Direct-tension indicators.
 - c. Tension-control, high-strength bolt-nut-washer assemblies.
 - d. Shear stud connectors.
 - e. Shop primers.
5. Source quality-control reports.

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1, P2, or P3 as applicable for exposure or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
- E. Comply with applicable provisions of the following specifications and documents:
 1. AISC 303.
 2. AISC 341 and AISC 341s1.
 3. AISC 360.
 4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- F. Preinstallation Conference: Conduct conference at Project site.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 2. Clean and re-lubricate bolts and nuts that become dry or rusty before use.
 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.10 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than the following:
 - 1. W-Shapes: 60 percent.
 - 2. Channels, Angles, M, S-Shapes: 60 percent.
 - 3. Plate and Bar: 25 percent.
 - 4. Cold-Formed Hollow Structural Sections: 25 percent.
 - 5. Steel Pipe: 25 percent.
 - 6. All Other Steel Materials: 25 percent.
- B. W-Shapes: Refer Structural General Notes.
- C. Channels, Angles, M, S-Shapes: Refer Structural General Notes.
- D. Plate and Bar: Refer Structural General Notes.
- E. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: ASTM A 588, Grade 50.
- F. Cold-Formed Hollow Structural Sections: Refer Structural General Notes.
- G. Steel Pipe: Refer Structural General Notes.
 - 1. Weight Class: See Plans.
 - 2. Finish: Black except where indicated to be galvanized.
- H. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts.
 - 1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.
- B. Zinc-Coated High-Strength Bolts, Nuts, and Washers (All bolts located in Crawl Space): ASTM A 325, Type 1, heavy-hex steel structural bolts.
 - 1. Finish: Hot-dip or mechanically deposited zinc coating.
 - 2. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with mechanically deposited zinc coating finish.
- C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex or round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain or Mechanically deposited zinc coating, where required.
- D. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.
- E. Unheaded Anchor Rods: ASTM F 1554, See Anchor Bolt Schedule on Drawings for Grade.
 1. Configuration: Straight.
 2. Nuts: ASTM A 563 heavy-hex carbon steel.
 3. Plate Washers: ASTM A 36 carbon steel.
 4. Washers: ASTM F 436, Type 1, hardened carbon steel.
 5. Finish:
 - a. General Condition – Plain
 - b. Crawl Space - Hot-dip zinc coating, ASTM A 153, Class C.
- F. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.
- G. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.
- H. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.
- I. Structural Slide Bearings: Low-friction assemblies, of configuration indicated, that provide vertical transfer of loads and allow horizontal movement perpendicular to plane of expansion joint while resisting movement within plane of expansion joint.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Amscot Structural Products Corp.
 - b. Fluorocarbon Company Limited.
 - c. R.J. Watson Bridge & Structural Engineered Systems.
 - d. Seismic Energy Products, L.P.
 2. Mating Surfaces: PTFE and PTFE or mirror-finished stainless steel.
 3. Coefficient of Friction: Not more than 0.05.
 4. Design Load: Not less than 5,000 psi .
 5. Total Movement Capability: 2 inches.

2.3 PRIMER

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Primer (General): Fabricator's standard lead- and chromate-free, non-asphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- C. Primer (Crawl Space Steel): Tnemec Perimeprime Series 394.
- D. Galvanizing Repair Paint: SSPC-Paint 20.

2.4 GROUT

- A. Refer Section 03 30 00.

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
1. Camber structural-steel members where indicated.
 2. Fabricate beams with rolling camber up.
 3. Identify high-strength structural steel according to ASTM A 6 and maintain markings until structural steel has been erected.
 4. Mark and match-mark materials for field assembly.
 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC specifications referenced in this Section and in final approved Shop Drawings.
1. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize field handling of materials.
 2. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other effects.
 3. Camber structural steel members where indicated. The camber specified is the camber that is measured in the field with the beam on its side so that the beam weight has no effect. During shipment and handling, cambered members shall be supported in a way that will not result in loss of camber.
 4. Camber tolerance
 - a. Beams 50 feet and less; plus or minus 1/2 inch.
 - b. Beams greater than 50 feet; plus or minus 1/2 inch, except tolerance can be increased 1/8 inch for each 10 feet or fraction thereof in excess of 50 feet.
 - c. Contact engineer for members outside specified camber tolerance. Provide engineer with a list of beam locations and actual measured camber amounts. Submit an engineered shoring plan, if requested, that will allow the beam to deflect to the horizontal position after concrete placement without overloading the framing below.
 5. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.
 6. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.
- C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- D. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- E. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- F. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 3, "Power Tool Cleaning."
- G. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.
- H. Holes for Other Work: Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on approved shop drawings.

1. Provide threaded nuts welded to framing, and other specialty items as indicated to receive other work.
 2. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes by burning.
- I. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces. Base plates hole sizes for anchor bolts may be oversized to facilitate erection:
1. Bolts 3/4 inch to 7/8 inch diameter: 1/2 inch oversize.
 2. Bolts 1 inch to 1 1/2 inch diameter: 3/4 inch oversize.
 3. Bolts over 1 3/4 inch diameter: 1 inch oversize.
- J. Base Plate Washers: Sizes shall be as follows:
1. 3/4 inch diameter Bolts: 2 inch diameter x 1/4 inch thick
 2. 7/8 inch diameter Bolts: 2 1/2 inch diameter x 5/16 inch thick
 3. 1 inch diameter Bolts: 3 inch diameter x 3/8 inch thick
 4. 1 1/4 inch diameter Bolts: 3 inch diameter x 1/2 inch thick
 5. 1 1/2 inch diameter Bolts: 3 1/2 inch diameter x 1/2 inch thick
 6. 1 3/4 inch diameter Bolts: 4 inch diameter x 5/8 inch thick
 7. 2 inch diameter Bolts: 5 inch diameter x 3/4 inch thick
- K. Architecturally Exposed Structural Steel (AESS): Fabricate with exposed surfaces smooth, square, and free of surface blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.
1. Remove blemishes by filling, grinding, or by welding and grinding, prior to cleaning, treating, and shop priming.
 2. Comply with fabrication requirements, including tolerance limits, of AISC's "Specification for Architecturally Exposed Structural Steel" for architecturally exposed structural steel.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: Snug tightened, Pretensioned, or Slip critical as required or indicated on Drawings.
- B. Weld Connections: Comply with AWS D1.1 and AWS D1.8, where required, for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 2. Surfaces to be field welded.
 3. Surfaces to be high-strength bolted with slip-critical connections.
 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing) excluding crawl space steel. Crawl space steel shall be primed regardless of whether it is to receive fireproofing.
 5. Galvanized surfaces.

- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
- D. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.
- E. Crawl space steel to be primed to a DFT between 2.5 and 3.5 mils.
- F. Painting: Prepare steel and apply a one-coat, non-asphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils.
- G. GALVANIZING
- H. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123.
 - 1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
 - 2. Galvanize lintels and shelf angles attached to structural steel frame and located in exterior walls.

2.8 SOURCE QUALITY CONTROL

- A. Testing Agency: Refer Section 01 45 23.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with steel Erector present, elevations of concrete and masonry bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations, to elevations indicated, and according to AISC 303 and AISC 360.
- B. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 2. Weld plate washers to top of baseplate.
 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow it to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 1. Level and plumb individual members of structure.
 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 Bolts" for type of bolt and type of joint specified.
 1. Joint Type: Snug tightened, Pretensioned, or Slip critical as indicated on Drawings.
- B. Weld Connections: Comply with AWS D1.1 and AWS D1.8 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.

3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: See Section 01 45 23.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION 05 12 00

SECTION 05 12 13 - ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes architecturally exposed structural-steel framing.
 - 1. Requirements in Section 05 12 00 "Structural Steel Framing".
- B. Related Sections:
 - 1. Section 01 45 23 "Testing and Inspection Services".
 - 2. Section 05 12 00 "Structural Steel Framing".

1.3 DEFINITIONS

- A. Architecturally Exposed Structural Steel: Structural steel designated as "architecturally exposed structural steel" or "AESS" in the Contract Documents.
- B. Category 1 AESS: AESS that is within 96 inches (2400 mm) vertically and 36 inches (900 mm) horizontally of a walking surface and is visible to a person standing on that walking surface or is designated as "Category 1 architecturally exposed structural steel" or "AESS-1" in the Contract Documents.
- C. Category 2 AESS: AESS that is within 20 feet (6 m) vertically and horizontally of a walking surface and is visible to a person standing on that walking surface or is designated as "Category 2 architecturally exposed structural steel" or "AESS-2" in the Contract Documents.
- D. Category 3 AESS: AESS that is not defined as Category 1 or Category 2 or that is designated as "Category 3 architecturally exposed structural steel" or "AESS-3" in the Contract Documents.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: Show fabrication of AESS components. Shop Drawings for structural steel may be used for AESS provided items of AESS are specifically identified and requirements below are met for AESS.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain. Indicate grinding, finish, and profile of welds.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
 - 5. Indicate exposed surfaces and edges and surface preparation being used.
 - 6. Indicate special tolerances and erection requirements.
- B. Samples: Submit samples of AESS to set quality standards for exposed welds for Category 1 AESS.

1. Two steel plates, 3/8 by 8 by 4 inches (9.5 by 200 by 100 mm), with long edges joined by a groove weld ground smooth.
2. Steel plate, 3/8 by 8 by 8 inches (9.5 by 200 by 200 mm), with one end of a short length of rectangular steel tube, 4 by 6 by 3/8 inches (100 by 150 by 9.5 mm), welded to plate with a continuous fillet weld ground smooth and blended.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer and fabricator.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- B. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1, P2, or P3 as applicable for exposure or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
- D. Preinstallation Conference: Conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Use special care in handling to prevent twisting, warping, nicking, and other damage. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Where AESS is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication.

1.9 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

PART 2 - PRODUCTS

2.1 BOLTS, CONNECTORS, AND ANCHORS

- A. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, round-head assemblies, consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
 1. Finish: Plain.

- B. Corrosion-Resisting (Weathering Steel), Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 3, round-head assemblies, consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

2.2 PRIMER

- A. Primer: Comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
- B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- C. Galvanizing Repair Paint: SSPC-Paint 20.

2.3 FABRICATION

- A. Shop fabricate and assemble AESS to the maximum extent possible. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection.
- B. In addition to special care used to handle and fabricate AESS, comply with the following:
 - 1. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, and roughness.
 - 2. Grind sheared, punched, and flame-cut edges of Category 1 AESS to remove burrs and provide smooth surfaces and edges.
 - 3. Fabricate Category 1 AESS with exposed surfaces free of mill marks, including rolled trade names and stamped or raised identification.
 - 4. Fabricate Category 1 and Category 2 AESS with exposed surfaces free of seams to maximum extent possible.
 - 5. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.
 - 6. Fabricate with piece marks fully hidden in the completed structure or made with media that permits full removal after erection.
 - 7. Fabricate Category 1 AESS to the tolerances specified in AISC 303 for steel that is designated AESS.
 - 8. Fabricate Category 2 and Category 3 AESS to the tolerances specified in AISC 303 for steel that is not designated AESS.
 - 9. Seal-weld open ends of hollow structural sections with 3/8-inch (9.5-mm) closure plates for steel that is designated AESS.
- C. Curved Members: Fabricate indicated members to curved shape by rolling to final shape in fabrication shop.
 - 1. Distortion of webs, stems, outstanding flanges, and legs of angles shall not be visible from a distance of 20 feet (6 m) under any lighting conditions.
 - 2. Tolerances for walls of hollow steel sections after rolling shall be approximately 1/2 inch (13 mm).
- D. Coping, Blocking, and Joint Gaps: Maintain uniform gaps of 1/8 inch (3.2 mm) with a tolerance of 1/32 inch (0.8 mm) for Category 1 AESS.
- E. Bolt Holes: Cut, drill, mechanically (CNC) thermal cut, or punch standard bolt holes perpendicular to metal surfaces.
- F. Cleaning Corrosion-Resisting Structural Steel: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

- G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
1. Cut, drill, mechanically (CNC) thermal cut, or punch holes perpendicular to steel surfaces.
 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.4 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: Snug tightened, Pretensioned (TC), or Slip critical as indicated on Drawings.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work, and comply with the following:
1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding specified tolerances.
 2. Use weld sizes, fabrication sequence, and equipment for AESS that limit distortions to allowable tolerances.
 3. Provide continuous, sealed welds at angle to gusset-plate connections and similar locations where Category 1 and 2 AESS is exposed to weather.
 4. Provide continuous welds of uniform size and profile where Category 1 and 2 AESS is welded.
 5. Grind butt and groove welds flush to adjacent surfaces within tolerance of plus 1/16 inch, minus 0 inch (plus 1.5 mm, minus 0 mm) for Category 1 and Category 2 AESS.
 6. Remove backing bars or runoff tabs; back-gouge and grind steel smooth for Category 1 and Category 2 AESS.
 7. At locations where welding on the far side of an exposed connection of Category 1 and Category 2 AESS occurs, grind distortions and marking of the steel to a smooth profile aligned with adjacent material.
 8. Make fillet welds for Category 1 and Category 2 AESS oversize and grind to uniform profile with smooth face and transition.

2.5 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
 2. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
 3. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.

2.6 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
 2. Surfaces to be field welded.
 3. Surfaces to be high-strength bolted with slip-critical connections.
 4. Surfaces to receive sprayed fire-resistive materials.
 5. Galvanized surfaces.

- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning."
- C. Preparing Galvanized Steel for Shop Priming: After galvanizing, thoroughly clean steel of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
- D. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Examine AESS for twists, kinks, warping, gouges, and other imperfections before erecting.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep AESS secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
 - 1. If possible, locate welded tabs for attaching temporary bracing and safety cabling where they will be concealed from view in the completed Work.

3.3 ERECTION

- A. Set AESS accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
 - 1. Erect Category 1 AESS to the tolerances specified in AISC 303 for steel that is designated AESS.
 - 2. Erect Category 2 and Category 3 AESS to the tolerances specified in AISC 303 for steel that is not designated AESS.
- B. Do not use thermal cutting during erection.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened, Pretensioned (TC), or Slip critical as indicated on Drawings.

- B. Weld Connections: Comply with requirements in "Weld Connections" Paragraph in "Shop Connections" Article.
 - 1. Remove backing bars or runoff tabs; back-gouge and grind steel smooth for Category 1 and Category 2 AESS.
 - 2. Remove erection bolts in Category 1 and Category 2 AESS, fill holes, and grind smooth.
 - 3. Fill weld access holes in Category 1 and Category 2 AESS and grind smooth.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect AESS as specified in Section 05 12 00 "Structural Steel Framing." The testing agency will not be responsible for enforcing requirements relating to aesthetic effect.
- B. Architect will observe AESS in place to determine acceptability relating to aesthetic effect.

3.6 REPAIRS AND PROTECTION

- A. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Grind steel smooth.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.
- C. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Clean and prepare surfaces by SSPC-SP 3 power-tool cleaning.

END OF SECTION 05 12 13

SECTION 05 21 00 – STEEL OPEN WEB JOIST FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. K-series steel joists.
 - 2. KCS-type K-series steel joists.
 - 3. K-series steel joist substitutes.
 - 4. LH- and DLH-series long-span steel joists.
 - 5. CJ-series composite steel joists.
 - 6. Joist girders.
 - 7. Joist accessories.
 - 8. Extended ends.
 - 9. Ceiling extensions.
 - 10. Bearing plates.
 - 11. Bridging.
 - 12. Side wall anchors.
- B. Related Requirements:
 - 1. Section 03 30 00 "Cast-in-Place Concrete".
 - 2. Section 01 45 23 "Testing and Inspection Services"
 - 3. Section 04 20 00 "Unit Masonry".
 - 4. Section 05 12 00 "Structural Steel Framing".
 - 5. Section 05 31 13 "Steel Floor Decking".
 - 6. Section 05 31 23 "Steel Roof Decking".

1.3 REFERENCES

- A. Comply with applicable provisions of the following specifications and documents. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
- B. AWS D1.1 Structural Welding Code
- C. SJI "Standard Specification Load Tables and Weight Tables for Steel Joists and Joist Girders".
- D. SDI "Design Manual for Composite Decks, Form Decks, Roof Decks, Cellular Metal Floor Deck with Electrical Distribution".
- E. SSPC Steel Structures Painting Council Painting Manual.
- F. UL Fire Resistance Directory.
- G. ICBO Product Evaluation Reports.
- H. FM Roof Assembly Classifications.

- I. In the case of conflict between the Contract Documents and a reference standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.4 DEFINITIONS

- A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."
- B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support non-uniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product.
Review LEED requirements with Project Architect and edit as needed. References to LEED credits below MAY NOT be current.
- B. Shop Drawings:
 1. Include layout, designation, number, type, location, and spacing of joists.
 2. Include joining and anchorage details, bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
 3. Indicate locations and details of bearing plates to be embedded in other construction.
 4. Shop drawings containing special joists shall be submitted with a design load summary for each special joist design. Load summary will be reviewed and returned with the joist submittal. Shop drawings containing special joists submitted without the specified load summary will be returned unchecked as an incomplete submittal. Shop drawings containing special joists shall be signed and sealed by the qualified professional engineer responsible for the design of the joists.

1.6 INFORMATIONAL SUBMITTALS

- A. Submit the following informational submittals:
 1. Qualification Data: For manufacturer.
 2. Welding certificates.
 3. Manufacturer certificates.
 4. Mill Certificates: For each type of bolt.
 5. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."
- B. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
- C. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

- B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.9 SEQUENCING

- A. Deliver steel bearing plates to be built into cast-in-place concrete and or masonry construction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
- B. Use ASD; data are given at service-load level.
- C. Design special joists to withstand design loads with live-load deflections no greater than the following:
 - 1. Floor Joists: Vertical deflection of 1/360 of the span.
 - 2. Roof Joists: Vertical deflection of 1/360 of the span.
- D. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.

2.2 MATERIALS

- A. Steel: Comply with SJI's "Specifications" for chord and web members.

2.3 K-SERIES STEEL JOISTS

- A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
 - 1. Joist Type: K-series steel joists and KCS-type K-series steel joists.
- B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
- C. Provide holes in chord members for connecting and securing other construction to joists.
- D. Top-Chord Extensions and Extended Ends: Provide top chord extension or extended ends where shown on plans. Design for load indicated on plans.
- E. Camber joists according to SJI's Specifications unless noted otherwise.
- F. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.4 LONG-SPAN STEEL JOISTS

- A. Manufacture steel joists according to "Standard Specifications for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as indicated on plan.
 - 1. Joist Type: Refer to Drawings.

2. End Arrangement: Refer to Drawings.
3. Top-Chord Arrangement: Refer to Drawings.

- B. Provide holes in chord members for connecting and securing other construction to joists.
- C. Camber long-span steel joists according to SJI's Specifications unless noted otherwise.
- D. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.5 JOIST GIRDERS

- A. Manufacture joist girders according to "Standard Specifications for Joist Girders" in SJI's "Specifications," with steel-angle top- and bottom-chord members; with end and top-chord arrangements as indicated on plan.
 1. End Arrangement: Refer to Drawings.
 2. Top-Chord Arrangement: Refer to Drawings.
- B. Provide holes in chord members for connecting and securing other construction to joist girders.
- C. Camber joist girders according to SJI's Specifications unless noted otherwise.
- D. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.6 PRIMERS

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

2.7 JOIST ACCESSORIES

- A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" and "Standard Specifications for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
- B. Fabricate steel bearing plates from ASTM A 36/A 36M steel with integral anchorages of sizes and thicknesses indicated. Shop prime paint for interior exposure or Hot-dip zinc coat according to ASTM A 123/A 123M for exterior or weather exposure.
- C. Furnish ceiling extensions (where indicated), either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated.
- D. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A, carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.
Finish: Plain, uncoated.

- E. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers. Finish: Plain.
- F. Welding Electrodes: Comply with AWS standards.
- G. Galvanizing Repair Paint: ASTM A 780.
- H. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.8 CLEANING AND SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.
- B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.
- C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 2 mil thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications", "Standard Specifications for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice," joist manufacturer's written recommendations, and requirements in this Section.
- C. Before installation, splice joists delivered to Project site in more than one piece. Space, adjust, and align joists accurately in location before permanently fastening.
- D. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
- E. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.
- F. Field weld joists to supporting steel bearing plates and framework as indicated on Drawings. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance, and quality of welds, and methods used in correcting welding work.

- G. Bolt joists to supporting steel framework using high-strength structural bolts as indicated on Drawings. Comply with Research Council on Structural Connection's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.
- H. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: See Section 01 45 23.

3.4 REPAIR AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.
- C. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2, or power-tool cleaning according to SSPC-SP 3.
 - 1. Apply a compatible primer of same type as primer used on adjacent surfaces.
- D. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 21 00

SECTION 05 31 13 - STEEL FLOOR DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Composite floor deck.
 - 2. Electrified cellular floor deck.
 - 3. Noncomposite form deck.
 - 4. Noncomposite vented form deck.
- B. Related Requirements:
 - 1. Section 01 45 23 "Testing and Inspection Services".
 - 2. Section 03 30 00 "Cast-in-Place Concrete".
 - 3. Section 05 12 00 "Structural Steel Framing".
 - 4. Section 05 21 00 "Steel Joist Framing"

1.3 REFERENCES

- A. Comply with applicable provisions of the following specifications and documents. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
 - 1. AWS D1.1 - Structural Welding Code
 - 2. AWS D1.3 – Structural Welding Code – Sheet Steel
 - 3. SDI – Design Manual for Composite Decks, Form Decks, Roof Decks, Cellular Metal Floor Deck with Electrical Distribution.
 - 4. SSPC – Painting Manual
 - 5. UL – Fire Resistance Directory
 - 6. ICBO – Product Evaluation Reports

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings:
 - 1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.5 INFORMATIONAL SUBMITTALS

- A. Submit the following informational submittals:
 - 1. Welding certificates.
 - 2. Product Certificates: For each type of steel deck.
 - 3. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - 4. Power-actuated mechanical fasteners.
 - 5. Evaluation Reports: For steel deck.
 - 6. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Refer Section 01 45 23.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- D. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 COMPOSITE FLOOR DECK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ASC Profiles, Inc.; a Blue Scope Steel company.
 - 2. Canam United States; Canam Group Inc.
 - 3. CMC Joist & Deck.
 - 4. Consolidated Systems, Inc.; Metal Dek Group.
 - 5. Cordeck.
 - 6. DACS, Inc.
 - 7. Epic Metals Corporation.
 - 8. Marlyn Steel Decks, Inc.
 - 9. New Millennium Building Systems, LLC.
 - 10. Nucor Corp.; Vulcraft Group.
 - 11. Roof Deck, Inc.
 - 12. Verco Manufacturing Co.
 - 13. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
- B. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel

Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:

1. Galvanized-Steel Sheet: As indicated in Structural General Notes.
2. Profile Depth: As indicated on plan.
3. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.
4. Span Condition: Triple span or more.

2.3 ELECTRIFIED CELLULAR FLOOR DECK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. CMC Joist & Deck.
 2. Consolidated Systems, Inc.; Metal Dek Group.
 3. Cordeck.
 4. HH Robertson Floor Systems; a CENTRIA company.
 5. Marlyn Steel Decks, Inc.
 6. New Millennium Building Systems, LLC.
 7. Nucor Corp.; Vulcraft Group.
 8. Verco Manufacturing Co.
 9. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
- C. Source Limitations for Electrified Cellular Floor Deck: Obtain cellular floor-deck units and compatible electrical components, such as preset inserts, activation kits, afterset inserts, service fittings, header ducts, and trench header ducts, from single manufacturer.
- D. Electrified Cellular Floor Deck: Fabricate steel-sheet cellular floor-deck panels, consisting of a ribbed top section welded to a lower flat-bottom sheet with interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck" in SDI Publication No. 31. Fabricate deck to the minimum section properties, width of panel, number and area of cells per panel indicated, and the following:
1. Cellular Deck Type: Composite.
 2. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 33, G60 zinc coating.
 3. Profile Depth: As indicated on plan.
 4. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated in Structural General Notes.
 5. Span Condition: Triple span or more.
 6. Factory punch holes, of size and arrangement indicated, into each deck cell at preset inserts and header duct locations.

2.4 NONCOMPOSITE FORM DECK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ASC Profiles, Inc.; a Blue Scope Steel company.
 2. Canam United States; Canam Group Inc.
 3. CMC Joist & Deck.
 4. Consolidated Systems, Inc.; Metal Dek Group.
 5. Cordeck.
 6. DACS, Inc.
 7. Marlyn Steel Decks, Inc.
 8. New Millennium Building Systems, LLC.
 9. Nucor Corp.; Vulcraft Group.
 10. Roof Deck, Inc.
 11. Valley Joist; Subsidiary of EBSCO Industries, Inc.

12. Verco Manufacturing Co.
 13. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
- B. Noncomposite Form Deck: Fabricate ribbed-steel sheet non-composite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
1. Prime-Painted Steel Sheet: ASTM A 1008, Structural Steel (SS), Grade 80 minimum, with top and underside surface shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: Manufacturer's standard Gray.
 2. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 80, G90 zinc coating.
 3. Profile Depth: As indicated on Plan.
 4. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.
 5. Span Condition: Triple span or more.
 6. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.5 NONCOMPOSITE VENTED FORM DECK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ASC Profiles, Inc.; a Blue Scope Steel company.
 2. Canam United States; Canam Group Inc.
 3. CMC Joist & Deck.
 4. Consolidated Systems, Inc.; Metal Dek Group.
 5. Marlyn Steel Decks, Inc.
 6. New Millennium Building Systems, LLC.
 7. Nucor Corp.; Vulcraft Group.
 8. Roof Deck, Inc.
 9. Verco Manufacturing Co.
 10. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
- B. Noncomposite Vented Form Deck: Fabricate ribbed- and vented-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, and with the following:
1. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 80, G60 zinc coating.
 2. Profile Depth: As indicated on Plan.
 3. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.
 4. Span Condition: Triple span or more.
 5. Side Laps: Overlapped or interlocking seam at Contractor's option.
 6. Vent Slot Area: Manufacturer's standard vent slots providing 1.5 percent open area.

2.6 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth unless otherwise indicated on Drawings.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.
- I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.
- J. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.
- K. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch wide flanges and sloped recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.
- L. Galvanizing Repair Paint: ASTM A 780.
- M. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
 - 1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 FLOOR-DECK INSTALLATION

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
 - 1. Weld Diameter: 3/4 inch, nominal.
 - 2. Weld Spacing: Space and locate welds as indicated on Drawings.
 - 3. Weld Washers: Install weld washers at each weld location where deck is 22 gage or less.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 36 inches, and as follows:
 - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
 - 2. Mechanically clinch or button punch only with concrete filled decks.
 - 3. Fasten with a minimum of 1-1/2-inch- long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Butted.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.
- E. Revise "Floor-Deck Closures" Paragraph below to suit Project. Sealing cellular deck openings, butt joints, and junctions with trench headers with tape is not included in this Section. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.
- F. Electrified Cellular Floor Deck: Install cellular floor system with deck assembled from units indicated.
 - 1. Coordinate layout and installation of trench headers, preset inserts, duct fittings, and other components specified in Section 260539 "Underfloor Raceways for Electrical Systems" with installation of electrified cellular metal floor deck.
- G. Install piercing hanger tabs at 14 inches apart in both directions, within 9 inches of walls at ends, and not more than 12 inches from walls at sides unless otherwise indicated.

3.4 COMPOSITE FLOOR DECK INSTALLATION

- A. The composite steel deck shall be connected to the supporting steel beams by welding the shear/headed stud connectors through the deck as indicated in the drawings. Contractor to verify the attachment of the deck to the supporting member after the headed stud is welded.

Improper amperage may cause burn through around the stud and the deck may not be adequately attached to the supporting deck.

- B. Where shear/headed stud connectors are not specified, the metal deck shall be attached to the supporting steel with 3/4-inch diameter puddle welds at a maximum spacing of 12 inches.
- C. Where the specified shear/headed stud connector spacing exceeds 12 inches, provide 3/4-inch diameter puddle welds between shear/headed stud connectors to maintain a maximum deck connection of 12 inches.
- D. Where deck units abut side to side or end to end over a supporting member provide 3/4-inch diameter puddle welds on each deck unit at a maximum spacing of 12 inches.
- E. Shear/Headed Stud Connectors: Field weld shear/headed stud connectors through deck to supporting frame according to AWS D1.1 and manufacturer's written instructions. Located connectors as indicated in the drawings. Remove and discard arc shields after welding shear/headed stud connectors.

3.5 DECK AND FLOOR DEFLECTION

- A. The metal deck is designed to deflect up to 3/4-inch.
- B. Uncambered steel beams are designed to be within code required deflection limits (Span/240). Cambered steel beams are designed to have a final deflected shape of less than 1/2-inch. Due to field tolerances and camber tolerances, these design limits may be slightly exceeded.
- C. The contractor shall account for any additional concrete required due to these deflected shape tolerances.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Refer Section 01 45 23.
- B. Remove and replace work that does not comply with specified requirements.
- C. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.7 PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
 - 1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
- C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 31 00

SECTION 05 31 23 - STEEL ROOF DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Roof deck.
 - 2. Acoustical roof deck.
 - 3. Noncomposite vented roof deck.
- B. Related Requirements:
 - 1. Section 01 45 23 "Testing and Inspection Services"
 - 2. Section 05 12 00 "Structural Steel Framing".

1.3 REFERENCES

- A. Comply with applicable provisions of the following specifications and documents. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
 - 1. AWS D1.1 – Structural Welding Code
 - 2. AWS D1.3 – Structural Welding Code – Sheet Steel
 - 3. SDI – Design Manual
 - 4. SSPC – Painting Manual
 - 5. UL – Fire Resistance Directory
 - 6. ICBO – Product Evaluation Reports
 - 7. FM – Roof Assembly Classifications
- B. In the case of conflict between the Contract Documents and a referenced standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings:
 - 1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Certificates: For each type of steel deck.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - 1. Power-actuated mechanical fasteners.
 - 2. Acoustical roof deck.

- D. Evaluation Reports: For steel deck.
- E. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Refer Section 01 45 23.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."
- C. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
 - 1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- D. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 ROOF DECK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ASC Profiles, Inc.; a Blue Scope Steel company.
 - 2. Canam United States; Canam Group Inc.
 - 3. CMC Joist & Deck.
 - 4. Consolidated Systems, Inc.; Metal Dek Group.
 - 5. Cordeck.
 - 6. DACS, Inc.

7. Epic Metals Corporation.
 8. Marlyn Steel Decks, Inc.
 9. New Millennium Building Systems, LLC.
 10. Nucor Corp.; Vulcraft Group.
 11. Roof Deck, Inc.
 12. Valley Joist; Subsidiary of EBSCO Industries, Inc.
 13. Verco Manufacturing Co.
 14. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
- B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
1. Prime-Painted Steel Sheet: ASTM A 1008, Structural Steel (SS), Grade 40 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: Manufacturer's standard.
 2. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 40, G60 zinc coating.
 3. Galvanized and Shop-Primed Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 40, G60 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: Manufacturer's standard.
 4. Deck Profile: As indicated on plan.
 5. Profile Depth: As indicated on plan.
 6. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.
 7. Span Condition: Triple span or more.
 8. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.3 ACOUSTICAL ROOF DECK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ASC Profiles, Inc.; a Blue Scope Steel company.
 2. Canam United States; Canam Group Inc.
 3. CMC Joist & Deck.
 4. Consolidated Systems, Inc.; Metal Dek Group.
 5. Cordeck.
 6. DACS, Inc.
 7. Epic Metals Corporation.
 8. Marlyn Steel Decks, Inc.
 9. New Millennium Building Systems, LLC.
 10. Nucor Corp.; Vulcraft Group.
 11. Roof Deck, Inc.
 12. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
- B. Acoustical Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
1. Prime-Painted Steel Sheet: ASTM A 1008, Structural Steel (SS), Grade 40 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: Manufacturer's standard.
 2. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 40, G60 zinc coating.
 3. Deck Profile: As indicated in Structural General Notes.
 4. Cellular Deck Profile: As indicated in Structural General Notes.
 5. Profile Depth: As indicated in Structural General Notes.
 6. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.

7. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated in Structural General Notes.
8. Span Condition: Triple span or more.
9. Side Laps: Overlapped or interlocking seam at Contractor's option.
10. Acoustical Perforations: Deck units with manufacturer's standard perforated vertical webs.
11. Sound-Absorbing Insulation: Manufacturer's standard pre-molded roll or strip of glass or mineral fiber.
 - a. Factory install sound-absorbing insulation into cells of cellular deck.

2.4 NONCOMPOSITE VENTED ROOF DECK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. ASC Profiles, Inc.; a Blue Scope Steel company.
 2. Canam United States; Canam Group Inc.
 3. CMC Joist & Deck.
 4. Consolidated Systems, Inc.; Metal Dek Group.
 5. Marlyn Steel Decks, Inc.
 6. New Millennium Building Systems, LLC.
 7. Nucor Corp.; Vulcraft Group.
 8. Roof Deck, Inc.
 9. Verco Manufacturing Co.
 10. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
- B. Noncomposite Vented Roof Deck: Fabricate ribbed- and vented-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, and with the following:
 1. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 40, G60 zinc coating.
 2. Profile Depth: As indicated in Structural General Notes.
 3. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.
 4. Span Condition: Triple span or more.
 5. Side Laps: Overlapped or interlocking seam at Contractor's option.
 6. Vent Slot Area: Manufacturer's standard vent slots providing 1-1/2.

2.5 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth unless otherwise indicated.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.
- I. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.
- J. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch-wide flanges and sloped recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.
- K. Galvanizing Repair Paint: ASTM A 780.
- L. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.
 1. Fasteners shall provide diaphragm shear and uplift resistance equal to or greater than welding indicated herein and on Drawings.

3.3 ROOF-DECK INSTALLATION

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:
 1. Weld Diameter: As indicated on Structural Plans.
 2. Weld Spacing: As indicated on Structural Plans.
 3. Weld Washers: Install weld washers at each weld location if deck gauge is lighter than 22 gauge.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals shown on Structural Plans:
 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
 2. Fasten with a minimum of 1-1/2-inch- long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 1. End Joints: Lapped 2 inches minimum or butted at Contractor's option.
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld or mechanically fasten flanges to top of deck. Space welds or mechanical fasteners not more than 12 inches apart with at least one weld or fastener at each corner.
 1. Install reinforcing channels or zees in ribs to span between supports and weld or mechanically fasten.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
 1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: See Section 01 45 23.
- B. Field welds will be subject to inspection.
- C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
 - 1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.

- C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 31 00

SECTION 05 40 00 – COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Soffit framing.
 - 2. Accessories necessary for a complete installation.

1.3 RELATED SECTIONS

- A. Section 05 50 00 – Metal Fabrications.
- B. Section 09 21 16 – Gypsum Board Assemblies.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: General Contractor shall engage a qualified professional engineer, licensed in the State of Texas, to design cold formed steel framing.
- B. Structural Performance: Delegated design engineer shall provide cold-formed steel framing designs capable of withstanding all code required design loads within limits and under conditions indicated on the construction documents and within this specification.
 - 1. Design Loads: Designs shall be capable of withstanding the worst case loading as indicated on the Structural Drawings, and/or as required by the locally adopted Building Code. The design shall cover the worst case loading in all instances.
 - 2. Coordinate the requirements on the Structural and Architectural Drawings with the requirements of this Section. If a conflict exists, notations on the Structural Drawings take precedence.
 - 3. The following document governs the Work, except where more restrictive items are specified:
 - a. AISI Design of Cold-Formed Steel Structural Members Wind Load
Minimum Design Loads for exterior and/or load bearing and/or soffit applications:
 - 1. As required by code officials having jurisdiction.
 - 2. Deflection: 1/600 for clear simple spans
 - 3. Deflection: 1/300 for cantilever conditions and roof parapets
 - 4. Gauge: 16 gauge minimum, unless noted otherwise.
 - b. Minimum Design Loads for interior and/or exterior suspended furr-downs with a maximum vertical drop on either side of 5'-0" or greater:
 - 1. As required by code officials having jurisdiction.
 - 2. Deflection: 1/600 for clear simple spans
 - 3. Deflection: 1/300 for cantilever conditions and roof parapets
 - 4. Gauge: 20 gauge minimum, unless noted otherwise.
 - 5. It is a common practice for studs with thinner than 20 gauge to be crimped and/or ribbed to increase the strength of the overall stud cross section for various loading applications. These studs are typically noted by manufacturer as "Equivalent" to a thicker gauge. These "Equivalent" type studs are not

allowed in a vertically suspended application with greater than 5'-0" of vertical wall drop, 20 Gauge is the minimum thickness allowed for these applications.

4. Welding Qualifications: Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure".
 5. Studs, tracks, channels, and other light gauge framing members shall conform to requirements of ASTM C955.
 6. Fire-Rated Assemblies: Where framing units are components of assemblies indicated for a fire-resistance rating, including those required for compliance with governing regulations, provide units that have been approved by governing authorities that have jurisdiction.
 7. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 degrees F (67 degrees C).
 8. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure:
 - a. Upward and downward movement of 1-1/2 inches (38 mm).
 9. Design exterior nonload bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- C. Cold Formed Steel Framing Design Standards:
1. Floor and Roof Systems: AISI S210.
 2. Wall Studs: AISI S211.
 3. Headers: AISI S212.
 4. Lateral Design: AISI S213.

1.5 SUBMITTALS

- A. Product Data: Technical data for cold formed steel framing product and accessories including factory applied primers.
- B. Shop Drawings: Submit layout, spacings, sizes, thickness, and types of cold formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
1. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
 2. Shall bear the seal of a Registered Professional Engineer, licensed in the State of Texas.
- C. Supplementary Design Details: The general design is presumed adequate to permit compliance with the specified performance. Provide engineering calculations and shop drawings to supplement the general design. Calculations shall bear the seal of a Registered Professional Engineer, licensed in the State of Texas. Calculations and shop drawings must show design will with stand wind loading commiserate with class and rating of the project.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
1. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. AWS D1.1/D1.1M Structural Welding Code - Steel.
 - b. AWS D1.3/D1.3M Structural Welding Code - Sheet Steel.
 - c. CCFSS Technical Bulletin: "AISI Specification Provision for Screw Connections."
 2. Comply with AISI North American Specification for the Design of Cold Formed Steel Structural Members and Standard for Cold Formed Steel Framing - General Provisions.

- a. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.
 3. Fire Resistance Ratings: ASTM E 119; testing by a UL. Identify products with appropriate markings of applicable testing agency. Indicate design designations from UL *Fire Resistance Directory*.
 4. Installer Qualifications: Company specializing in the installation of cold formed metal framing components with minimum five years documented experience.
 5. Install system to provide for movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
 6. Install system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
 7. Mill certificates signed by steel sheet producer indicating steel sheet complies with requirements, including uncoated steel thickness, yield strength, tensile strength, total elongation, chemical requirements and galvanized-coating thickness
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the State of Texas and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold formed metal framing that are similar to those indicated in material, design, and extent.
1. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and structural data.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.
- B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. CEMCO; California Expanded Metal Products Co.
 2. ClarkDietrich Building Systems.
 3. Consolidated Fabricators Corp.; Building Products Division.
 4. Marino\WARE.
 5. Mill Steel Framing.
 6. SCAFCO Corporation.
 7. The Steel Network.

2.2 SOFFIT FRAMING

- A. Exterior Soffit Frame: C shaped steel sections, of web depths indicated, with stiffened flanges:
 1. Minimum Base Metal Thickness: 0.0428 inch (1.09 mm) [0.0538 inch (1.37 mm)].
 2. Flange Width: 1-5/8 inches (41 mm) minimum.

2.3 FRAMING ACCESSORIES

- A. Fabricate steel framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Anchors, Clips, and Fasteners:
 - 1. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot dip process according to ASTM A 123/A 123M.
 - 2. Expansion Anchors: Fabricated from corrosion resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
 - 3. Power Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
 - 4. Mechanical Fasteners: ASTM C 1513, corrosion resistant coated, self-drilling, self-tapping, steel drill screws.
 - a. Head Type: Low profile head beneath sheathing.
 - 5. Welding Electrodes: Comply with AWS standards.
- C. Miscellaneous Materials:
 - 1. Galvanizing Repair Paint: SSPC-Paint 20 or ASTM A 780.
 - 2. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage compensating agents, and plasticizing and water reducing agents, complying with ASTM C 1107/C 1107M, with fluid consistency and 30 minute working time.
 - 3. Shims: Load bearing, high density multimonomer plastic, and nonleaching; or of cold formed steel of same grade and coating as framing members supported by shims.
 - 4. Sealer Gaskets: Closed cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from standard widths to match width of bottom track or rim track members.

2.4 FABRICATION

- A. Fabricate cold formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI specifications and standards, manufacturer written instructions, and specified requirements.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

2. Squareness: Fabricate each cold formed steel framing assembly to a maximum out of square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the work.

3.2 PREPARATION

- A. Before sprayed fire resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire resistive materials, remove only as much as necessary to complete installation of cold formed framing without reducing thickness of fire resistive materials below required thickness to obtain fire resistance rating indicated. Protect remaining fire resistive materials from damage.
- C. Install load bearing shims or grout between the underside of load bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.
- D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 ERECTION

- A. General:
 1. Track Anchors: Install anchors maximum 4 feet - 0 inches on center; design anchors and spacing to carry live, dead and wind loads.
 2. Track Splices: Provide channel inserts or weld track splices.
 3. Erection: Install members plumb, level, and in a true plane.
 4. Fastenings: Make assembly rigid and secure, with welds free of voids and burnouts.
- B. Install metal framing systems in accordance with stud manufacturer's printed instructions.
- C. Secure studs to top track and bottom runner track by means of approved self-drilling screws or welding at both inside and outside flanges of 14 gauge or heavier material. Screws and welds shall be of sufficient size to insure strength of connection. All welding shall comply with American Welding Society "Specification for Welding Sheet Steel in Structures."
- E. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.
- F. Where stud system abuts structural columns or walls, including masonry walls, anchor ends of stiffeners to supporting structure. Use Zee clips as specified above. Weld "Z" shaped clips to structural members as shown on drawings. Maximum 2 feet on center vertical.
- G. Install supplementary framing, blocking and bracing in the metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to the wall or partition. Where type of supplementary support is not otherwise indicated, comply with the stud manufacturer's

recommendations and industry standards in each case, considering the weight or loading resulting from the item supported.

- H. Install bracing/bridging in accordance with manufacturer's instructions and design conditions.
- I. Touch up field welds and damaged galvanized coating, except touch up of field cut studs is not required.
- J. Frame both sides of expansion and control joints with separate studs; do not bridge the joint with components of stud system.
- K. Install horizontal stiffeners in stud system, space (vertical distance) at no more than 54 inches on center. Weld at each intersection.

END OF SECTION 05 40 00

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Miscellaneous metal items and their related components which are not necessarily individually described shall be furnished and installed in accordance with the intent of the drawings and specifications and as required to complete the Work.
 - 2. The Work of this Section is governed by Section 05 12 00, Structural Steel, except where more stringent requirements are contained herein or on the Structural Drawings. If a conflict exists, notations on the Structural Drawings take precedence.
- B. Requirements including but not limited to:
 - 1. Steel framing and supports for overhead doors and grilles.
 - 2. Steel framing and supports for countertops.
 - 3. Steel tube reinforcement for low partitions.
 - 4. Steel framing and supports for mechanical and electrical equipment.
 - 5. Shelf angles.
 - 6. Trench drain.
 - 7. Metal ladders.
 - 8. Alternating tread devices.
 - 9. Miscellaneous steel trim including steel angle corner guards, steel edgings, and loading dock edge angles.
 - 10. Abrasive metal nosings, treads, and thresholds.
 - 11. Loose bearing and leveling plates.
 - 12. Loose steel lintels.
 - 13. Accessible or traffic signs posts.
 - 14. Handrails.
 - 15. Steel weld plates and angles for casting into concrete for applications.
 - 16. Accessories necessary for a coordinated and complete installation.

1.3 DEFINITIONS

- A. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design ladders and countertop supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance of Ladders: Provide ladders and landings capable of withstanding the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

- C. Structural Performance of Alternating Tread Devices: Alternating tread devices shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
 2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
 3. Uniform and concentrated loads need not be assumed to act concurrently.
 4. Alternating Tread Device Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
- D. Structural Performance:
1. Countertops: Provide countertop and vanity framing capable of withstanding the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections, or of exhibiting excessive deflections in any of the components making up the countertops:
 - a. All deadloads.
 - b. 500 pound live load placed on the countertop and vanity.
 - c. Deflection at Midspan: $L/1000$ times span or 1/8 inch whichever is less.
- E. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

1.5 SUBMITTALS

- A. Product Data: Submit data for miscellaneous metal fabrications and paint, coatings, and grout accessories.
- B. Shop Drawings: Submit shop drawings detailing the fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
1. For installed products indicated to comply with design loads, include structural analysis data, for information only, signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Delegated Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Welding certificates.
- E. Paint Compatibility Certificates: Submit manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
1. Building Code: Comply with applicable requirements of the IBC for metal fabrications.
 2. Welding: Qualify procedures and personnel according to the following:
 - a. AWS D1.1/D1.1M Structural Welding Code - Steel.
 - b. AWS D1.2/D1.2 M Structural Welding Code - Aluminum.
 - c. AWS D1.6/D1.6M Structural Welding Code - Sheet Steel.

- d. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- B. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails:
 - a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
- C. Fabricator/Installer Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project for a minimum of 5 years, with a record of successful in service performance, with sufficient production capacity to produce required units without causing delay in the Work.
- D. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of metal fabrications that are similar to those indicated in material, design, and extent.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
 - 2. Provide allowance for trimming and fitting at site.

1.8 STORAGE, DELIVERY AND HANDLING

- A. Store metal fabrications in a dry, well ventilated, weathertight place. Deliver and handle so as to prevent any type of damage to the fabricated Work.

1.9 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other Work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.10 CONTRACTOR'S RESPONSIBILITIES

- A. As scope and performance documents, the Drawings and Specifications do not necessarily indicate or describe all the work required for the performance and completion of the Work. Contracts will be let on the basis of such documents with the understanding that the Contractor shall furnish and install the items required for proper completion of the Work without adjustment to price or schedule. Work shall be of sound, quality construction and the Contractor shall be solely responsible for the inclusions of adequate labor and materials to cover the proper and

timely fabrication and installation of the miscellaneous metal items indicated, described, or implied.

- B. As a performance specification, the criteria for the solution of structurally sound miscellaneous metal items indicated on the Drawings or specified herein are the sole purpose of defining the design intent and performance requirements. The details shown are intended to emphasize the acceptable profiles and performance requirements for this Project. To avoid any misunderstanding or lack of interpretation, the Contractor is hereby advised that the responsibility for the miscellaneous metal items are totally his and that designs and resolutions proposed in the Contractor's shop drawings, structural calculations, and related documentation shall be demonstrated throughout the Work and warranty period specified or required.
- C. Design proposal submissions which follow exactly the details indicated on the Drawings, will not relieve the Contractor of his responsibility for the design, fabrication, erection, or performance of the Work of this Section.
- D. In the event of a controversy over the design, the decision of the Architect will take precedence.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Stainless Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.
- D. Stainless Steel Bars and Shapes: ASTM A 276, Type 304.
- E. Steel Tubing: ASTM A 500/A 500M, cold formed steel tubing.
- F. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.
- G. Slotted Channel Framing: Cold formed metal box channels (struts) complying with MFMA-4.
 - 1. Size of Channels: 1-5/8 inches by 1-5/8 inches (41 mm by 41 mm).
 - 2. Material: Galvanized steel, ASTM A 653/A 653M, commercial steel, Type B. with G90 (Z275) coating; [0.108 inch (2.8 mm) nominal thickness.
 - 3. Cold Formed Metal Channels: Flange edges returned toward web and with 9/16 inch (14.3 mm) wide slotted holes in webs at 2 inches (51 mm) o.c.
 - 4. Width of Channels: 1-5/8 inches (41 mm).
 - 5. Depth of Channels: Indicated on Drawings.
 - 6. Metal and Thickness: Galvanized steel complying with ASTM A 653/A 653M, structural quality, Grade 33 (Grade 230), with G90 (Z275) coating; 0.108 inch (2.8mm) nominal thickness.
 - 7. Finish: Hot dip galvanized after fabrication.
- H. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.
- I. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.
- J. Aluminum Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.

- K. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.
- L. Fasteners: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
1. Provide stainless steel fasteners for fastening aluminum.
 2. Provide stainless steel fasteners for fastening stainless steel.
 3. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
 4. Steel Bolts and Nuts: Regular hexagon head bolts, ASTM A 325, Type 3 (ASTM A 325M, Type 3); with hex nuts, ASTM A 563, Grade C3 (ASTM A 563M, Class 8S3); and, where indicated, flat washers.
 5. Stainless Steel Bolts and Nuts: Regular hexagon head annealed stainless steel bolts, ASTM F 593 (ASTM F 738M); with hex nuts, ASTM F 594 (ASTM F 836M); and, where indicated, flat washers; Alloy.
 6. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
 - a. Hot dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
 7. Anchors: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
 8. Cast in Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot dip galvanized per ASTM F 2329.
 9. Slotted Channel Inserts: Cold formed, hot dip galvanized steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee head bolts, complete with washers and nuts, all zinc plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.
- M. Miscellaneous Materials:
1. Shop Primer for Ferrous Metal: Universal primer, organic zinc rich primer, complying with SSPC-Paint 20 and compatible with topcoat. Provide 10-99 (red) or 10-09 (gray) by Tnemec Company.
 2. Universal Shop Primer: Fast curing, lead and chromate free, universal modified alkyd primer and compatible with topcoat. Use primer containing pigments that make it easily distinguishable from zinc rich primer.
 3. Water Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel and compatible with topcoat.
 4. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc coated metal and compatible with finish paint systems indicated.
 5. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in steel, complying with SSPC-Paint 20. Provide Tneme-Zinc 90-97 by Tnemec Company.
 6. Bituminous Paint: Cold applied asphalt emulsion complying with SSPC-Paint 12, containing no asbestos fibers, or cold applied asphalt emulsion complying with ASTM D 1187 ASTM D 1187/D 1187M.

7. Nonshrink, Nonmetallic Grout: Factory packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
8. Concrete Materials and Properties: Composed of ASTM C150 Type I Portland cement, ASTM C33 sand and coarse aggregates and potable water to produce a low slump mix suitable for placement. Grade coarse aggregate from 1/8" with at least 95 % passing a 3/8" sieve and not more than 10% passing a No. 8 sieve. Fill shall be proportioned to provide a minimum 28 day compressive strength of 3000 psi (20 MPa).

2.2 FABRICATION

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
 1. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
 2. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing Work.
 3. Form exposed Work with accurate angles and surfaces and straight edges.
 4. Weld corners and seams continuously to comply with the following:
 - a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - b. Obtain fusion without undercut or overlap.
 - c. Remove welding flux immediately.
 - d. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
 5. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
 6. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
 7. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
 8. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
 9. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 inch by 1-1/2 inches (3.2 mm by 38 mm), with a minimum 6 inch (150 mm) embedment and 2 inch (50 mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.
- B. Miscellaneous Framing and Supports: Provide steel framing and supports necessary to complete the Work and which are not a part of the structural framework, including but not limited to framing and supports for overhead lobby door frames, sliding doors, countertops, and tube framing for partial height walls, CMU partition head supports, mechanical and electrical equipment.
 1. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction. Cut, drill, and tap units to receive hardware, hangers, and similar items.
 - a. Fabricate units from slotted channel framing where indicated.

- b. Furnish inserts for units installed after concrete is placed.
 2. Operable Partitions: Fabricate supports for operable partitions from continuous steel beams of sizes recommended by partition manufacturer with attached bearing plates, anchors, and braces as recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.
 3. Countertop Framing: Custom fabricate countertop and vanity framing, using steel shapes and plates, and cold finished mild steel bars at exposed conditions, for support framing and plywood, to the thicknesses, sizes and shapes shown, and as required to produce Work of adequate strength and durability, without objectionable deflections. Use proven details of fabrication, as required, to achieve proper assembly and alignment of the various components of the Work.
 4. CMU Partition Head Supports: Fabricate supports from 4" x 4" x 1/4" x 36" (100 mm by 100 mm by 6 mm by 900 mm) long structural steel angles. Drill supports a maximum of 12 inches (300 mm) o.c. to receive expansion bolts.
 5. Galvanize miscellaneous framing and supports at exterior locations; prime paint miscellaneous framing and supports at interior locations.
- C. Handrails and Brackets:
1. Steel Pipe Handrails and Brackets: Furnish and install 1-1/2 inch O.D. Schedule 40 steel pipe rails for outdoor stairs and ramps, unless noted otherwise. Brackets shall be wall type. Include all other components required for finished installation. All work shall comply with local codes and Texas Accessibility Standards (TAS). Hot dip galvanized all components after fabrication.
 2. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- D. Shelf Angles: Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4 inch (19 mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.
1. Provide mitered and welded units at corners.
 2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches (50 mm) larger than expansion or control joint.
 3. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
 4. Galvanize and prime shelf angles located in exterior walls.
 5. Prime shelf angles located in exterior walls with zinc rich primer.
 6. Furnish wedge type concrete inserts, complete with fasteners, to attach shelf angles to cast in place concrete.
- E. Ladders: Comply with ANSI A14.3. For elevator pit ladders, comply with ASME A17.1/CSA B44
1. Steel Ladders:
 - a. Space siderails 18 inches (457 mm) apart unless otherwise indicated.
 - b. Siderails: Continuous, 3/8 inch by 2-1/2 inch (9.5 mm by 64 mm) steel flat bars, with eased edges.
 - c. Rungs: 3/4 inch (19 mm) square steel bars.
 - d. Fit rungs in centerline of siderails; plug weld and grind smooth on outer rail faces.
 - e. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum oxide granules set in epoxy resin adhesive or by using a type of manufactured rung filled with aluminum oxide grout.
 - f. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.

- 1) Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a) Harsco Industrial IKG, a division of Harsco Corporation.
 - b) SlipNOT Metal Safety Flooring; W.S. Molnar Company.
- g. Provide platforms as indicated fabricated from welded or pressure locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 1/2 inch (12 mm) in least dimension.
- h. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets.
- i. Galvanize ladders, including brackets and fasteners.

2.3 TRENCH DRAINS

- A. Provide 304L stainless steel, non-porous linear drain top grates.
- B. Basis of Design: S-DG 65 Series as manufactured by Infinity Drain, (516) 767-6786.
- C. Physical Properties:
 1. Channel: PVC Channel.
 2. Flow rate: 16 gpm per outlet.

2.4 MISCELLANEOUS STEEL TRIM

- A. Miscellaneous Steel Trim: Unless otherwise indicated, fabricate units from structural steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
 1. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other Work.
 - a. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction, spaced not more than 6 inches (150 mm) from each end, 6 inches (150 mm) from corners, and 24 inches (600 mm) o.c.
 2. Cast in Pit Angles and Edge Angles: Provide edge angles, and pit angles, fabricated from angles of size as shown, or required, with welded on stud anchors spaced 24 inches (600 mm) on center. Provide pit and edge angles in as long lengths as possible. Miter and weld corners and provide splice plates for alignment between sections.
 3. Galvanize miscellaneous steel trim.

2.5 ABRASIVE METAL THRESHOLDS, NOSINGS, AND TREADS

- A. Cast Metal Units: Cast aluminum with an integral abrasive, as cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Safety Tread Co., Inc.
 - b. Barry Pattern & Foundry Co., Inc.
 - c. Nystrom, Inc.
 - d. Granite State Casting Co.
 - e. Safe-T-Metal Company, Inc.
 - f. Wooster Products Inc.
 2. Nosings: Cross hatched units, 4 inches (100 mm) wide with 1 inch (25 mm) lip, for casting into concrete.

3. Treads: Cross hatched units, full depth of tread with 3/4 inch by 3/4 inch (19 mm by 19 mm) nosing, for application over bent plate treads or existing stairs.
 4. Thresholds: Fluted saddle type units, 5 inches (125 mm) wide by 1/2 inch (12 mm) high, with tapered edges.
- B. Extruded Units: Aluminum with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ACL Industries, Inc.
 - b. American Safety Tread Co., Inc.
 - c. Amstep Products.
 - d. Armstrong Products, Inc.
 - e. Balco, Inc.
 - f. Granite State Casting Co.
 - g. Nystrom, Inc.
 - h. Wooster Products Inc.
 2. Provide ribbed units, with abrasive filler strips projecting 1/16 inch (1.5 mm) above aluminum extrusion.
 3. Provide solid abrasive type units without ribs.
 4. Nosings: Beveled back units, 3 inches (75 mm) wide with 1-3/8 inch (35 mm) lip, for surface mounting on existing stairs.
 5. Nosings: Two piece units, 3 inches (75 mm) wide, with subchannel for casting into concrete steps.
 6. Treads: Beveled back units, full depth of tread with 1-3/8 inch (35 mm) lip, for application over existing stairs.
- C. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
- D. Drill for mechanical anchors and countersink. Locate holes not more than 4 inches (100 mm) from ends and not more than 12 inches (300 mm) o.c., evenly spaced between ends, unless otherwise indicated. Provide closer spacing if recommended by manufacturer.
1. Provide two rows of holes for units more than 5 inches (125 mm) wide, with two holes aligned at ends and intermediate holes staggered.
- E. Apply bituminous paint to concealed surfaces of cast metal units.
- F. Apply clear lacquer to concealed surfaces of extruded units.
- 2.6 LOOSE BEARING AND LEVELING PLATES**
- A. Loose Bearing and Leveling Plate: Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
1. Galvanize plates.
- 2.7 LOOSE STEEL LINTELS**
- A. Loose Steel Lintels: Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

1. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 8 inches (200 mm) unless otherwise indicated.
2. Galvanize and prime loose steel lintels located in exterior walls.

2.8 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.9 ACCESSIBLE OR TRAFFIC SIGN POST

- A. Accessible Parking Sign Posts: 2 inch by 12 inch galvanized steel tube with integral welded galvanized post cap, painted in color selected by Architect.
 1. Post Anchor Bolts: Two (2) galvanized 1/2 inch by 6-1/8 inch Nelson stud anchor bolts welded to steel tube front and back.
 2. Signs: Refer to Section 10 14 00 – Graphics.

2.10 MOUNTING POST

- A. Traffic Signage Mounting Post
 1. Post: 2-3/8 inch diameter galvanized steel.
 2. Height as indicated on Drawings.

2.11 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch (3mm) maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch (1.5mm).
- C. Maximum Misalignment of Adjacent Members: 1/16 inch (1.5mm).
- D. Maximum Bow: 1/8 inch (3mm) in 48 inches (1.2m).
- E. Maximum Deviation From Plane: 1/16 inch (1.5mm) in 48 inches (1.2m).

2.12 FINISHES

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surfaces.

2.13 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

- D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
 - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 4. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
- F. Stainless Steel Finishes: Remove tool and die marks and stretch lines or blend into finish.
 - 1. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
 - 2. Bright, Directional Polish: No. 4 finish.
 - 3. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.14 ALUMINUM FINISHES

- A. As-Fabricated Finish: AA-M12.
- B. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.
 - 1. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 607.1.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 - 1. Cast Aluminum: Heavy coat of bituminous paint.
 - 2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for operable partitions, overhead doors, and overhead grilles securely to, and rigidly brace from, building structure.
 - 1. CMU Partition Head Supports: Unless otherwise indicated place partition head supports on alternate faces of CMU partitions every 6 feet o.c. and expansion bolt to underside of structure. Do not bolt to CMU partitions.
- C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
 - 1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

3.3 INSTALLING NOSINGS, TREADS, AND THRESHOLDS

- A. Center nosings on tread widths unless otherwise indicated.
- B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.
- C. Seal thresholds exposed to exterior with elastomeric sealant complying with Section 079200 "Joint Sealants" to provide a watertight installation.

3.4 INSTALLING RAILINGS

- A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:
 - 1. Anchor posts to steel by welding to steel supporting members.
 - 2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with postinstalled anchors and bolts.
- B. Attach handrails to wall with wall brackets. Locate brackets at spacing required to support structural loads. Secure wall brackets to building construction as required to comply with performance requirements.
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.

3.5 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.8 ERECTION TOLERANCES

- A. Maximum Variation from Plumb: 1/4 inch (6mm) per story, noncumulative.
- B. Maximum Offset from True Alignment: 1/4 inch (6mm).
- C. Maximum Out of Position: 1/4 inch (6mm).

3.9 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0 mil (0.05 mm) dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 90 00.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 05 50 00

SECTION 05 51 00 - STEEL STAIRS, HANDRAILS, AND RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 1. Preassembled steel stairs.
 2. Treads, concrete filled and steel.
 3. Steel tube handrails and railings.
 4. Accessories necessary for a complete installation.

1.3 RELATED SECTIONS

- A. Section 03 30 00 – Cast-In-Place Concrete.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer licensed in the State of Texas and experienced in the design of steel stairs and railings to design stairs and railings.
- B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
 2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
 3. Uniform and concentrated loads need not be assumed to act concurrently.
 4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
 5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch (6.4 mm), whichever is less.
- C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 2. Infill of Guards:
 - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
 - b. Infill load and other loads need not be assumed to act concurrently.
- D. Seismic Performance of Stairs: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. Component Importance Factor: 1.5.

1.5 SUBMITTALS

- A. Product Data: Technical data for metal pan stairs and the following:
 - 1. Prefilled metal pan stair treads.
 - 2. Precast concrete treads.
 - 3. Epoxy resin filled stair treads.
 - 4. Nonslip aggregates and nonslip aggregate finishes.
 - 5. Abrasive nosings.
 - 6. Paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type and finish of nosing and tread.
- D. Delegated-Design Submittal: For stairs and railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Welding certificates.
- F. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. AWS D1.1/D1.1M Structural Welding Code - Steel.
 - b. AWS D1.3/D1.3M Structural Welding Code - Sheet Steel.
- B. Installer Qualifications: Fabricator of products, having minimum of 5 years documented experience in the fabrication and installation of metal stairs.

1.7 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Coordinate locations of hanger rods and struts with other work so that they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alfab, Inc.
 - 2. American Stair, Inc.
 - 3. Lapeyre Stair Inc.

4. Pacific Stair Corporation.
 5. Worthington Metal Fabricators.
- B. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- E. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- F. Uncoated, Cold Rolled Steel Sheet: ASTM A 1008/A 1008M, structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.
- G. Uncoated, Hot Rolled Steel Sheet: ASTM A 1011/A 1011M, structural steel, Grade 30 (Grade 205), unless another grade is required by design loads.
- H. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating, structural steel, Grade 33 (Grade 230), unless another grade is required by design loads.
- I. Expanded Metal, Carbon Steel: ASTM F 1267, Class 1 (uncoated).
- J. Perforated Metal: Cold rolled steel sheet, ASTM A 1008/A 1008M, or hot rolled steel sheet, ASTM A 1011/A 1011M, commercial steel Type B.
- K. Perforated Metal: Galvanized steel sheet, ASTM A 653/A 653M, G90 (Z275) coating, commercial steel Type B.
- L. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.
- M. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.
- N. Nickel Silver Castings: ASTM B 584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).
- O. Abrasive Nosings
1. Cast Metal Units: Cast aluminum, with an integral abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) American Safety Tread Co., Inc.
 - 2) Barry Pattern & Foundry Co., Inc.
 - 3) Granite State Casting Co.
 - 4) Nystrom, Inc.
 - 5) Safe-T-Metal Company, Inc.
 - 6) Wooster Products Inc.
 - b. Configuration: Cross-hatched units, 2 inches (75 mm) wide without lip.
 - c. Thickness: 3/8 inch.

2. Extruded Units: Aluminum units with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) ACL Industries, Inc.
 - 2) American Safety Tread Co., Inc.
 - 3) Amstep Products.
 - 4) Armstrong Products, Inc.
 - 5) Granite State Casting Co.
 - 6) Nystrom, Inc.
 - 7) Wooster Products Inc.
 - b. Provide ribbed units, with abrasive filler strips projecting 1/16 inch (1.5 mm) above aluminum extrusion.
 - c. Provide solid abrasive type units without ribs.
 - d. Thickness: 3/8 inch.
 3. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
 4. Apply bituminous paint to concealed surfaces of cast-metal units set into concrete.
 5. Apply clear lacquer to concealed surfaces of extruded units set into concrete.
- P. Fasteners: Provide zinc plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.
1. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
 2. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
 - a. Provide mechanically deposited or hot dip, zinc coated anchor bolts.
 3. Post Installed Anchors: Torque controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
 - a. Material for Interior Locations: Carbon steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
 - b. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 (A4) stainless steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).
- Q. Miscellaneous Materials:
1. Shop Primer for Ferrous Metal: Universal primer, organic zinc rich primer, complying with SSPC-Paint 20 and compatible with topcoat. Provide 10-99 (red) or 10-09 (gray) by Tnemec Company.
 2. Universal Shop Primer: Fast curing, lead and chromate free, universal modified alkyd primer and compatible with topcoat. Use primer containing pigments that make it easily distinguishable from zinc rich primer.
 3. Water Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel and compatible with topcoat.

4. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc coated metal and compatible with finish paint systems indicated.
5. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in steel, complying with SSPC-Paint 20. Provide Tneme-Zinc 90-97 by Tnemec Company.
6. Bituminous Paint: Cold applied asphalt emulsion complying with SSPC-Paint 12, containing no asbestos fibers, or cold applied asphalt emulsion complying with ASTM D 1187 ASTM D 1187/D 1187M.
7. Concrete Materials and Properties: Comply with requirements in Section 033000 for normal weight, air entrained, ready mix concrete with a minimum 28 day compressive strength of 3000 psi (20 MPa) unless otherwise indicated.
8. Nonslip Aggregate Concrete Finish: Factory packaged abrasive aggregate made from fused, aluminum oxide grits or crushed emery; rustproof and nonglazing; unaffected by freezing, moisture, or cleaning materials.
9. Welded Wire Reinforcement: ASTM A 185/A 185M, 6 by 6 inches (152 by 152 mm), W1.4 by W1.4, unless otherwise indicated.

R. Precast Concrete Treads:

1. Concrete Materials and Properties: Comply with requirements in Section 033000 for normal weight, ready mixed concrete with a minimum 28 day compressive strength of 5000 psi (35 MPa) and a total air content of not less than 4 percent or more than 6 percent.
2. Reinforcement: Galvanized, welded wire reinforcement, 2 inches by 2 inches (50 mm by 50 mm) by 0.062 inch (1.6 mm) diameter wire; comply with ASTM A 185/A 185M and ASTM A 82/A 82M, except for minimum wire size.

2.2 FABRICATION

- A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
 1. Join components by welding unless otherwise indicated.
 2. Use connections that maintain structural value of joined pieces.
- B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Weld exposed corners and seams continuously unless otherwise indicated.

- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

2.3 STEEL FRAMED STAIRS

- A. NAAMM Stair Standard: Comply with *Recommended Voluntary Minimum Standards for Fixed Metal Stairs* in NAAMM AMP 510 *Metal Stairs Manual*, unless more stringent requirements are indicated.
- B. Stair Framing:
 - 1. Fabricate stringers of steel plates or channels.
 - a. Provide closures for exposed ends of channel stringers.
 - 2. Construct platforms of steel plate or channel headers and miscellaneous framing members as needed to comply with performance requirements.
 - 3. Weld stringers to headers; weld framing members to stringers and headers.
 - 4. Where stairs are enclosed by gypsum board shaft wall assemblies, provide hanger rods or struts to support landings from floor construction above or below. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire resistance rated stair enclosure.
 - 5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.
- C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch (1.7 mm).
 - 1. Steel Sheet: Uncoated cold rolled steel sheet unless otherwise indicated.
 - 2. Steel Sheet: Galvanized steel sheet, where indicated.
 - 3. Directly weld metal pans to stringers; locate welds on top of subtreads where they are concealed by concrete fill. Do not weld risers to stringers.
 - 4. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
 - 5. Shape metal pans to include nosing integral with riser.
 - 6. Attach abrasive nosings to risers.
 - 7. Provide subplatforms of configuration the same as subtreads. Weld subplatforms to platform framing.
 - a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.

2.4 STAIR RAILINGS

- A. Steel Tube Railings: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.
 - 1. Rails and Posts: 1-5/8 inch (41 mm) diameter top and bottom rails and 1-1/2 inch (38 mm) square posts.
 - 2. Picket Infill: 1/2 inch (13 mm) square pickets spaced less than 4 inches (100 mm) clear.
 - 3. Intermediate Rails Infill: 1-5/8 inch (41 mm) diameter intermediate rails spaced less than 12 inches (305 mm) clear.
- B. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Finish welds to comply with NOMMA *Voluntary Joint Finish Standards* for Type 1 welds: no evidence of a welded joint as shown in NAAMM AMP 521.

- C. Form changes in direction of railings:
 - 1. As detailed.
 - 2. By bending or by inserting prefabricated elbow fittings.
 - 3. By flush bends or by inserting prefabricated flush elbow fittings.
 - 4. By radius bends of radius indicated or by inserting prefabricated elbow fittings of radius indicated.
 - 5. By inserting prefabricated flush elbow fittings.
- D. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- E. Close exposed ends of railing members with prefabricated end fittings.
- F. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- G. Connect posts to stair framing by direct welding unless otherwise indicated.
- H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
 - 1. For galvanized railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous metal components.
 - 2. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt that provides 1-1/2 inch (38 mm) clearance from inside face of handrail to finished wall surface.
- I. Fillers: Provide fillers made from steel plate, or other suitably crush resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.5 FINISHES

- A. Finish metal stairs after assembly.
- B. Galvanizing: Hot dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
 - 2. Fill vent and drain holes that are exposed in the finished work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- C. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with SSPC-SP 3 *Power Tool Cleaning*.
- D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1 Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel for shop painting.

PART 3 - EXECUTION

3.1 INSTALLING METAL PAN STAIRS

- A. Fastening to In Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot dip galvanized after fabrication and are for bolted or screwed field connections.
- F. Place and finish concrete fill for treads and platforms to comply with Section 033000. Install abrasive nosings with anchors fully embedded in concrete. Center nosings on tread width.
- G. Install precast concrete treads with adhesive supplied by manufacturer.

3.2 INSTALLING RAILINGS

- A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:
 - 1. Anchor posts to steel by welding to steel supporting members.
 - 2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with postinstalled anchors and bolts.
- B. Attach handrails to wall with wall brackets. Locate brackets at spacing required to support structural loads. Secure wall brackets to building construction as required to comply with performance requirements.
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.
 - 3. For steel framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.

3.3 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0 mil (0.05 mm) dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 05 51 00

SECTION 05 58 13 - COLUMN COVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes formed metal column covers.

1.3 REFERENCE STANDARDS

- A. American Architectural Manufacturer's Association (AAMA):
 1. AAMA 620 – Voluntary Specification High Performance Organic Coatings on Coil Coated Architectural Aluminum.
 2. AAMA 621 – Voluntary Specification for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates.
 3. AAMA 2605 – Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

1.4 SUBMITTALS

- A. Product Data: For each type of product, including finishing materials.
- B. Shop Drawings: Show fabrication and installation details for column covers.
 1. Include details showing attachment to support structure.
 2. Indicate materials, sizes, thickness, fastenings and profiles. Show details of weatherproofing at edges, termination, penetrations and connections to adjacent materials.
- C. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes.
- D. Samples for Verification: For each type of exposed finish required, prepared on 6-inch- square Samples of metal of same thickness and material indicated for the Work.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architect and owners and other information specified.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing column covers similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

- B. Installer Qualifications: Installer shall be the fabricator or an experienced firm acceptable to the fabricator for installation of the products specified.
- C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Build mockups of typical column covers.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver column covers wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Basis of Design: Fry Reglet Corporation, Phoenix, AZ. Other manufacturers are subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Alumafab Metal Sales, LLC Burnsville, MN.
 - 2. Atlas International, Inc., Allentown, PA.
 - 3. Pittcon Industries, Riverdale, MD.
 - 4. Firestone Metal Products, Anoka, MN.
- B. Other manufacturers must have a minimum of five (5) years' experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions in order to be considered.

2.2 MATERIALS

- A. Aluminum Face Sheet: Coil-coated, ASTM B209, 3003-H14 alloy.
 - 1. Face Sheet Thickness: 0.080 inch (2.0 mm) thick.
 - 2. Face Width: 24 inch.
 - 3. Surface: Smooth.
 - 4. Joint Type: Vertical, Series E (Economical Butt Joint).

2.3 FORMED METAL COLUMN COVERS

- A. Butt Joint and Reveal Type Column Covers: Form column covers from metal substrate indicated, with vertical edges formed with return leg stiffener configured with tight butt joint. Form vertical and horizontal joints as specified, in locations indicated on Drawings.
 - 1. Column Cover Shape: Round.
 - 2. Substrate: Aluminum sheet.
 - 3. Vertical Joints: Hairline V-joint with keyhole connection.
 - 4. Color: Anodized Champagne.
 - 5. Exposed Trim and Fastener Finish: Match column cover finish.
 - 6. Apply manufacturer's recommended sound-deadening mastic to backs of column covers.

2.4 MISCELLANEOUS MATERIALS

- A. Provide manufacturer's recommended fasteners, shims, sealants, and gaskets required for a complete installation.
- B. Formed Trim: Aluminum, minimum thickness 0.063 inch (1.59 mm). Include manufacturer-provided extruded trim for the following locations and as indicated on Drawings:
 - 1. Base trim.
 - 2. Top trim.
 - 3. Reveal trim.
- C. Stiffeners: Manufacturer's standard stiffeners and joint backing as required for installation.
- D. Fasteners: Provide self-tapping screws, bolts, nuts, self-locking rivets and bolts, and other suitable fasteners as required for installation.
 - 1. Concealed Fasteners: Corrosion-resistant, as recommended by column cover manufacturer for application.
- E. Sealants: Type recommended by column cover manufacturer for application.
- F. Sound-Deadening Materials:
 - 1. Mastic: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.5 FABRICATION

- A. General: Fabricate column covers and accessories at factory using manufacturer's standard procedures and processes to minimize field splicing and assembly. Form metal to indicated profiles in maximum sizes to minimize joints. Form bent metal corners to the smallest radius possible without causing grain separation or otherwise damaging the work.

2.6 FINISH

- A. General Requirements
 - 1. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
 - 2. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.
 - 3. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Finish:
 - 1. Architect to select finish from clear anodized, color anodized, two coat fluoropolymer, baked enamel, and powder coat. Architect to select color from manufacturer's full range of colors.
 - 2. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
 - 3. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 - 4. Baked Enamel or Powder Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, application, and baking.
 - 5. Two Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of column covers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Locate and place column covers plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install column covers.
 - 1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.
- B. Use concealed anchorages where possible.
- C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.
- D. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.

3.3 PROTECTION

- A. Protect finishes from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION 05 58 13

SECTION 05 70 00 - DECORATIVE METAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirement including but not limited to:
 - 1. Decorative, framed metal dividers.
 - 2. Accessories necessary for a complete installation,

1.3 COORDINATION

- A. Coordinate installation of anchorages for decorative metal items. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 SUBMITTALS

- A. Product Data: Technical data for each type of product, including finishing materials.
- B. Shop Drawings: Show fabrication and installation details for decorative metal, including plans, elevations, component details, and attachment details.
 - 1. Indicate materials and profiles of each decorative metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.
- C. Samples: Submit for each type of exposed finish.
 - 1. Full size Samples of castings and forgings.

1.5 QUALITY ASSURANCE

- A. Fabricator/Installer Qualifications: A firm having minimum 5 years documented experience in producing and installing decorative metal similar to that indicated.
- B. Preinstallation Conference: Conduct conference at site.
- C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store decorative metal in a well-ventilated area, away from uncured concrete and masonry, and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.
- B. Deliver and store cast metal products in wooden crates surrounded by enough packing material to ensure that products are not cracked or otherwise damaged.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with decorative metal by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Framed Dividers as manufactured by Móz Designs, Inc.; (510) 632-0853 or comparable product approved by Architect.

2.2 METALS

- A. Metal Surfaces: Use materials with smooth, flat surfaces unless otherwise indicated. Use materials without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Aluminum: Fabricate products from alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.
 - 1. Plate and Sheet: Alloying complying with ASTM B 209 (ASTM B 209M), 0.63 inch, type 5052.
 - 2. Sizes: Refer to the Drawings.
 - 3. Perforations: 1/8 inch diameter hole with 3/16 inch centers.
 - 4. Hole Type: Round.
 - 5. Color: Ebony-Fog-Polymate.
- C. Fastener Materials: Unless otherwise indicated, provide the following:
 - 1. Aluminum Items: Type 304 stainless steel fasteners.

2.3 FABRICATION

- A. Assemble items in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

2.4 FINISHES

- A. Comply with NAAMM *Metal Finishes Manual for Architectural and Metal Products* for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Aluminum Finishes: Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - 1. Powder Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - a. Color: Selected by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of decorative metal.
- B. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

- A. Provide anchorage devices and fasteners where needed to secure decorative metal to in-place construction.
- B. Perform cutting, drilling, and fitting required to install decorative metal. Set products accurately in location, alignment, and elevation, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items to be built into concrete, masonry, or similar construction.
- C. Fit exposed connections accurately together to form tight, hairline joints or, where indicated, uniform reveals and spaces for sealants and joint fillers. Where cutting, welding, and grinding are required for proper shop fitting and jointing of decorative metal, restore finishes to eliminate evidence of such corrective work.
- D. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.
- E. Install concealed gaskets, joint fillers, insulation, and flashings as work progresses.
- F. Restore protective coverings that have been damaged during shipment or installation. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at same location.
 - 1. Retain protective coverings intact; remove coverings simultaneously from similarly finished items to preclude nonuniform oxidation and discoloration.
- G. Field Welding: Comply with applicable AWS specification for procedures of manual shielded metal arc welding and requirements for welding and for finishing welded connections. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
- H. Field Brazing: Comply with requirements for brazing and for finishing brazed connections. Braze connections that are not to be left as exposed joints but cannot be shop brazed because of shipping size limitations.
- I. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
 - 1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.3 CLEANING AND PROTECTION

- A. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.

- B. Clean copper alloys according to metal finisher's written instructions to leave an undamaged and uniform finish matching approved Sample.
- C. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0 mil (0.05 mm) dry film thickness.
- D. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.
- E. Protect finishes of decorative metal from damage during construction period with temporary protective coverings approved by decorative metal fabricator. Remove protective covering at time of Substantial Completion.
- F. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 05 70 00

SECTION 05 73 00 – DECORATIVE RAILING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Pre-engineered, component-based, ornamental stainless steel railing system.

1.3 REFERENCES

- A. National Ornamental & Miscellaneous Metals Association (NOMMA)
 - 1. Guideline 1 – Joint Finishes.

1.4 DESIGN REQUIREMENTS

- A. Railing system shall be designed to conform to building code and ADA requirements for openings and stress.
- B. Railing system shall withstand the minimum concentrated loads in accordance with ASTM E935:
 - 1. Vertical and Horizontal Force: 200 pounds concentrated load at any point without damage or permanent set.

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, including description of materials, components, fabrication, and finishes, including maintenance and cleaning instructions.
- B. Shop Drawings: Submit manufacturer's shop drawings, including elevations, sections, and details, indicating materials, components, sizes, dimensions, tolerances, hardware, fasteners, finishes, options, accessories, and installation. Show details of attaching railing system to supports.
- C. Samples: Submit manufacturer's samples of metal finishes for Architect's approval.
- D. Installation instructions include all structural computations and test reports provided by the manufacturer evidencing compliance with the specifications.
- E. Manufacturer's Quality Assurance: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.
- F. Test Reports: Submit test reports from qualified independent testing agency indicating compliance with ASTM E 985.
- G. Maintenance Instructions: Submit manufacturer's maintenance and cleaning instructions.
- H. Warranty: Submit manufacturer's standard warranty.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

- B. Storage: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.
- C. Handling: Protect materials and finish from damage during handling and installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.
 - 1. Architectural Metal Crafts; (281) 449-1881;
 - 2. Big D Metalworks; (800) 299-9767;
 - 3. Livers Bronze Co.; (816) 300-2828
 - 4. McNichols Co., (877) 844-4653.
 - 5. York Metal Fabricators, Inc.; 528-7495.
 - 6. VIVA Railings, LLC.

2.2 DECORATIVE RAILING SYSTEM

- A. Pre-Engineered, Component-Based, Ornamental Railing System: Perforated Metal Infill.
 - 1. Basis of Design: McNichols Co.
 - 2. Guardrail Posts with fascia (side-mounted) rail.
 - a. Material: 2-inch OD steel tube, Type 304.
 - b. Height: 42 inches.
 - c. Spacing: 5'-0" on center maximum.
 - 3. Handrails: 1-1/2-inch OD steel tube, Type 304.
 - 4. Finish: Steel Handrails and Posts: Circular #4 satin.
 - 5. Perforated Metal:
 - a. Type: Stainless steel, Satin #6.
 - b. Thickness: 1/8 inch.
 - c. Style: As shown on the Drawings.
 - 6. Miscellaneous accessories: Provide necessary fasteners, grout filler, splice connectors, setting blocks and shims, gaskets, sealants, and other accessories as instructed by manufacturer for complete installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive railing system. Verify that field conditions are acceptable and are ready to receive work.
- B. Notify Architect if areas are not acceptable. Do not begin installation until unacceptable conditions have been corrected.

3.2 INSTALLATION

- A. Install railing system in accordance with manufacturer's instructions.
- B. Install railing system plumb, level, square, true to line, and rigid.

- C. Attach railing system securely in place using fasteners supplied or approved by manufacturer. Do not place aluminum in direct contact with concrete or dissimilar metals, provide primer or bituminous paint as instructed by manufacturer.
- D. Attach railing system to supports supplied or approved by manufacturer. Mount panels in longest practical lengths to meet performance criteria, and as indicated in approved shop drawings so that spaces between panels are laid out uniformly and symmetrically across balcony or space. Place panels 1/2 inch apart. Do not provide silicone sealant between panels.
- E. Field weld handrail and cap components as approved by manufacturer. Welding shall be in accordance with NOMMA Guidelines Finish No. 1.
- F. Use manufacturers supplied hardware.
- G. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Architect.
- H. Remove and replace defective or damaged components that cannot be successfully repaired as determined by Architect.

3.3 CLEANING

- A. Clean railing system promptly after installation in accordance with manufacturer's instructions.
- B. Do not use harsh cleaning materials or methods that would damage finish.
- C. Do not use abrasive cleaners.

3.4 PROTECTION

- A. Protect installed railing system and finish from damage during other construction.

END OF SECTION 05 73 00

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. All rough carpentry items including, but not limited to:
 - 1. Wood blocking for support of items supported on or recessed into wood framing or requiring wood blocking for support, including but not limited to casework, TV mounts, marker boards, metal shelving, toilet partitions, toilet accessories and window blinds, door strikes, wall stops, wall panels.
 - 2. Miscellaneous framing items and plywood sheathing.

1.3 RELATED WORK

- A. All Sections of Work supported on or recessed into wood framing or requiring wood blocking for support, such as wall trim, wall cabinets, handrails, lockers, toilet compartments, toilet and bath accessories, markerboards, tackboards, projection screens, fire extinguisher cabinets, etc., as applicable to the Project.

1.4 SUBMITTALS

- A. Product Data: Manufacturer's data on wood treatment materials.

1.5 STANDARDS AND GRADING

- A. All lumber used structurally shall be graded and marked with grade and trademark of a lumber grading organization approved by the Architect, except that a certification of grade from such a grading organization may be accepted in lieu of grade and trademarks when approved by Architect. Trademark of manufacturer shall also appear on each piece.
- B. Each piece of plywood used structurally shall carry the American Plywood Association trademark.
- C. Grading Rules: Conform with all applicable requirements of American Lumber Standards "Simplified Practice Recommendations R-16" and to grading rules of manufacturer's association under whose rules the lumber is produced.
- D. Reference Standards: Conform with all requirements.
 - 1. U.S. Dept. of Commerce Product Standards (PS).
 - 2. American Plywood Association (APA).
 - a. Standards and Construction Guide.
 - 3. American Wood Preservers Association (AWPA).
 - a. Standards, as they apply.
 - 4. Architectural Woodwork Institute (AWI)
 - a. "Quality Standards."
 - 5. National Woodwork Manufacturers' Association (NWMA).
 - a. Standards.

6. Western Wood Products Association (WWPA).
 - a. Manual.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Lumber:

1. Treated No. 2, S4S Southern Yellow Pine, #1 kiln dried.
 - a. Comply with NWMA Standards
 - b. Use for blocking, stripping, grounds, cants and miscellaneous wood items in contact with concrete, or exposed to the weather.
2. No. 2, S4S Southern Yellow Pine: Use for framing, blocking, stripping and miscellaneous concealed interior lumber not exposed to concrete, or moisture, when FRS lumber is not required by building code.
3. Fire Retardant No. 2, S4S Southern Pine: Refer to Fire Retardant Treatment below. Use for framing, plates and blocking in all walls and partitions where required by building code or noted on drawings.

B. Plywood:

1. General: Comply with APA Standards.
2. APA A-D, Group 1 Interior used where appearance of only one side is exposed to view for interior locations. Use for wall liner at MDF/IDF closets and telephone boards in mechanical and telephone rooms. 3/4 inch thick unless required or shown otherwise. Paint per Section 09 91 00.
3. Exterior plywood, Group 1, APA rated sheathing. Use where miscellaneous plywood is exposed to concrete, weather, or at roof construction as sheathing.
4. Fire Retardant Treated Plywood: Refer to Fire Retardant Treatment below. Use when required by building code or noted on drawings.
5. Underlayment: If shown or required, APA rated Sturdi-floor, exterior grade, tongue and groove edges.
6. APA C-D, Interior DFPA grade-use at mechanical rooms, electrical closets, etc, where wall mounted panels are required for equipment.

C. Rough Hardware:

1. Nails, Spikes, and Staples: Galvanized for exterior locations, high humidity locations, and treated wood; plain finish for other interior locations: Size and type to suit application. Do not use to resist "pull-out" loads.
2. Bolts, Nuts, Washers, Lags, and Screws: Medium carbon steel; size and type to suit application. Galvanize for exterior locations, high humidity locations, and treated wood. Plain finish for other interior locations.
3. Fasteners: Toggle bolt type for anchorage to hollow masonry. Expansion shield and lag bolt type for anchorage to solid masonry and concrete. Bolts or power activated type for anchorage to steel.

D. Wood Treatment:

1. Preservative Treatment (Concealed Conditions):
 - a. Micronized Copper Quaternary (MCQ): Pressure impregnate preservative to net retention of 0.25 lbs./cu.ft., in plant licensed by manufacturer in accordance with the following standards:
 - 1) Preservative Treatment Standard: AWPA P5.
 - 2) Structural Lumber Treatment Standard: AWPA C31.
 - 3) Plywood Treatment Standard: AWPA C9.
 - b. Brush two (2) coats of preservative on bored or sawn surfaces of treated lumber.

- c. Provide Quality Mark Stamp on treated wood for identification and will not be concealed by paint.
 - d. Fasteners: Metal fasteners in contact with preservative treated wood shall be G-90 galvanized, minimum, or stainless steel in accordance with manufacturer's instructions. No uncoated steel shall come in contact with preservative wood.
 - e. ACQ and CCA preservatives not permitted.
 - f. Acceptable Manufacturers: Osmose "MicroPro" Smart Sense; or Architect approved equal.
2. Fire Retardant Treatment:
- a. Lumber shall be pressure-impregnated with non-combustible fire retardant chemicals in accordance with U.L. FRS Fire Hazard Classification. All lumber must be dried following treatment in accordance with AWPA Standard C20.
 - b. Plywood shall be pressure-impregnated with non-combustible fire retardant chemicals in accordance with U.L. FRS Fire Hazard Classification. All plywood must be dried following treatment in accordance with AWPA Standards C27.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Wood Framing:
1. Framing and blocking shall be accurately cut and fitted true to line and levels, avoiding shims and wedges.
 2. Wood blocking for wall mounted accessories to be fire retardant.
 3. Steel plate installed at location of door hardware impact, 12 inch x 12 inch, where hardware could strike wall. Refer to Division 5.
 4. All interior wood blocking shall be fire resistant.
 5. All interior wood blocking shall be exterior grade fire resistant.
 6. Spiking and nailing shall be done using largest size spikes and nail practicable.
 7. Unless otherwise shown, use 2 inch by 4 inch wood studs spaced 16 inches o.c. with 4 inch face perpendicular to direction of wall or partition. Provide single bottom plate and double-top plates 2 inches thick by width of studs.
 8. Bolt nailers and blocking to steel, masonry or concrete members with bolts or proportionate strength of members attached from each end, except as otherwise noted on plans.
 9. Provide blocking, bucks and framing as necessary and for other trades as required.
 10. Drill lumber accurately for bolts and fit all bolts with suitable washers.
 11. Perimeter wood blocking to be attached 2'-0" staggered with 1/2" galvanized bolts through both nailers.
 12. Screws are to be used for perimeter edge nailers. No nailing permitted.
- B. Plywood:
1. Install plywood over framing in accordance with instruction of American Plywood Association Construction Guide Form No. E30C.
 2. Install underlayment plywood as shown in accordance with instructions of American Plywood Association. Space panel joints and edges 1/32 inch. Fill and sand panel edge joints, surface roughness, and damaged or open areas. Nail with 4d ring-shank nails spaced at six (6) inches at edges and eight (8) inches in field each way.

END OF SECTION 06 10 00

SECTION 06 20 00 - FINISH CARPENTRY AND MILLWORK

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Providing all finish carpentry items including, but not limited to:
 - 1. Finish Carpentry.
 - 2. Millwork and Cabinetry.
 - 3. Plastic Laminate.
 - 4. Casework Hardware.
 - 5. Miscellaneous Millwork.
- B. Installation of:
 - 1. Door hardware.
 - 2. Plastic laminate faced wood doors.

1.3 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI A156.9 - Cabinet Hardware
 - 2. ANSI A161.1 - Woodwork Testing Standards
 - 3. ANSI A208.1 - Mat-Formed Wood Particleboard.
- B. Architectural Woodwork Institute:
 - 1. AWI - Quality Standards Illustrated.
- C. National Electrical Manufacturers Association:
 - 1. NEMA LD 3 - High Pressure Decorative Laminates.

1.4 PERFORMANCE REQUIREMENTS

- A. Unless otherwise indicated, perform work in accordance with AWI "Quality Standards Illustrated", Custom Grade, except where specification exceeds those standards, the more stringent shall govern.
- B. Fabricate millwork and cabinetry in accordance with ANSI A161.1, NEMA LD3, and general static load testing performed and certified by an independent testing agency, covering the following areas of product performance, with these minimum results:
 - 1. Base cabinet construction/racking test: 800 lbs.
 - 2. Cabinet front joint loading test: 425 lbs.
 - 3. Wall cabinet static load test: 2,000 lbs.
 - 4. Drawer front joint loading test: 600 lbs.
 - 5. Drawer construction/static load test: 750 lbs.
 - 6. Cabinet adjustable shelf support device/static load test: 300 lbs.
- C. Shelf Loading: Comply with loading/deflection standards of the Composite Panel Association.

1.5 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's preprinted product information for all hardware proposed on the project.
 - 3. Manufacturer's preprinted maintenance instructions for the casework hardware.
- B. Shop Drawings:
 - 1. Indicate size, material and finish.
 - 2. Show locations and installation procedures, including hardware, sinks, service fixtures, trim and other pertinent data for each unit.
- C. Certification: Provide manufacturer's certification that casework has been fabricated and installed according to AWI "Custom" Grade guidelines or better.
- D. Samples:
 - 1. Two (2) each, 6 inch by 6 inch by 3/4 inch sample of specified particleboard core with grade stamp for use as verification of installed product.
 - 2. Plastic laminates, 8 inches by 10 inches (200 mm by 250 mm), for each type, color, pattern.
- E. Closeout:
 - 1. Record Drawings: indicate revisions to original drawings and shop drawings
 - 2. Manufacturer contact names, addresses and phone numbers.
 - 3. Finish Material Schedule: names and color numbers of laminates and stains.
 - 4. Keys: Provide additional master key for each room and additional locksets totaling one percent of total project for attic stock.

1.6 QUALITY ASSURANCE

- A. Manufacturer: Minimum of five (5) years experience in providing manufactured casework systems for similar types of projects, produce evidence of financial stability, bonding capacity, and adequate facilities and personnel required to perform on this project.
- B. Delivery conference: 48 hours prior to delivery, notify Architect of delivery date and time. At the Architect's discretion, a representative of the Architect may be present at the time of delivery. Casework not conforming to the specified requirements, as reasonably determined by the Architect's representative, shall be removed and returned to manufacturer for repair or replacement at no additional cost to the Owner or increase in time.
- C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockups of typical architectural cabinets shown on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
 - 3. Provide a full-scale mock-up, including a base cabinet unit with countertop, wall cabinet and at least one accessible and one non-accessible cubby for review and approval by Architect.

1.7 PRE-INSTALLATION CONFERENCE

- A. Section 01 31 00 – Project Management and Coordination.

1.8 PRODUCT HANDLING

- A. Deliver completed laminate clad casework, countertops and related products only after wet operations in building are completed. Store in ventilated place, protected from the weather, with relative humidity range of 20 to 50 percent.
- B. Protect finished surfaces from soiling and damage during handling and installation with a protective covering.

1.9 JOB CONDITIONS

- A. Environmental Requirements: do not install casework until permanent HVAC systems are operating and temperature and humidity have been stabilized for at least one (1) week.
 - 1. Manufacturer/Supplier shall advise Contractor of temperature and humidity requirements for architectural casework installation areas.
 - 2. After installation, control temperature and humidity to maintain relative humidity between 25 and 55 percent.
- B. Conditions: Do not store or install casework in building until concrete, masonry, and drywall/plaster work is dry.

1.10 COORDINATION

- A. Coordinate the Work of this Section with plumbing work specified in Division 15. Coordinate sink opening construction with sinks specified in Division 15.
- B. Coordinate location of blocking in walls for installation and support of wall cabinets.

1.11 WARRANTY

- A. Warranty the work specified herein for five (5) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to the following:
 - 1. Rough or difficult operation, or loose or missing parts.
 - 2. Delamination of surfaces.
 - 3. Noticeable deterioration of finish.
 - 4. Warped or misaligned surfaces or telegraphing of subsurface imperfections.

PART 2 - PRODUCTS

2.1 MILLWORK MANUFACTURERS

- A. Manufacturers listed below are certified by AWI Quality Certification Program and are listed for the Contractor's convenience only and shall not preclude the Contractor from using other manufacturers, provided they produce equivalent products of the type specified for the scope and size of the Project. Other manufacturers must have experience manufacturing products meeting or exceeding the specifications and must comply with the criteria specified in paragraph 1.6 above and with Division 1 requirements regarding substitutions.
 - 3. Casework:
 - a. Jericho Woodworks; (281) 313-5780. **(Basis-Of-Design)**
 - b. Calmar Manufacturing Co., Inc., a subsidiary of Imperial Woodworking Company; (563)562-3261.
 - c. Case Systems, Inc., (989) 496-9510.
 - d. Global Casework Manufacturing, Inc.; (281) 494-6181.
 - e. MGC Millwork, LP; (713) 772-0294.
 - f. Robert Shaw Mfg. Co., Inc.; (817) 927-2557.

- g. Stevens Industries, Inc.; (217) 540-3100.
- h. Terrill Manufacturing Co.; (915) 655-7133.
- i. TMI Systems Design Corp., Dickenson, ND; (701) 456-6716.

2.2 MILLWORK MATERIALS

- A. Plastic Laminate (PL-1): High-pressure decorative laminate complying with NEMA LD3, and the following requirements:
- 1. Exterior Color Selection Available:
 - a. Basis of Design: Wilsonart standard laminate.
 - b. Architect to select from minimum of 250 selections available, including wood grain patterns and solid colors.
 - c. Provide 5 different colors available per project.
 - d. If laminate has wood grain, direction of grain shall be vertical on door, end panels, fascia panels, and exposed backs; horizontal on drawer faces, aprons, and top rails.
 - 2. Laminate grades:
 - a. Exposed doors, finished end panels, and other vertical surfaces: GP28 (0.028 inch thick nominal).
 - b. Horizontal and vertical surfaces other than top: GP28 (0.028 inch thick nominal). Shall meet NEMA LD3-2000 VGS standards including thickness.
 - c. Cabinet Liner: CL20 (0.020 inch nominal), white. Shall meet NEMA LD3-2000 LS standards including thickness. No melamine.
 - d. Work Surfaces and Countertops: GP50 (0.050 inch thick nominal) with BK20 (0.20 inch thick) backer sheet.
 - e. Backsplash: PH42 (0.042 inch nominal) with nominally balanced backer sheet.
 - f. Open Shelving: CL20 (0.020 inch nominal), white.
 - 3. Adhesive: PVA water resistant adhesive. Contact adhesives not permitted.
 - 4. Pressure Fused Laminate:
 - a. NEMA LD3 VGL, and NEMA LD3 CLS, Melamine resin impregnated, 120 gram PSM minimum, thermofused to core under pressure.
 - b. Color:
 - 1) Closed interiors, underside of wall cabinets: White.
 - 2) Exposed and Semi-exposed open cabinets: Match exterior.
 - c. Provide balanced construction with same thermofused melamine. Unsurfaced coreboard or simple backers not allowed.
- B. Core Material:
- 1. Particleboard: ANSI 208.1, minimum 45 pcf density, Grade M-3.
 - 2. Plywood: Shop sanded, exterior grade veneer cored, hardwood faced, any species, with no defects affecting strength or utility. Overlay plywood not permitted. Plywood allowed at countertops and toe-base only.
 - 3. Water resistant treated plywood: shall have 24 hour thickness swell factor of five percent or less and 24 hour water absorption factor of ten percent or less; P.S. 51, Type II or better.
 - 4. Cabinet components shall be of the following minimum core thicknesses:
 - a. Cabinet backs, drawer body, and drawer bottoms: 1/2 inch particleboard
 - b. Door and drawer face, base, wall, and tall cabinet tops and bottoms, cabinet sides, drawer spreaders, cabinet back rear hangstrips, structural dividers, and exposed cabinet backs: 3/4 inch particleboard
 - c. Work surfaces and countertops: minimum 1 inch particleboard or plywood, except use Solid surface material (no laminate or wood) at counters with sinks.

- d. Shelves: 3/4 inch particleboard core for 30 inches long or less, 1 inch thick particleboard core for more than 30 inches long; 14 inch deep, unless otherwise noted. Provide vertical dividers for shelves over 36 inches long.
 - e. Cabinet Toe-Base: 3/4 inch plywood. No particleboard within four (4) inches of floor.
- C. Countertops and Backsplashes:
- 1. Countertops: Provide countertops with plastic laminate edge in as long as practical continuous lengths. Provide field glued splines at joints. No joints closer than 24 inches either side of sink cutout.
 - 2. Backsplash: Integral to countertop, 4 inch high unless otherwise shown. Fabricate with single continuous sheet of laminate from front counter to top of splash with no joints from horizontal to vertical application. No joints shall occur at sink openings.
 - 3. At exposed countertop end corners, provide 1 inch radius, or similar safety treatment.
- D. Toe Spaces: Leave toe spaces unfinished for installation of resilient base, unless otherwise shown.
- E. End Panels and Filler Strips: Match adjacent case-piece.
- F. Edging:
- 1. Provide the following in accordance with "Edging Locations":
 - a. Flat Edge PVC: 1 mm, solid, high-impact, purified, color-thru, acid resistant, machine-applied with hot melt adhesives.
 - b. 3 mm PVC: Solid, high-impact, purified, color-thru, acid resistant, pre-lamination primed edging, machine-applied with hot melt adhesives, and machine profiled to 1/8 inch radius.
 - 2. Edging Locations:
 - a. Cabinet body edge, including door/drawer front spacer rail: Flat Edge PVC, color matched to door/drawer face or as selected.
 - b. Forward edge of interior body components, interior dividers, shelf, and top edges of drawer body: Flat Edge PVC to match cabinet interior surface color.
 - c. Door/Drawer-Front edging: 3mm PVC, color matched to standard laminates.

2.3 CABINET HARDWARE

- A. All hardware shall meet ANSI A156.9 and shall be subject to approval by the Architect. All keying shall match existing master key system and be approved by the Owner.
- 1. Acceptable Manufacturers:
 - a. Accuride
 - b. National
 - c. Knappe & Vogt
 - d. Ives
 - e. Stanley
 - f. As specified herein, provide specified product, or Architect approved equal.
- B. Hinges:
- 1. Heavy duty, five-knuckle 2 3/4 inch institutional type hinge shall meet ANSI/BHMA A156.9 Grade 1 requirements. Mill ground, hospital tip, Teflon coated tight pin feature with all edges eased. Hinge shall be full wrap around type of tempered steel 0.095 inch thick. Each hinge shall have minimum of 9

- screws, #7, 5/8 inch FHMS to assure positive door attachment. No "European" style hinges.
2. One pair per door to 48 inch height. One and one-half pair over 48 inches in height. Hinge shall accommodate 13/16 thick laminated door and allow 270 degree swing.
 3. Finish: US26D.
- C. Pulls:
1. Wire design, 4 inches, Chrome, US26D finish.
- D. Sliding Door Hardware:
1. Frameless 1/4 inch glass sliding doors: double track rolling door assembly.
 2. Framed 13/16 inch thick stile and rail sliding doors: top mounted track with dual roller hangers. Vertical adjustment for accurate alignment.
- E. Drawer Slides:
1. Standard Drawers: 3/4 extension, self-closing, white epoxy-coated, lever disconnect, positive in-stop/out-stop, nylon rollers, minimum 100 pound dynamic load rating at full extension.
 2. File Drawers: Full extension, 3-part progressive opening slide, precision steel ball bearing, minimum 100 pound dynamic load rating at full extension, zinc plated or epoxy coated at manufacturer's option.
 3. Provide body mounted molded rails for hanging file system for legal or letter size as indicated by manufacturer's model number. Cutting or machining of drawer body/face not permitted.
 4. Paper Storage Drawers: Full extension, self-closing, white epoxy-coated, lever disconnect, positive in-stop/out-stop, nylon rollers, minimum 150 pound dynamic load rating at full extension.
 5. Self-Closing.
- F. Catches: Provide opening resistance in compliance with the Americans with Disabilities Act.
1. Provide top-mounted magnetic catch for base and wall cabinet door.
 2. Provide two at each tall cabinet door. Catch housing shall be molded in White.
- G. Adjustable Shelf Supports:
1. Dual-pin design with anti tip-up shelf restraints for both 3/4 inch and 1 inch shelves.
 2. Include keel to retard shelf slide-off, and slot for mechanical attachment of shelf to clip.
 3. Load rating shall be minimum 300 pounds each support without failure.
- H. Wardrobe Rod: 1-1/6 inch diameter plated steel rod, with captive sockets.
- I. Coat Hooks: Single and double prong, wall mount - Satin Aluminum.
- J. Locks: Five-disk tumbler cam-style with strike. Locks on cabinets in same room keyed alike. Provide two (2) keys per room where doors and drawers are scheduled to receive locks. Dull chrome finish. Lock core shall be removable with a control key, permitting Owner to change lock arrangements without tools.
- K. Cabinet Door Silencers: Round, clear, self-adhesive.

2.4 SPECIALTY ITEMS

- A. Grommets:
 - 1. Size: 2-1/2 inches diameter with "Flip-Top"™ tab in cap.
 - 2. Colors: As selected by Architect from manufacturer's available colors.
 - 3. Number/Location: Where electrical, telephone, and computer data wiring need to pass through tops whether shown or not.
 - 4. Approved Product/Manufacturer: Model No. EDP3 manufactured by Doug Mockett & Company, Inc., Manhattan Beach, CA; (800) 523-1269, or Architect approved equal.
- B. Keyboard Drawers (At all knee spaces):
 - 1. Approved Product/Manufacturer: No. SD-1 as manufactured by Knape & Vogt; or Architect approved equal.
- C. Molded Personal Pencil Drawer: High-impact 100 Polystyrene with in-stop, out-stop, and self-closing features. Provide under top mounted 100 lb self-closing slides. Twelve compartment drawer body, and slides, Black. Provide where indicated on plans.
- D. Mailbox Label Holder: Brass, card size 1/2" x 2-3/16". Provide one (1) at each opening.

2.5 SOLID STOCK

- A. Moisture Content: Percent of moisture in relation to over-dry weight shall be between 8 percent and 13 percent at time of installation.
- B. Natural Finish Hardwood:
 - 1. Occasional knot permitted provided it is tight and smooth.
 - 2. Grain Pattern: Rift-cut
 - 3. Species: AWI "Premium" Grade, White Oak
- C. Paint Grade Hardwood: Any species, including Parana Pine, except do not use Oak, Elm or similar species which have coarse grain.

2.6 MILLWORK FABRICATION

- A. Fabricate casework, countertops and related products to dimensions, profiles and details shown on drawings. Fabricate casework square, plumb, and true.
- B. Detailed Requirements For Cabinet Construction:
 - 1. Toe-Base:
 - a. Continuous, ladder type platform with concealed fastening to cabinet bottom, level and secured to floor
 - b. Toe-base at exposed cabinet end panels shall be recessed 1/4 inch from face of finished end, for flush installation of finished base material.
 - c. No cabinet sides-to-floor will be allowed.
 - 2. Cabinet Top and Bottom:
 - a. Solid sub-top shall be furnished for all base and tall cabinets.
 - b. At cabinets over 36 inches bottoms and tops shall be mechanically joined by a fixed divider.
 - c. Assembly devices shall be concealed on bottom side of wall cabinets.
 - 3. Cabinet Sides:
 - a. Doweled, and glued under pressure, or attached with fully concealed interlocking mechanical fasteners to sub-top and bottom.
 - b. Drill holes for adjustable shelves 1-1/4 inches on center.
 - 4. Cabinet Backs:

- a. Side bound, captured in grooves, recessed from cabinet rear, and securely fastened at top and bottom.
 - b. Hang rails shall be located at rear of cabinet back and fastened to cabinet sides. Provide minimum of two (2) at base, two (2) at wall, and three (3) at tall cabinets as instructed by casework manufacturer.
 - c. Provide removable back panels and closure panels for plumbing access at all sink cabinets, and where shown on drawings.
5. Exposed end corner and face frame attachment:
- a. Butt joint, glued and finish nailed; or attached with fully concealed interlocked mechanical fasteners.
6. Door and Drawer Fronts:
- a. Drawer fronts and hinged doors shall be full overlay the cabinet body. Maintain a maximum 1/8 inch reveal between pairs of doors, between door and drawer front, or between multiple drawer fronts within the cabinet.
 - b. Where indicated, provide Stile and Rail doors with full 1/4 inch plate glass, hinged or sliding. Exposed lite-opening edges shall be trimmed and glazed with extruded glazing bead.
 - c. Where indicated, frameless sliding glass doors shall be 1/4 inch thick plate glass with ground and polished edges. Fit with anodized aluminum shoes and nylon rollers.
 - d. Plywood shall be the core material for millwork doors. Door finish to be high pressure decorative laminate to match the rest.
- C. Drawers:
1. Drawer fronts: apply to separate drawer body component sub-front.
 2. Drawer sides: doweled to receive front and back, glued under pressure, machine squared.
 3. Drawer bottom: set into front and sides, 1/4 inch deep groove with minimum 3/8 inch standing shoulder, continuously glued. Reinforce drawer bottoms with 1/2 inch by 4 inch front-to-back intermediate underbody stiffeners, mechanically fastened. One at 24 inches, two at 36 inches, and over.
 4. Paper storage drawers: fitted with full width hood at back.
 5. Hanging file drawers shall be fabricated to accept letter size hanging folders compatible with Pendaflex system.
- D. Vertical and Horizontal Dividers: As required by manufacturer for type and style of component.
- E. Door/Drawer Front Rail: As required by manufacturer for type and style of component, and hardware placement.
- F. ADA Accessible, Americans with Disabilities Act Requirements: The following special requirements shall be met, where specifically indicated on architectural plans as "ADA", or by General Note. Shall be in compliance with Federal Register Volume 56, No. 144, Rules and Regulations:
1. Countertop height: With or without cabinet below, not to exceed a height of 34 inches Above Finished Floor (A.F.F.), at a surface depth of 24 inches
 2. Kneespace clearance: minimum 29 inches A.F.F. at apron, and 30 inches clear span width.
 3. 12 inch deep shelving, adjustable or fixed: Not to exceed a range from 9 inches A.F.F. to 54 inches A.F.F.
 4. Wardrobe cabinets: Provide with rod/shelf adjustable to 48 inches A.F.F. at a maximum 21 inch shelf depth.

5. Sink cabinet clearances: In addition to above, upper kneespace frontal depth shall be no less than 8 inches, and lower toe frontal depth shall be no less than 11 inches, at a point 9 inches A.F.F., and as further described in Volume 56, Section 4.19.

- G. Typical Desk or Counter Height at Kneespace Locations: 30" above finished floor.

PART 3 - EXECUTION

3.1 MILLWORK INSTALLATION

- A. Positioning: Place approximately level, plumb and at right angles to adjacent work.
- B. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging the products and adjacent work.
- C. Anchorage: Attach securely so the products will perform to their maximum ability without damage from inadequate fastenings.
- D. Fasten tops to frames with concealed clips, screws and glue.
- E. Install simulated wood trim in locations shown on drawings and in accordance with manufacturer's instructions.
- F. Do not install architectural woodwork until the building is enclosed, the permanent heating and cooling system is in operation, and residual moisture from plaster, concrete, or masonry has dissipated.

3.2 FINISH HARDWARE INSTALLATION

- A. The supplier will mark each item of hardware for location. Protect the markings until each item is installed. If any item is delivered to the job not properly marked, return it to the supplier for marking before attempting to install it.
- B. Check markings on hardware for proper location. Install and make necessary adjustments for proper working order. Any hardware damaged by improper adjustment or careless abuse will be replaced by the Contractor at his expense.
- C. Provide clean, properly sized and accurately placed mortises and drilled holes for all mortise hardware such as locksets and for cylindrical locks where specified only.
- D. Fit all surface-applied hardware accurately.
- E. After hardware is installed, protect exposed surfaces by use of heavy paper and masking tape and maintain until job completion.
- F. Remove all door hardware except that which is primed for painting before painter's finish is applied. Permanently replace and re-adjust for proper function after painter's finish has dried hard.
- G. Millwork contractor shall be responsible for hardware on millwork.

END OF SECTION 06 20 00

SECTION 06 40 23 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Reception desk.
 - 2. Free-standing plywood fin screen.
 - 3. Top and bottom mounted plywood fin screen.
 - 4. Wall paneling with plywood fins
 - 5. Wood furring, blocking, shims, and hanging strips for installing interior architectural woodwork items that are not concealed within other construction.
 - 6. Shop finishing of interior architectural woodwork.

1.3 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections, to ensure that interior architectural woodwork can be supported and installed as indicated.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Anchors.
 - 2. Adhesives.
 - 3. Shop finishing materials.
- B. Sustainable Design Submittals:
 - 1. Product Data: For adhesives, indicating VOC content.
- C. Shop Drawings:
 - 1. Include the following:
 - a. Dimensioned plans, elevations, and sections.
 - b. Attachment details.
 - 2. Show large-scale details.
 - 3. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.
- D. Samples: For each exposed product and for each shop-applied color and finish specified.
 - 1. Size:
 - a. Panel Products: 12 inches by 12 inches (300 mm by 300 mm).
 - b. Lumber Products: Not less than 5 inches (125 mm) wide by 12 inches (300 mm) long, for each species and cut, finished on one side and one edge.
 - c. Metal Channels and Tubing: 12-inch (300mm) long with painted finish.
- E. Digital Sample: Indicate design, pattern, form, and joints, where applicable, in an electronic 3D mockup with ability for different views and revisions.
- F. Mock Up: Contractor shall submit a full-scale mock up, including a case cabinet unit with countertop, wall cabinet and at least one accessible and one non-accessible cubby for review

and approval by District and Architect, prior to fabrication and if required by Design Team. The mock-up may be incorporated into the finished work after approval.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For architectural woodwork fabricator.

1.7 QUALITY ASSURANCE

- A. Fabricator's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
 - 1. Installer Qualifications: Fabricator of products.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockups of typical interior architectural woodwork as shown on Drawings.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver interior architectural woodwork until painting and similar finish operations that might damage woodwork have been completed in installation areas.
- B. Store woodwork in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.
 - 1. Handle and store fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 17 and 50 percent during the remainder of the construction period.
- B. Field Measurements: Where interior architectural woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being concealed by construction, and indicate measurements on Shop Drawings.
- C. Established Dimensions: Where interior architectural woodwork is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.10 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Flame Spread and Smoke Developed: Class C minimum per ASTM E84.

2.2 ARCHITECTURAL WOODWORK FABRICATORS

- A. Approved Fabricators: Subject to compliance with requirements, provide products by the following:
 - 1. Basis of Design: MAK Fabrication, www.makstudio.us, 713-505-1234. Contact: Jose Aguilar, 832-444-8133, jose@makstudio.us.
 - 2. Comparable product approved by Architect.

2.3 HARDWOOD SHEET MATERIALS

- A. Plywood Panel for Transparent Finish: Baltic Birch Plywood, B/BB, single piece face and back veneer, face veneer clear and free of defects with light-uniform color.
 - 1. Panel Core Construction: Baltic Birch.
 - 2. Layers of plywood laid up for color contrast when routed.
 - 3. No substitutions.
 - 4. Thickness: As indicated.
- B. Hardwood Veneer Plywood Paneling for Opaque Finish: Manufacturer's stock hardwood plywood panels complying with HPVA HP-1.
 - 1. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.
 - 2. Face Veneer Species and Cut: Rotary cut Birch, A-A.
 - 3. Backing Veneer Species: Same species as face veneer.
 - 4. Construction: Veneer core.
 - 5. Thickness: As indicated.
 - 6. Glue Bond: Type II (interior).
- C. Exposed Panel Edges: Sanded smooth.
- D. Fire-Retardant-Treatment: Intumescent fire-retardant varnish with clear fire-retardant varnish overcoat that dries to a tough, durable, clear finish.
 - 1. Finish: Clear, high-gloss.
 - 2. Panels shall have a Class A flame-spread index with 15 or less and a smoke-developed index of 50 or less per ASTM E 84, and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 3. Basis-of-Design Product: Flame Control Coatings, LLC; Flame Control No. 166 and No. 167.
- E. Assemble panels by gluing and concealed fastening.

2.4 SOLID WOOD SPACERS

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.
- B. Species and Grade: As scheduled.
- C. Face Surface: Surfaced (smooth).
- D. Ease edges of lumber less than 1 inch (25 mm) in nominal thickness to 1/16-inch (1.5-mm) radius and edges of lumber 1 inch (25 mm) or more in nominal thickness to 1/8-inch (3-mm) radius.

2.5 SOLID SURFACE MATERIALS

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Avonite Surfaces.
 - b. E. I. du Pont de Nemours and Company.
 - c. Formica Corporation.
 - d. LG Chemical, Ltd.
 - e. Livingstone Surfaces.

- f. Samsung Chemical USA, Inc.
 - g. Wilsonart..
- 2. Type: Provide Standard type unless Special Purpose type is indicated.
 - 3. Colors and Patterns: As scheduled.

2.6 PLASTIC-LAMINATE MATERIALS

- A. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Abet Laminati Inc.
 - b. Formica Corporation.
 - c. Lamin-Art, Inc.
 - d. Pionite; a Panolam Industries International, Inc. brand.
 - e. Wilsonart.
- B. Laminate Cladding for Exposed Surfaces:
 - 1. Horizontal Surfaces: Grade HGS.
 - 2. Postformed Surfaces: Grade HGP.
 - 3. Vertical Surfaces: Grade HGS.
 - 4. Edges: Grade HGS.
 - 5. Pattern Direction: As indicated.
 - 6. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.
- C. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. As scheduled.

2.7 METAL MATERIALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Channel: Cold-rolled steel box channel complying with MFMA 4, ASTM A1008/a1008m, size as required by design but no less than 18-gage.
- C. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.
- D. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.
- E. Sizes: As indicated.

2.8 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Nailers: Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Mounting Accessories: Fasteners, clips, and other accessories required for complete installation.
- C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage.
 - 1. Provide metal expansion sleeves or expansion bolts for post-installed anchors.
 - 2. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- D. Fasteners: Unless otherwise indicated, provide zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5 for interior use. Select fasteners for type, grade, and class required.
- E. Installation Adhesive: Product recommended by fabricator for each substrate for secure anchorage.

2.9 FABRICATION

- A. Fabricate interior architectural woodwork to dimensions, profiles, and details indicated.
- B. Routing:
 - 1. Make cuts using CNC router utilizing template or pattern. Form cutouts to smooth, even curves using a CNC router.
 - a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces.
- C. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site.
 - 1. Disassemble components only as necessary for shipment and installation.
 - 2. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
 - 3. Notify Architect seven days in advance of the dates and times interior architectural woodwork fabrication will be complete.
 - 4. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled.
 - a. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting.
 - b. Verify that parts fit as intended, and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.
- D. All countertops, millwork doors, drawers and other vertical edges must be edged with 3mm PVC applied with hot melt adhesive and radiused with automatic trimmers.

2.10 SOLID SURFACING FABRICATION

- A. Fabricate according to solid surface material manufacturer's written instructions.
- B. Configuration: As indicated on Drawings and approved shop drawings.
- C. Fabricate with shop-applied edges unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
- D. Joints: Fabricate in sections for joining in field, with joints at locations indicated.
- E. Patterns, Cutouts, Bevels, and Holes:
 - 1. Make cuts using CNC router utilizing template or pattern. Form cutouts to smooth, even curves using a CNC router.
 - a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces.
- F. Finishing: Sand and polish surfaces of solid surfacing exposed to view in final installation including tops, bottoms, and edges.
- G. Pre-drill holes for screws as recommended by fabricator. Align adjacent surfaces and, using adhesive in color to match, form seams to comply with fabricator's instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- H. Secure materials with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match material, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- I. Bond joints with adhesive and draw tight as materials are set. Mask areas of materials adjacent to joints to prevent adhesive smears.
 - 1. Clamp units to temporary bracing, supports, or each other to ensure that materials are properly aligned and joints are of specified width.
- J. Complete cutouts not finished in shop. Mask areas of materials adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

2.11 SHOP FINISHING

- A. Finish interior architectural woodwork at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.
- B. Transparent Finish:
 - 1. Oil rubbed.
 - 2. Clear coat.
 - 3. Staining: As scheduled.
- C. Opaque Finish - Wood:
 - 1. Color: As selected by Architect from manufacturer's full range.
- D. Painted Finish – Metal:
 - 1. Two coats direct-to-metal.
 - 2. Basis-of-Design Product: Sherwin-Williams; Direct-to-Metal Alkyd Enamel.
- E. Sheen: Gloss, 61-100 gloss units measured on 60-degree gloss meter according to ASTM D 523.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition interior architectural woodwork to humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.
- B. Before installing interior architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming of concealed surfaces.

3.2 INSTALLATION

- A. Assemble interior architectural woodwork and complete fabrication at Project site to the extent that it was not completed during shop fabrication.
- B. Do not install architectural woodwork until the building is enclosed, the permanent heating and cooling system is in operation. And residual moisture from plaster, concrete, or masonry has dissipated.
- C. Install interior architectural woodwork level, plumb, true in line, and without distortion.
 - 1. Shim as required with concealed shims.
 - 2. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).
- D. Scribe and cut interior architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor interior architectural woodwork to anchors or blocking built in or directly attached to substrates.
 - 1. Secure with countersunk, concealed fasteners and blind nailing.
 - 2. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with interior architectural woodwork.
 - 3. For shop-finished items, use filler matching finish of items being installed.

3.3 REPAIR

- A. Repair damaged and defective interior architectural woodwork, where possible, to eliminate functional and visual defects and to result in interior architectural woodwork being in compliance with requirements of Architectural Woodwork Standards for the specified grade.
- B. Where not possible to repair, replace defective woodwork.
- C. Shop Finish: Touch up finishing work specified in this Section after installation of interior architectural woodwork.
 - 1. Fill nail holes with matching filler where exposed.

2. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

3.4 CLEANING

- A. Clean interior architectural woodwork on exposed and semiexposed surfaces.

END OF SECTION 06 40 23

SECTION 06 82 00 - FIBERGLASS REINFORCED PLASTIC PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Fiberglass reinforced plastic (FRP) panels.
- B. Trim and installation accessories.

1.3 SUBMITTALS

- A. Product Data: Provide manufacturer's standard details and catalog data demonstrating compliance with referenced standards. Provide installation instructions.
- B. Samples:
 - 1. Submit six (6) inch by six (6) inch samples of each surface and color required.
 - 2. Submit six (6) inch long samples of each trim profile and trim color required.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store products indoors and protect from moisture, construction traffic, and damage.
- B. Store panels flat on clean, dry surface. Do not stand on edge or stack on fresh concrete or other surfaces that emit moisture.
- C. Store panels at least 24 hours temperature and humidity conditions approximating the average environment of the finish room.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

- A. Specifications are based on "Structoglas" manufactured by Sequentia, Inc., Grand Junction, TN; (800) 238-6874, (901) 764-2153. Manufacturers named below who manufacture a product which meets or exceeds the specifications are approved. Other manufacturers must have a minimum of five (5) years experience manufacturing fiberglass reinforced panels meeting or exceeding the specifications and be approved through requirements of Division 1 prior to their consideration for use on the Project.
 - 1. Kemlite Company, Joilet, IL; (800) 435-0080
 - 2. Newcourt, Inc., Texarkana, TX; (903) 838-0521
 - 3. Nudo Products, Inc., Springfield, IL; (800) 826-4132

2.2 COMPONENTS

- A. Fiberglass Reinforced Plastic Panels:
 - 1. Size: 4 feet-0 inches wide x 0.090 inch thick x length as shown on drawings or required to minimize joints.

2. Series/Type: #1200 Standard.
 3. Finish:
 - a. Exposed Surface: Pebble-like embossed finish.
 - b. Back Surface: Smooth. Imperfections which do not affect functional properties are not cause for rejection.
 4. Color: Shall be uniform throughout in color selected by Architect from manufacturer's standard color range.
- B. Moldings and Trim: All exposed panel edges shall be finished with appropriate one-piece and two-piece non-staining vinyl extruded moldings.
- C. Caulks and Adhesives: High quality construction grade adhesives and clear silicone sealants of type recommended by manufacturer to suit intended use and recommended installation procedures.
- D. Fasteners: Non-corroding mechanical Truss head nylon drive rivets or stainless steel screws of size and type recommended by manufacturer to suit intended use. Color shall match panel or be as selected by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive panels to ensure that surfaces are smooth, dry, true, and free of dirt, dust, oil, or grease.
- B. Remove high spots. Fill low spots.
- C. Apply leveling coat of plaster to concrete block walls, if required to bring surface to a true plane.
- D. Verify that substrate construction is completed and approved.
- E. Correct deficiencies in substrate before installing panels.

3.2 INSTALLATION

- A. Install panels and accessories in accordance with manufacturer's printed installation instructions, using both mechanical fasteners and adhesive.
- B. Cutting Panels:
 1. Cut panels with carbide-tipped saw blade or swivel head shear.
 2. Allow 1/2 inch clearance in length per eight (8) foot panel length.
 3. Allow 1/8 inch clearance at cut-outs for penetrations.
- C. Pre-drill fastener holes before applying adhesive. Use carbide-tipped drill.
 1. Drill 3/8-inch holes for 1/4 inch nominal fasteners.
 2. Space at eight (8) inches maximum on center at perimeter, approximately one (1) inch from panel edge.
 3. Space at in field in rows 16 inches on center, with fasteners spaced at 12 inches maximum on center.
- D. Apply adhesive between 50 and 90 degrees F, unless otherwise approved.
 1. Spread adhesive 1/4 inch deep over entire back side of panel to achieve 100 percent

- coverage.
 - 2. Do not use beads of adhesive.
 - 3. Do not use mechanical fasteners or adhesive alone.
 - 4. Allow open time recommended by adhesive manufacturer before setting panels into position.
 - 5. Once in position, apply sufficient pressure to make full contact between panel and wall.
 - 6. Roll panel surface to ensure complete contact.
 - 7. If necessary, install bracing to maintain intimate contact until adhesive cures in accordance with manufacturer's instructions.
- E. Panel Fasteners:
- 1. Apply silicone sealant in pre-drilled fastener holes.
 - 2. Drive fasteners for snug fit. Do not over-tighten.
 - 3. Fasten leading edge of each panel after installing moldings.
- F. Moldings:
- 1. Trim division bar to accommodate ceiling and base moldings.
 - 2. Apply bead of silicone sealant to one side of division bar and install on leading edge of first panel.
 - 3. Push molding all the way onto panel and pull back to allow 1/8 inch clearance.
 - 4. Check plumb.
 - 5. Fasten molding with coated lath nails, installed to leading edge of molding, only.
 - 6. Complete fastening of panel, and remove excess sealant.
 - 7. Apply sealant to leading edge of molding to receive next panel. Allow 1/8 inch clearance when installing panel.
 - 8. Remove excess sealant from panels and moldings.
- G. Sealants: Seal corner seams, ceiling and base junctures, around door frames and other openings, and between penetrating items and panel cut-outs.

3.3 ADJUST AND CLEAN

- A. Remove scraps and debris from the site, and leave in a neat and clean condition.

END OF SECTION 06 82 00

SECTION 07 05 43 – THERMAL CLIPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide thermal clips including but not limited to following:
1. Sub-framing thermal spacers.
 2. Spacer fasteners.
 3. Cladding support sub-framing.
- B. Related Sections:
1. Coordination with cast-in-concrete: Section 03 30 00, Cast-In-Place Concrete.
 2. Coordination with masonry construction: Section 04 20 00, Unit Masonry.
 3. Coordination with structural steel framing: Section 05 12 00, Structural Steel.
 4. Coordination with structural steel studs framing: Section 05 41 00, Structural Metal Stud Framing System.
 5. Coordination with wood stud framing: Section 06 10 00, Rough Carpentry.
 6. Coordination with building insulation: Section 07 21 00, Building Insulation.
 7. Coordination with aluminum modular plate system: Section 07 42 43, Aluminum Modular Plate System.
 8. Coordination with aluminum siding system: Section 07 46 16, Aluminum Siding System.
 9. Coordination with metal siding system: Section 07 46 19, Metal Siding System.
 10. Coordination with aluminum framed curtain wall system: Section 08 44 13, Glazed Aluminum Curtain Wall.

1.2 REFERENCES

- A. Definitions:
1. Rain Screen Principle: A theory governing the design of a building enclosure in such a way as to prevent water penetration due to rain; in other words, a scientific approach to eliminating water leakage.
- B. Reference Standards:
1. ASTM B117-19 - Standard Practice for Operating Salt Spray (Fog) Apparatus
 2. ASTM D570-98(18) - Standard Test Method for Water Absorption of Plastics
 3. ASTM D638-14 - Standard Test Method for Tensile Properties of Plastics
 4. ASTM D695-15 - Standard Test Method for Compressive Properties of Rigid Plastics
 5. ASTM D790-17 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
 6. ASTM D792-20 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
 7. ASTM G155-13 - Standard Practice for Operating Xenon Arch Light Apparatus for Exposure of Non-Metallic Materials

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meetings: Arrange preinstallation meeting 1 week prior to commencing work with all parties associated with trade as designated in Contract Documents or as requested by Architect. Presided over by Contractor [Construction Manager], include Architect who may attend, Subcontractor performing work of this trade, Owner's representative, testing company's

representative and consultants of applicable discipline. Review Contract Documents for work included under this trade and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, materials to be used, installation of materials, sequence and quality control, Project staffing, restrictions on areas of work and other matters affecting construction, to permit compliance with intent of work of this Section.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. Submit Shop Drawings for work of this Section in accordance with Section [01 30 00] [01 33 23]. Ensure to include size, spacing and location of thermal clips.
 - 2. Ensure a licensed engineer specified herein is responsible for:
 - a. production and review of Shop Drawings.
 - b. sealing and signing each Shop Drawing and any associated calculations performed.
- B. Certificates: Submit in accordance with Section [01 30 00] [01 33 23]. Submit thermal clip manufacturer's written certification that Products, systems and assemblies have been installed in accordance with manufacturer's requirements.

1.5 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installers: Provide work of this Section executed by competent installers with minimum 5 years experience in the application of Products, systems and assemblies specified and with approval and training of the Product manufacturers.
 - 2. Licensed Professionals: Employ a licensed engineer carrying professional liability insurance and is registered in the State of [State].
- B. Mock-Ups: Construct minimum 100 sq ft mock-up sample at Project location designated by Architect for review. Once reviewed with on objections recorded, sample remains part of finished work and used as a quality reference standard for balance of Project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer List: Products of following manufacturers are permitted subject to conformance to requirements of Drawings, Schedules and Specifications. Manufacturers other than those listed must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
 - 1. Cascadia Windows Ltd., Cascadia Clip®; www.cascadiaclip.com

2.2 COMPONENTS

- A. Performance/Design Criteria:
 - 1. Provide thermal spacers that meet or exceed following physical properties when tested in accordance with standards specified herein:
 - a. Tensile Strength and Modulus: Minimum 59,600 psi tensile and 24,500 ksi modulus when tested to ASTM D638.
 - b. Flexural Strength and Modulus:
 - 1) Lengthwise Control: Minimum 64,000 psi flexural and 1,900 ksi modulus when tested to ASTM D790.

- 2) Crosswise Control: Minimum 18,400 psi flexural and 1,200 ksi modulus when tested to ASTM D790.
 - c. Compressive Strength:
 - 1) Lengthwise: Minimum 29,800 psi when tested to ASTM D695.
 - 2) Crosswise: Minimum 12,000 psi when tested to ASTM D695.
 - d. Water Absorption: Maximum 0.09% when tested to ASTM D570.
 - e. Density and Specific Gravity: Maximum 0.067 lbs/cu in density and 1.854 sp.gr 23/23° specific gravity when tested to ASTM D792.
 - f. Accelerated Weathering: No cracking, checking, crazing, erosion or other characteristics that might affect performance after 2000 hours of accelerated weathering when tested to ASTM G155.
 - g. Salt Spray: No cracking, checking, crazing, erosion or other characteristics that might affect performance after 3000 hours of salt spray exposure when tested to ASTM B117.
2. Structural Design: Employ a licensed engineer specified herein to:
 - a. design components for work of this Section requiring structural performance.
 - b. be responsible for determining sizes, yield strengths, gauge thicknesses and joint spacing to allow thermal movement and loading of components in accordance with applicable codes and regulations.
- B. Sub-Framing Thermal Spacer: 100% Pultruded glass fiber and thermoset polyester resin insulation clip.
1. Thermal Spacer thickness for top, base and web: 3/16 in. nominal.
 2. Thermal Spacer Depth: [2 in.] [2-1/2 in.] [3 in.] [3-1/2 in.] [4 in.] [5 in.] [6 in.] [8 in.] nominal.
 - a. Depth Tolerance: +/-0.005 in.
 3. Basis of Design: "Cascadia Clip®" by Cascadia Windows Ltd.
- C. Spacer Fasteners: High hex head washer head with sharp twin threaded design of heat-treated corrosion resistant coated steel.
1. Fastener for Steel Framing: 1/4 - 14 x [4 in.] [5 in.] [6 in.] [7 in.] [8 in.] [10 in.] long with hex head. Ensure fasteners are supplied by Cascadia Windows Ltd., minimum 1-1/2 in. longer than clip depth to allow for sheathing and penetration on steel stud.
 - a. Permitted Product: "Master Driller™ No. 2 Mini Drill Point with NZF3000 coating" by Leland Industries Inc.
 2. Fastener for Wood Framing: 1/4 - 14 x [4 in.] [5 in.] [6 in.] [7 in.] [8 in.] [10 in.] long with hex head. Ensure fasteners are supplied by Cascadia Windows Ltd., minimum 1-1/2 in. longer than clip depth to allow for sheathing and penetration on wood stud.
 - a. Permitted Product: "Master Gripper™ with DT2000 or NZF3000 coating" by Leland Industries Inc.
 3. Fastener for Cast-In-Place Concrete and Concrete Masonry Units: 1/4 - 14 concrete screw with hex head. Fasteners to be supplied by Cascadia, minimum 1-1/2 in. longer than Clip depth to allow for sheathing and penetration into concrete or concrete masonry unit.
 - a. Permitted Product: "Concrete Screw with DT2000 or NZF3000 coating" by Leland Industries Inc.
 - b. Embedment Depth: 1-1/2 in., except when into hollow concrete masonry unit, not less than 1 in.
 4. Cladding Support Sub-Framing:
 - a. Material Basis-of-Design: Minimum 18 ga, 33 ksi, factory-punched sheet steel with fastener holes to match fiberglass thermal spacers.
 - b. Corrosion Resistant Coating on Sub-Framing: Galvalume AZM 150 (AZ 50)

- c. Sub-Framing Profiles: As shown on design drawings. Typically, Z-profile for vertically oriented sub-framing and hat-profile for horizontally oriented sub-framing, and additionally as required by cladding manufacturer or cladding structural engineer.
 - 1) Typical Sub-Framing Depth: 1 in.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Architect in writing of any conditions which would be detrimental to the installation.
- B. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2 PREPARATION

- A. Pre-drill concrete or concrete masonry unit substrate to 1/2 in. deeper than anticipated embedment depth of fastener into substrate.
- B. Use drill diameter approximately 1/16 in. less than screw diameter in accordance with fastener manufacturer's written recommendations.
- C. Sub-Framing: Ensure thermal spacer type is selected to accommodate orientation of vertical and horizontal sub-framing.

3.3 INSTALLATION

- A. Sub-framing Thermal Spacer Installation: Install thermal spacers in accordance with spacer manufacturer's written recommendations.
- B. Thermal Spacer Installation:
 - 1. Clip thermal spacer to Z-girt and hat track [[at centres determined using Cascadia Clip Calculator <http://www.cascadiawindows.com/tools/cascadia-clip-calculator> [or as directed by [Cladding Engineer] [Architect]].
 - 2. Installation sequence for spacers, sub-framing and insulation: See <https://www.cascadiawindows.com/products/cascadia-clip#installation> for sequencing
 - a. Pre-punch holes or pre-drill holes in Z-girts and tracks to accommodate fasteners.

3.4 SITE QUALITY CONTROL

- A. Site Tests and Inspections:
 - 1. Structural Inspection: Ensure a licensed engineer specified herein inspects work of this Section during erection/installation and submits sealed and signed Field Review Report within 5 Days of site visit.
- B. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Architect at no cost to Owner.

END OF SECTION

SECTION 07 13 00 - SHOWER STALL WATERPROOFING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Shower stall waterproofing installed at floors of all showers.

1.3 DEFINITIONS

- A. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

1.4 REFERENCES

- A. ASTM International (ASTM)
 - 1. D4068, Standard Specification for Chlorinated Polyethylene (CPE) Sheeting for Concealed Water-Containment Membrane

1.5 RESPONSIBILITY OF COORDINATION

- A. Coordinate the work specified with the following work:
 - 1. Concrete work
 - 2. Plumbing work
 - 3. Gypsum wallboard work

1.6 SUBMITTALS

- A. Product Data: Submit literature and illustrations to indicate the performance and fabrication procedures.
- B. Samples: Submit 12 inch by 12 inch samples for final approval.

1.7 DELIVERY AND STORAGE

- A. Delivery: Deliver clearly labeled, undamaged materials in the manufacturer's unopened containers.
- B. Timing and Coordination: Deliver materials to allow for minimum storage time at the project site. Coordinate delivery with the scheduled time of installation.
- C. Storage: Store materials in a clean, dry location, protected from weather and abuse.

1.8 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 00 – Project Management and Coordination.

1.9 WARRANTY

- A. Warrant the work specified herein for the life of the original installation against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to, the following:
 - 1. Deterioration
 - 2. Leaking
 - 3. Releasing from substrate

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufactures listed whose products meet or exceed the specifications are approved for use on the project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
 - 1. Chloraloy 240 CPE Shower Pan Liner manufactured by The Noble Company; (800) 878-5788 or comparable product.

2.2 MATERIALS

- A. Shower Pan:
 - 1. Type: Chlorinated polyethylene (CPE) waterproofing/cleavage membrane for full mortar bed ceramic tile installations at shower pans and shower floor waterproofing and drain systems.
 - 2. Thickness: 0.040 inch nominal.
 - 3. Weight: Approximately 60 lbs. per roll.
 - 4. Coverage: 200 square feet per roll.
 - 5. Roll Sizes: 60 inches wide x 40 feet long and 48 inches wide x 50 feet long.
- B. Adhesive and Accessories: Type recommended by manufacturer to suit application.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Locations: Install membrane in accordance with manufacturer's instructions under shower stall floors and around perimeter of shower area, up walls and over curbs, where indicated.
- B. Coordinate work with Section 03 30 00, Cast-In-Place Concrete and Section 09 21 16, Gypsum Wallboard Systems.
- C. Adjacent work: Protect work by masking, covering, or other precautionary methods. Remove protection when no longer necessary.
- D. Lengths: Install membrane with minimum number of joints within the shower floor. If membrane is not available in a single width, join by lapping membrane minimum two (2) inches and seal joint throughout its length in accordance with manufacturer's instructions.
- E. Penetrations: Where drain penetrates membrane, make opening snug and seal in accordance with manufacturer's instructions.

END OF SECTION 07 13 00

SECTION 07 14 00 - COLD FLUID APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirement including but not limited to:
 - 1. Polyurethane waterproofing.
 - 2. Accessories necessary for a complete installation.

1.3 SUBMITTALS

- A. Product Data: Technical data for each type of waterproofing including construction details, material descriptions, and tested physical and performance properties of waterproofing.
 - 1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.
- B. Shop Drawings: Indicate locations and extent of waterproofing.
 - 1. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
- C. Qualification Data: Submit installer's qualification data.
- D. Field quality control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An entity having minimum 5 years documented experience and employs installers and supervisors who are trained and approved by waterproofing manufacturer.
- B. Source Limitations for Waterproofing System: Obtain waterproofing materials from single source from single manufacturer.
- C. Preinstallation Conference: Conduct conference at site.
 - 1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer.
 - 1. Do not apply waterproofing to a damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than 5 degrees F (3 degrees C) above dew point.
 - 2. Do not apply waterproofing in snow, rain, fog or mist, or when such weather conditions are imminent during application and curing period.
- B. Maintain adequate ventilation during application and curing of waterproofing materials.

1.6 WARRANTY

- A. Written warranty signed by manufacturer in which manufacturer agrees to repair or replace waterproofing that fails in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SINGLE COMPONENT POLYURETHANE WATERPROOFING

- A. Single Component, Modified Polyurethane Waterproofing: ASTM C 836/C 836M and coal tar free.
 - 1. Basis of Design: Hydralastic 836 as manufactured by W.R. Meadows, Inc.; (800) 542-7665. Other manufacturers are subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems; (800) 526-1072.
 - b. Carlisle Coatings & Waterproofing, Inc. (800) 527-7092.
 - c. CETCO, a Minerals Technologies company; (800) 527-9948.
 - d. ITW Polymers Sealants North America (formerly Pacific Polymers, Inc.).
 - e. Neogard; a division of Jones-Blair, Inc.
- B. Single Component, Reinforced, Modified Polyurethane Waterproofing: ASTM C 836/C 836M and coal tar free.
 - 1. Manufacturers: Basis of Design: Hydralastic 836 with HCR Reinforcing Fabric as manufactured by W.R. Meadows, Inc.; (800) 542-7665. Other manufacturers are subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems.
 - b. Carlisle Coatings & Waterproofing Inc.
 - c. Urethane Polymers International, Inc.

2.2 TWO COMPONENT POLYURETHANE WATERPROOFING

- A. Two Component, Modified Polyurethane Waterproofing: ASTM C 836/C 836M and coal tar free.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. ITW Polymers Sealants North America (formerly Pacific Polymers, Inc.).
 - b. Carlisle Coatings & Waterproofing Inc.
 - c. Gaco Western LLC.
 - d. Urethane Polymers International, Inc.

2.3 LATEX RUBBER WATERPROOFING

- A. Two Component, Unreinforced, Latex Rubber Waterproofing: ASTM C 836/C 836M; coal tar free.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. GCP Applied Technologies (formerly Grace Construction Products).
 - 2. Hydrostatic Head Resistance: 65 feet (20 m) minimum; ASTM D 5385.
- B. Two Component, Reinforced, Latex Rubber Waterproofing: ASTM C 836/C 836M; coal-tar free.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. GCP Applied Technologies (formerly Grace Construction Products).
 - 2. Hydrostatic Head Resistance: 197 feet (60 m) minimum; ASTM D 5385.

2.4 AUXILIARY MATERIALS

- A. Provide auxiliary materials recommended in writing by waterproofing manufacturer for intended use and compatible with one another and with waterproofing.
 - 1. Furnish liquid type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
- B. Primer: Primer, sealer, or surface conditioner; factory formulated acrylic latex, polyurethane, or epoxy recommended by manufacturer compatible with waterproofing membrane.
- C. Sheet Flashing: 50 mil (1.3 mm) minimum, nonstaining, uncured sheet neoprene.
 - 1. Adhesive: Contact adhesive.
- D. Membrane Reinforcing Fabric: Fiberglass mesh or polyester fabric, recommended weight for type of waterproofing.
- E. Joint Reinforcing Strip: Manufacturer's recommended fiberglass mesh or polyester fabric.
- F. Joint Sealant: Multicomponent polyurethane sealant, compatible with waterproofing; ASTM C 920, Type M, Class 25 or greater; Grade NS for sloping and vertical applications and Grade P for deck applications; Use NT exposure complying with requirements of Section 079200; and recommended by manufacturer for substrate and joint conditions.
 - 1. Backer Rod: Closed cell polyethylene foam.

2.5 PROTECTION COURSE

- A. Protection Course: ASTM D 6506, semirigid sheets of fiberglass or mineral reinforced asphaltic core, pressure laminated between two asphalt saturated fibrous liners and as follows:
 - 1. Basis of Design: PC-2 as manufactured by W.R. Meadows, Inc.; (800) 542-7665. Other manufacturers are subject to compliance with requirements, provide products by one of the following:
 - a. Soprema, Inc.
 - 2. Thickness: 1/8 inch (3 mm), nominal, for vertical applications; 1/4 inch (6 mm), nominal, elsewhere.
 - 3. Adhesive: Rubber based solvent type recommended in writing by waterproofing manufacturer.
- B. Protection Course: Fan folded, with a core of extruded-polystyrene board insulation faced on one side with plastic film, nominal thickness of 1/4 inch (6 mm), with compressive strength of not less than 8 psi (55 kPa) according to ASTM D 1621 and maximum water absorption by volume of 0.6 percent according to ASTM C 272.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Dow Chemical Company (The).
- C. Protection Course: Fan folded, with a core of extruded-polystyrene board insulation faced on both sides with plastic film, nominal thickness of 1/4 inch (6 mm), with compressive strength of not less than 8 psi (55 kPa) according to ASTM D 1621 and maximum water absorption by volume of 0.6 percent according to ASTM C 272.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kingspan Insulation.
 - b. Owens Corning.

- D. Protection Course: Extruded-polystyrene board insulation with continuous surface skins on both faces intact, unfaced; ASTM C 578, Type X, 1/2 inch (13 mm) thick.
- E. Protection Course: Molded-polystyrene board insulation, ASTM C 578, Type I, 0.90-lb/cu. ft. (15-kg/cu. m) minimum density, 1-inch (25-mm) minimum thickness.

2.6 MOLDED SHEET DRAINAGE PANELS

- A. Nonwoven Geotextile Faced, Molded Sheet Drainage Panel: Composite subsurface drainage panel consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21 mm) sieve laminated to one side of the core and a polymeric film bonded to the other side; and with a vertical flow rate of 9 gpm to 18 gpm per ft. (112 to 220 L/min. per m).
 - 1. Basis of Design: Meldrain 5035b-vertical/ 9055b-horizontal as manufactured by W.R. Meadows, Inc.; (800) 542-7665. Other manufacturers are subject to compliance with requirements, provide products by one of the following:
 - a. American Hydrotech, Inc.
 - b. BASF Corporation; Construction Systems.
 - c. Carlisle Coatings & Waterproofing Inc.
 - d. CETCO, a Minerals Technologies company.
 - e. GCP Applied Technologies (formerly Grace Construction Products).
 - f. Insulation Solutions, Inc.
 - g. Polyguard Products, Inc.
 - h. Urethane Polymers International, Inc.
- B. Nonwoven Geotextile Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panel consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21 mm) sieve laminated to one side of the core, without a polymeric film bonded to the other side; and with a vertical flow rate of 9 gpm to 18 gpm per ft. (112 to 220 L/min. per m).
 - 1. Basis of Design: Meldrain 5035b-vertical/ 9055b-horizontal as manufactured by W.R. Meadows, Inc.; (800) 542-7665. Other manufacturers are subject to compliance with requirements, provide products by one of the following:
 - a. American Hydrotech, Inc.
 - b. BASF Corporation; Construction Systems.
 - c. Carlisle Coatings & Waterproofing Inc.
 - d. CETCO, a Minerals Technologies company.
 - e. GCP Applied Technologies (formerly Grace Construction Products).
 - f. Insulation Solutions, Inc.
 - g. Polyguard Products, Inc.
 - h. Soprema, Inc.
 - i. Urethane Polymers International, Inc.
 - j. W. R. Meadows, Inc.
 - k. CETCO, a Minerals Technologies company.

2.7 INSULATION

- A. Board Insulation: Extruded polystyrene board insulation according to ASTM C 578, shiplap edged.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Kingspan Insulation.
 - d. Owens Corning.
 - e. T. Clear Corporation, a subsidiary of Fin Pan Inc.

2. Type IV, 25-psi (173-kPa) minimum compressive strength.
3. Type VI, 40-psi (276-kPa) minimum compressive strength.

2.8 INSULATION DRAINAGE PANELS

- A. Unfaced, Wall Insulation Drainage Panels: Extruded polystyrene board insulation according to ASTM C 578, Type IV, 25-psi (173-kPa) minimum compressive strength; unfaced; fabricated with shiplap or channel edges and with one side having grooved drainage channels.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
- B. Unfaced, Wall Insulation Drainage Panels: Extruded polystyrene board insulation according to ASTM C 578, Type VI, 40-psi (276-kPa) minimum compressive strength; unfaced; fabricated with shiplap or channel edges and with one side having grooved drainage channels.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Owens Corning.
- C. Geotextile Faced, Wall Insulation Drainage Panels: Extruded polystyrene board insulation according to ASTM C 578, Type IV, 25-psi (173-kPa) minimum compressive strength; fabricated with tongue and groove edges and with one side having grooved drainage channels faced with a nonwoven geotextile filter fabric.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Owens Corning.
 - b. T. Clear Corporation, a subsidiary of Fin Pan Inc.

PART 3 - GENERAL

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements and other conditions affecting performance of the work.
 1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
 2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
- B. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

- C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.
- D. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, acid residues, and other penetrating contaminants or film-forming coatings from concrete.
 - 1. Abrasive blast clean concrete surfaces uniformly to expose top surface of fine aggregate according to ASTM D 4259 with a self-contained, recirculating, blast cleaning apparatus. Remove material to provide a sound surface free of laitance, glaze, efflorescence, curing compounds, concrete hardeners, or form release agents. Remove remaining loose material and clean surfaces according to ASTM D 4258.
- E. Remove fins, ridges, and other projections, and fill honeycomb, aggregate pockets, holes, and other voids.

3.3 PREPARATION AT TERMINATIONS, PENETRATIONS, AND CORNERS

- A. Prepare surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, sleeves, and corners according to waterproofing manufacturer's written instructions and to recommendations in ASTM C 1471.
- B. Apply waterproofing in two separate applications, and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.

3.4 JOINT AND CRACK TREATMENT

- A. Prepare, treat, rout, and fill joints and cracks in substrate according to waterproofing manufacturer's written instructions and to recommendations in ASTM C 1471. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258.
 - 1. Comply with ASTM C 1193 for joint sealant installation.
 - 2. Apply bond breaker on sealant surface, beneath preparation strip.
 - 3. Prime substrate along each side of joint and apply a single thickness of preparation strip at least 6 inches (150 mm) wide along each side of joint. Apply waterproofing in two separate applications and embed a joint reinforcing strip in the first preparation coat.

3.5 WATERPROOFING APPLICATION

- A. Apply waterproofing according to manufacturer's written instructions and to recommendations in ASTM C 898/C 898M and ASTM C 1471.
- B. Start installing waterproofing in presence of manufacturer's technical representative.
- C. Apply primer over prepared substrate unless otherwise instructed in writing by waterproofing manufacturer.
- D. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.
 - 1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases and pinholes, with a dry film thickness of 90 mils (2.25 mm).
 - 2. Apply waterproofing to prepared wall terminations and vertical surfaces.
 - 3. Verify manufacturer's recommended wet film thickness of waterproofing every 100 sq. ft. (9.3 sq. m).
- E. Reinforced Waterproofing Applications: Mix materials and apply waterproofing by roller, notched squeegee, trowel, or other suitable application method.

1. Apply first coat of waterproofing, embed membrane-reinforcing fabric, and apply second coat of waterproofing to completely saturate reinforcing fabric and to obtain a seamless reinforced membrane free of entrapped gases and pinholes, with an average dry film total thickness required by manufacturer to achieve specified warranty.
 2. Apply reinforced waterproofing to prepared wall terminations and vertical surfaces.
 3. Verify manufacturer's recommended wet film thickness of waterproofing every 100 sq. ft. (9.3 sq. m).
- F. Cure waterproofing, taking care to prevent contamination and damage during application and curing.
- G. Install protection course with butted joints over waterproofing before starting subsequent construction operations.
1. For horizontal applications, install protection course loose laid over fully cured membrane.
 2. For vertical applications, set protection course in nominally cured membrane, which will act as an adhesive. If membrane cures before application of protection course, use adhesive.

3.6 MOLDED SHEET DRAINAGE PANEL INSTALLATION

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesive or another method that does not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded sheet drainage panels during subsequent construction.
1. For vertical applications, install board insulation or protection course before installing drainage panels.

3.7 INSULATION INSTALLATION

- A. Install one or more layers of board insulation to achieve required thickness over waterproofed surfaces. Cut and fit to within 3/4 inch (19 mm) of projections and penetrations.
- B. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions.
- C. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.8 INSULATION DRAINAGE PANEL INSTALLATION

- A. Install drainage panels over waterproofed surfaces. Cut and fit to within 3/4 inch (19 mm) of projections and penetrations.
- B. Ensure that drainage channels are aligned and free of obstructions.
- C. On vertical surfaces, set insulation drainage panels in adhesive or tape applied according to manufacturer's written instructions.
- D. On horizontal surfaces, loosely lay insulation drainage panels according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections:
1. Testing agency shall verify thickness of waterproofing during application for each 600 sq. ft. (56 sq. m) of installed waterproofing or part thereof.

2. Flood Testing: Flood test each deck area for leaks, according to recommendations in ASTM D 5957, after completing waterproofing but before overlaying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.
 - a. Flood to an average depth of 2-1/2 inches (64 mm) with a minimum depth of 1 inch (25 mm) and not exceeding a depth of 4 inches (100 mm). Maintain 2 inches (50 mm) of clearance from top of sheet flashings.
 - b. Flood each area for 24 hours.
 - c. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing installation is watertight.
- B. Manufacturer's Field Service: Engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components and to furnish daily reports to Architect.
- C. If test results or inspections show waterproofing does not comply with requirements, remove and replace or repair the waterproofing as recommended in writing by manufacturer, and make further repairs after retesting and inspecting until waterproofing installation passes.
- D. Prepare test and inspection reports.

3.10 PROTECTION

- A. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect waterproofing from damage and wear during remainder of construction period.
- C. Protect installed board insulation or drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.
- E. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 07 14 00

SECTION 07 16 00 - BELOW GRADE WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Preparation of concrete surfaces to receive waterproofing membrane.
- B. Sealing of cracks and joints.
- C. Fluid applied waterproofing system, with prefabricated drainage composite or protection board at elevator pit walls and at Auditorium walls that fall below grade.
- D. Pre-applied waterproofing system, with joint sealing tape, and other accessories at below grade horizontal surfaces under the slab or elevator pit.

1.3 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Certifications:
 - 1. Manufacturer's certification that applicator is approved by manufacturer.
 - 2. Manufacturer's affidavit that materials used in Project contain no asbestos.
- C. Warranty: Submit a sample warranty identifying the terms and conditions stated in warranty.

1.4 QUALITY ASSURANCE

- A. Applicator Qualifications: Applicator shall be experienced in applying the same or similar materials and shall be specifically approved in writing by the membrane system manufacturer.
- B. Regulatory Requirements: Comply with applicable codes, regulations, ordinances, and laws regarding use and application of products that contain volatile organic compounds (VOC).

1.5 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 00 – Project Management and Coordination.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials job site in original, factory-sealed, unopened containers bearing manufacturer's name and label intact and legible with following information.
 - 1. Name of material.
 - 2. Manufacturer's stock number and date of manufacture.
 - 3. Material safety data sheet (MSDS).

- B. Store and handle in strict compliance with manufacturer's instructions, recommendations and material safety data sheet (MSDS).
- C. Protect from damage from sunlight, weather, excessive temperatures and construction operations.
- D. Remove damaged material from the site and dispose of in accordance with applicable regulations.
- E. Do not double-stack pallets of waterproofing on the job site. Provide cover on top and all sides.
- F. Store drainage composite and protection board flat and off the ground. Provide cover on top and all sides.
- G. Protect waterproofing materials from freezing. In cool temperatures, store the material for several hours at room temperature to facilitate mixing and application.
- H. Sequence deliveries of materials to avoid delays, but minimize on-site storage.

1.7 PROJECT CONDITIONS

- A. Perform Work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials and products used.
- B. Proceed with installation only when substrate construction and preparation work is complete and in condition to receive membrane waterproofing.
- C. Coordinate waterproofing Work with other trades to ensure adequate illumination, ventilation, and dust-free environment during application and curing of membrane. The applicator shall have sole right of access to the specified areas for the time needed to complete the application and allow the membrane to cure adequately.
- D. Protect adjoining surfaces not to be coated against damage or soiling. Protect plants, vegetation and animals which might be affected by waterproofing operations.
- E. Warn personnel against breathing of vapors and contact of material with skin or eyes. Wear applicable protective clothing and respiratory protection gear.
- F. Keep products away from spark or flame. Do not allow the use of spark producing equipment during application and until all vapors have dissipated. Post "NO SMOKING" signs.
- G. Maintain work area in a neat and orderly condition, removing empty containers, rags, and rubbish daily from the site.

1.8 WARRANTY

- A. Warrant the Work specified herein for two (2) years against becoming unserviceable or causing an objectionable appearance resulting from both defective or non-conforming materials and workmanship.

PART 2 - PRODUCTS

2.1 FLUID APPLIED WATERPROOFING SYSTEM

- A. Basis of Design: Hydralastic 836/ 98% Mel-Rol LM/70% as manufactured by W.R. Meadows. Other manufacturers must have a minimum of five (5) years' experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
 - 1. Carlisle Coatings and Waterproofing Incorporated, Sapulpa, OK (Barricoat).
 - 2. Grace Construction Products, W. R. Grace & Co.-Conn., Austin, TX.
- B. Waterproofing Membrane: Two (2) part, self-curing, synthetic rubber based material meeting or exceeding the performance requirements of ASTM C836 and other ASTM standards as indicated in the following table and conforming to W.R. Grace & Co. "Procor" waterproofing membrane.

Waterproofing Membrane Physical Properties, minimum:

Property	Test Method	Typical Value
Cured Film Thickness	ASTM D3767 Method A	1.5 mm (0.60 in.) nom
Solids Content	ASTM D1644	100 percent
Flexibility, 180 degree	ASTM D1970	Unaffected
Bend over 25 mm (1 in.)		
Mandrel at 32 degrees C (-25 degrees F)		
Elongation	ASTM D412	500 percent minimum
Peel Adhesion to Concrete	ASTM D903 Modified*	880 N/m (5 lbs./in.)

- C. Accessory Products:
 - 1. Prefabricated Drainage Composite: Shall be designed to promote positive drainage while serving as a protection course. Basis of Design: W.R. Meadows' Meldrain 5035b for use on all vertical surfaces and W.R. Meadows' Meldrain 9055b for use on all horizontal surfaces. Other manufacturers must have a minimum of five (5) years' experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
 - a. Hydroduct® 660 Drainage Composite for use on all horizontal surfaces.
 - b. Hydroduct® 220 Drainage Composite for use on all vertical surfaces.
 - 2. Protection Board (Use only where prefabricated drainage composite is not used):
 - a. Asphalt Hardboard: A pre-molded semi-rigid protection board consisting of bitumen, mineral core and reinforcement. Provide 3 mm (0.125 inch) thick hardboard on horizontal surfaces not receiving steel reinforced slab. Where steel reinforcing bars are to be used, apply two (2) layers of 3 mm (0.125 inch) thick hardboard or one (1) layer of 6 mm (0.25 inch) thick hardboard.
 - b. Expanded Polystyrene: 25 mm (1 inch) thick for vertical applications with the following characteristics:
 - 1. Normal Density: 1.0 pcf³
 - 2. Thermal Conductivity, K factor: 0.24 at 40 degrees F, 0.26 at 24.
 - 3. 75 degrees F.
 - 4. Thermal Resistance, R-Value: 4 per 1 inch of thickness.
- D. Locations: Vertical below-grade retaining walls and walls that fall below grade 0'-0" and where shown on drawings.

2.2 PRE-APPLIED WATERPROOFING SYSTEM

- A. Basis of Design: Precon as manufactured by W.R. Meadows. Other manufacturers must have a minimum of five (5) years' experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
 - 1. Carlisle Coatings and Waterproofing Incorporated, Sapulpa, OK.
 - 2. Grace Construction Products, W. R. Grace & Co.-Conn., Austin, TX.
- B. Waterproofing Membrane: Composite sheet comprising a thick HDPE film, an aggressive pressure sensitive adhesive and a weather resistant protective coating. Membrane provides a continuous seal that resists water ingress and migration between the membrane and the structure. The waterproofing system shall conform to the following products as manufactured by W.R. Grace & Co.:
 - 1. Membrane: Robust membrane for horizontal use below concrete slabs complying with Preprufe 200.
 - 2. Tape: Self-adhesive 8 inch wide strip applied to the surface of the membrane along the line of all concrete joints (application temperature range minus 25 degrees F to 86 degrees F. Product shall conform to Preprufe CJ Tape LT; or in hot climates (minimum 50 degrees F), use Preprufe CJ Tape HC.
 - 3. Sealing Membrane: For sealing around penetrations shall conform with Bituthene.
- C. Locations: Below grade horizontal surfaces under the slab, and where shown on drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before waterproofing work is started the all surfaces to be waterproofed shall be thoroughly examined for all deficiencies. Should deficiencies exist, the Architect shall be notified in writing and corrections made.

3.2 SURFACE PREPARATION

- A. Surfaces to which waterproofing is to be applied shall be thoroughly clean, dry and free from all surface contaminants or cleaning residue that may harmfully affect the adhesion of the membrane.
- B. Repair all cracks in accordance with manufacturer's instructions.

3.3 APPLICATION

- A. Priming: Shall be in accordance with membrane manufacturer's instructions.
- B. Apply waterproofing in accordance with membrane manufacturer's instructions.
- C. Liquid membrane waterproofing on vertical walls shall positively overlap turned up sheet membrane waterproofing from under slab as instructed by the manufacturer.
- D. Where shown or required, install specified perimeter drainage system as the first course of drainage composite immediately after membrane has cured on vertical surfaces. Install manufacturer's recommended drainage composite or protection board/protection course on remainder.

END OF SECTION 07 16 00

SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 1. Extruded polystyrene foam board
 2. Thermal insulation.
 3. Accessories necessary for a complete installation.

1.3 DEFINITIONS

- A. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

1.4 RELATED SECTIONS

- A. Section 04 20 00 - Unit Masonry.
- B. Section 07 81 00 - Applied Fireproofing.
- C. Section 07 84 00 – Firestopping.
- D. Section 07 84 13 – Penetration Firestopping.
- E. Section 09 21 16 - Gypsum Board Assemblies.
- F. Section 09 51 00 - Acoustical Ceiling Panels.
- G. Division 23 – Mechanical: Duct Insulation.

1.5 SUBMITTALS

- A. Product Data: Technical data and installation instructions for each type of insulation product specified.
- B. Samples: Six (6) inch x six (6) inch piece of rigid insulation for Architect's approval.
- C. Certifications:
 1. Manufacturer's certification of compatibility of rigid insulation with dampproofing mastic.
 2. Manufacturers affidavit that materials used in Project contain no asbestos.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:

1. Fire Performance Characteristics: Identify products with appropriate markings of applicable testing and inspecting organization.
 - a. Surface Burning Characteristic: ASTM E 84.
 - 1) Flame Spread Index: Maximum 25.
 - 2) Smoke Developed Index: Maximum 450.
 - b. Fire Resistance Ratings: ASTM E 119.
 - c. Combustion Characteristics: ASTM E 136.
 2. National Fire Prevention Association (NFPA) 255 Test of Surface Burning Characteristics of Building Materials.
 3. Underwriter's Laboratories (UL) 723 Tests for Surface Burning Characteristics of Building Materials.
- B. Cellulose Insulation Manufacturer: Manufacturer having minimum 5 years documented experience and ISO 9002 Certified.
1. Manufacturer shall provide independent laboratory follow up inspection services of Underwriters Laboratory and Factory Mutual. Label each bag accordingly.
- C. Cellulose Insulation Applicator: Applicator having minimum 5 years documented experience and licensed by manufacturer.
- D. Single Source Responsibility for Insulation Products: Obtain each type of building insulation from single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of Work.
- E. Environmental Requirements: Manufacture extruded polystyrene with HCFC or other CFC free blowing agents. Mark insulation boards and packages with manufacturer's name and product designation. Unmarked boards and packages will be rejected.
1. Wherever possible, provide boards from manufacturers who recycle insulation materials.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam plastic board insulation:
1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

1.8 PROJECT CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.
- B. Sequence Work to ensure fireproofing and firestop materials are in place before beginning Work.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS/PRODUCTS

- A. Specifications are based on any of the manufacturers listed below, with their product in parenthesis for the particular insulation application. Other manufacturers not listed must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 1 regarding substitutions to be considered.

2.2 EXTRUDED POLYSTYRENE FOAM BOARD

- A. Extruded, Polystyrene Foam Board: ASTM C578, Type IV.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Chemical Company (The).
 - b. Comparable product.

2.3 THERMAL INSULATION

- A. Thermal Insulation, Unfaced: ASTM C 665, Type I. with maximum flame spread and smoke developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Guardian Building Products, Inc.
 - c. Johns Manville; a Berkshire Hathaway company.
 - d. Knauf Insulation.
 - e. Owens Corning.
 2. Thickness/R- Values (minimum):
 - a. 3-1/2 inches/ R-11 where shown on the Drawings.
 - b. 6 inches/ R-19 where shown on the Drawings.

2.4 INSULATION FASTENERS

- A. Adhesively Attached, Spindle Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
1. Plate: Perforated, galvanized carbon steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
 2. Spindle: Coppercoated, low carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.
- B. Adhesively Attached, Angle Shaped, Spindle Type Anchors: Angle welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
1. Angle: Formed from 0.030 inch (0.762 mm) thick, perforated, galvanized carbon steel sheet with each leg 2 inches (50 mm) square.
 2. Spindle: Copper coated, low carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.
- C. Insulation Retaining Washers: Self-locking washers formed from 0.016 inch (0.41 mm) thick galvanized steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.

1. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
 - a. Crawl spaces.
 - b. Ceiling plenums.
 - c. Attic spaces.
- D. Insulation Standoff: Spacer fabricated from galvanized mild steel sheet for fitting over spindle of insulation anchor to maintain air space of 2 inches (50 mm) between face of insulation and substrate to which anchor is attached.
- E. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

2.5 ACCESSORIES

- A. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.
- B. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide ventilation between insulated attic spaces and vented eaves.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.
- B. Foam in Place Insulation: Verify that substrates are clean, dry, and free of substances that are harmful to insulation.
 1. Priming: Prime substrates where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

3.2 INSTALLATION

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Board Insulation: Install insulation that is undamaged, dry, and unsoiled and has not been exposed to ice, rain, or snow at any time.
 1. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
 2. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.
- C. Batt Insulation (Thermal and Sound): Walls: Insulation shall be friction fit between studs and provide full coverage where indicated on Drawings. Insulation shall be tight within spaces in partitions, around cut openings, behind and around electrical and mechanical items within or behind partitions and tight to items passing through partitions. Wall areas above ceiling: At side wall insulation in ceiling cavity, install adhesive-mounted impaling devices with metal caps at 2 feet-0 inches vertically and at four (4) inches from each side of blankets horizontally. Install

blankets with four (4) foot dimension running vertically on spikes, keeping blankets tight to exterior wall without crushing into each other.

- D. Cavity Wall Insulation: Foam Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.
1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 04 20 00 - "Unit Masonry."
 2. Cellular Glass Board Insulation: Install with closely fitting joints using attachment method according to manufacturer's written instructions.
- E. Framed Construction: Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
 5. For metal framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
 6. For wood framed construction, install blankets according to ASTM C 1320 and as follows:
 - a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.
- F. Curtain Wall: Install board insulation in curtain wall construction according to curtain wall manufacturer's written instructions.
1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of dimension indicated on Drawings between insulation and glass.
 2. Install insulation to fit snugly without bowing.

3.3 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00

SECTION 07 27 26 - FLUID APPLIED AIR BARRIER SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Fluid-applied air barrier membrane in exterior wall assemblies.
- B. Materials to bridge and seal the following air leakage pathways and gaps:
 - 1. Connections of the walls to the roof air barrier.
 - 2. Connections of the walls to the foundation air barrier.
 - 3. Seismic and expansion joints.
 - 4. Openings and penetrations of window frames, storefront, curtain wall and mechanical, electrical and plumbing systems.
 - 5. Barrier precast concrete and other envelope systems.
 - 6. Door frames.
 - 7. Piping, conduit, duct and similar penetrations.
 - 8. Masonry ties, screws, bolts and similar penetrations.
 - 9. All other air leakage pathways in the building envelope.
- C. Related Work in other Sections includes but is not limited to the following:
 - 1. Section 01 45 00 – Quality Control
 - 2. Section 01 50 00 – Temporary Facilities and Controls
 - 3. Section 03 30 00 – Cast-In-Place Concrete
 - 4. Section 04 20 00 – Unit Masonry
 - 5. Section 07 41 13 – Prefinished Metal Roofing
 - 6. Section 07 52 19 – Modified Bitumen “Cool Roof” Membrane Roofing System
 - 7. Section 07 65 00 – Flexible Flashing
 - 8. Section 07 90 00 – Joint Sealants
 - 9. Section 09 21 16 – Gypsum Wallboard Systems (Exterior Sheathing)

1.3 PERFORMANCE REQUIREMENTS

- A. Material Performance: Provide air barrier materials which have an air permeance not to exceed 0.004 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.004 cfm / ft² @ 1.57 psf), when tested in accordance with ASTM E2178 (unmodified).
- B. Provide materials with a water vapor permeance of 10.0 US perms or greater, determined in accordance with ASTM E96 Water method (Procedure B).
- C. Assembly Performance: Provide a continuous air barrier in the form of an assembly that has an air leakage not to exceed 0.04 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.04 cfm/ft² @ 1.57 psf) when tested in accordance with ASTM E2357. The assembly shall accommodate movements of building materials by providing expansion and control joints as required. Expansion / control joints, changes in substrate and perimeter conditions shall have appropriate accessory materials at such locations.

1. The air barrier assembly shall be capable of withstanding combined design wind, fan and stack pressures, both positive and negative on the envelope without damage or displacement, and shall transfer the load to the structure.
 2. Fluid applied air barriers shall not displace adjacent materials in the air barrier assembly under full load.
 3. The air barrier assembly shall be joined in an airtight and flexible manner to the air barrier materials of adjacent assemblies, allowing for the relative movement of assemblies due to thermal and moisture variations, creep, and anticipated seismic movement.
- D. Connections to Adjacent Materials: Provide connections to prevent air leakage at the following locations:
1. Foundation and walls, including penetrations, ties and anchors.
 2. Walls, windows, curtain walls, storefronts, louvers or doors.
 3. Different wall assemblies, and fixed openings within those assemblies.
 4. Wall and roof connections.
 5. Floors over unconditioned space.
 6. Walls, floor and roof across construction, control and expansion joints.
 7. Walls, floors and roof to utility, pipe and duct penetrations.
 8. Seismic and expansion joints.
 9. All other potential air leakage pathways in the building envelope.

1.4 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13 – Project Coordination

1.5 SUBMITTALS

- A. Submittals: Submit in accordance with Division 1 requirements.
- B. Installer Qualifications: Submit evidence of current Contractor accreditation and Installer certification under the Air Barrier Association of America's (ABAA). Submit accreditation number of the Contractor and certification number(s) of the ABAA Certified Installer(s).
- C. Product Data: Submit material Manufacturer's Product Data, material Manufacturer's instructions for evaluating, preparing, and treating substrate, temperature and other limitations of installation conditions, Technical Data, and tested physical and performance properties.
1. Submit letter from primary air barrier material Manufacturer indicating approval of materials that are proposed to be used that are not currently listed in the accessories section of this specification for that Manufacturer's material.
 2. Include statement from the primary air barrier material Manufacturer that the materials used in their air barrier assembly which will be used to adhere to the underlying substrate are chemically compatible to the substrate material.
- D. Samples: Submit clearly labeled samples, three (3) inch by four (4) inch minimum size of each material specified.
- E. Field Test Results of Mock-Up: Submit test results of air leakage test and water leakage test of mock-up in accordance with specified standards, including retesting if initial results are not satisfactory.
- F. Compatibility: Submit letter from primary material Manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use.

1.6 QUALITY ASSURANCE

- A. Air Barrier Installer Qualifications: Air barrier Subcontractor(s) shall be accredited at the time of bidding and during the complete installation period by the Air Barrier Association of America (ABAA).
 - 1. Fluid-applied membrane air barrier Installer(s) shall be certified in accordance with the requirements outlined by ABAA. Installers shall have their photo identification air barrier certification cards in their possession and available on the project site, for inspection upon request.
- B. Manufacturer: Obtain primary ABAA Evaluated Materials from a single ABAA Evaluated Manufacturer regularly engaged in manufacturing specified fluid-applied membranes. Obtain secondary materials from a source acceptable to the primary materials Manufacturer.
- C. Accredited Laboratory Testing for Materials: Laboratory accredited by International Accreditation Service Inc. (IAS), American Association for Laboratory Accreditation (A2LA), or the Standards Council of Canada (SCC).
- D. VOC Regulations: Provide products which comply with applicable regulations controlling the use of volatile organic compounds.
- E. Preconstruction Meeting: Convene a minimum of two weeks prior to commencing Work of this Section. Agenda shall include, at a minimum, construction of mock-up, sequence of construction, coordination with substrate preparation, air barrier materials approved for use, compatibility of materials, coordination with installation of adjacent and covering materials, and details of construction and chemical/fire safety plans. Attendance is required by the Fluid Applied Air Barrier System Manufacturer's field representative, representatives of related trades including covering materials, substrate materials and adjacent materials.
- F. Mock-Ups: Build mock-up representative of primary air barrier assemblies and glazing assemblies including backup wall and typical penetrations as acceptable to the Architect. Mock-up shall be dimensioned no less than eight (8) feet long by eight (8) feet high and include the air barrier materials and air barrier accessories proposed for use in the exterior wall assembly. The mock-ups shall remain visible and intact for the duration of the fluid applied air barrier system work scopes. Mock-ups shall be suitable for field testing.
- G. Mock-Up Tests for Air and Water Infiltration: The General Contractor shall provide testing of the window and door opening(s) in the mock-up for air and water infiltration. The testing shall be in accordance with AAMA 501.2 (hand wand field testing), ASTM E1186 (air leakage location), ASTM E783 (air leakage quantification) at a pressure differential of 1.57 lb/ft² (75 Pa) and ASTM E1105 (water penetration). Use smoke tracer to locate sources of air leakage. If deficiencies are found, the air barrier Contractor shall reconstruct mock-up at their cost for retesting until satisfactory results are obtained. Deficiencies include air leakage beyond values specified, uncontrolled water leakage, unsatisfactory workmanship.
- H. Air Barrier Assembly Testing: Verify air barrier assembly testing by the material Manufacturer by visiting the ABAA website to ensure an ASTM E2357 test has been completed and to obtain results. Visit the ABAA website for the reported air barrier assembly leakage rate and illustrations or CAD details which includes the methods in which the assembly test mock-ups shall be assembled.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original packages with seals unbroken, labeled with material Manufacturer's name, product, date of manufacture, and directions for storage.
- B. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by material Manufacturer. Protect stored materials from direct sunlight and other sources of ultra-violet light.
- C. Handle materials in accordance with Manufacturer's recommendations.

1.8 PROJECT CONDITIONS

- A. Temperature: Install fluid-applied air barrier material within range of ambient and substrate temperatures recommended by material Manufacturer. Do not apply air barrier to a damp or wet substrate.
- B. Field Conditions: Do not install air barrier in snow, rain, fog, or mist. Do not install air barrier when the temperature of substrate surfaces and surrounding air temperatures are below those recommended by the Manufacturer.
- C. Sequencing: Do not install air barrier material before the roof assembly has been sufficiently installed to prevent a buildup of water in the interior of the building.
- D. Compatibility: Do not allow air barrier materials to come in contact with chemically incompatible materials.
- E. Ultra-violet exposure: Do not expose air barrier materials to sunlight longer than as recommended by the material Manufacturer.

1.9 WARRANTY

- A. Material Warranty: Provide Manufacturer's standard product warranty, for a minimum 20 years from date of Substantial Completion.
- B. Subcontractor (approved by ABAA and Manufacturer) Installation Warranty: Provide a five (5) year installation warranty from date of Substantial Completion, including all accessories and materials of the air barrier assembly, against failures including loss of air tight seal, loss of watertight seal, loss of attachment, loss of adhesion and failure to cure properly.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Fluid Applied Membrane Air Barrier: Use regular, high temperature or low-temperature formulation depending on site conditions, within temperature ranges specified by Manufacturer. Subject to compliance with requirements, provide one of the following:
 - 1. BASF Corporation: MasterSeal AWB 660, Enershield HP, Finestop RA, Senershield R, Acrostop R and Sonowall FT R. Thickness for products are as specified by Manufacturer.
www.wallsystems.basf.com:
 - a. AIR BARRIER MATERIAL PROPERTIES:
 - 1) Air permeance for this material has been tested and reported as being 0.0000 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0000 cfm/ft² @ 1.57 psf), at 10 mils (wet) when tested in accordance with ASTM E2178 (unmodified).

- 2) Water vapor permeance for this material has been tested and reported as being 1004 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential ($1004 \text{ ng}/(\text{Pa}\cdot\text{s}\cdot\text{m}^2)$ / 17.6 US perms) at 10 mils (wet) when tested in accordance with ASTM E96 (water method – unmodified).
- b. AIR BARRIER ACCESSORY MATERIALS:
 - 1) Fabric Reinforcement: Sheathing fabric to be saturated with BASF Fluid-Applied Membrane for use at sheathing joints, penetrations and window rough openings.
 - 2) Flashing and Transition Membrane: WS Wrap polyester-faced 30-mil self-adhesive membrane or WS Membrane 20-mil self-adhesive membrane.
 - 3) Water-based Primer for Self-Adhesive Membranes: WS Flashing Primer.
 - 4) Mastics: As recommended by Manufacturer.
2. Carlisle Coatings and Waterproofing: Fire-Resist Barritech VP at 60 mils thick (wet). www.carlisle-ccw.com:
 - a. AIR BARRIER MATERIAL PROPERTIES:
 - 1) Air permeance for this material has been tested and reported as being 0.0002 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot ($0.0002 \text{ cfm}/\text{ft}^2 @ 1.57 \text{ psf}$), at 65 mils (wet), when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 817 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential ($817 \text{ ng}/(\text{Pa}\cdot\text{s}\cdot\text{m}^2)$ / 14.295 US perms) at 60 mils (wet) [40 mils (dry)] when tested in accordance with ASTM E96 (water method – unmodified).
 - b. AIR BARRIER ACCESSORY MATERIALS:
 - 1) Detail Flashing: Fire-Resist 705 FR.
 - 2) Counter-flashing for Metal Wall Flashings: Fire-Resist 705 FR.
 - 3) Water-Based Primer for Detail Flashing: CCW-702 WB.
 - 4) Solvent-Based Primer for Detail Flashing: CCW-702 or CCW-702 LV.
 - 5) Solvent-Based Aerosol Primer for Detail Flashing: CAV-GRIP.
 - 6) Reinforcing Fabric: DCH Reinforcing Fabric.
 - 7) Glass Mat: LiquiFiber-W.
 - 8) Termination Mastic: SURE-SEAL Lap Sealant.
 - 9) Fill Compound: CCW-201 or CCW-703 V.
3. Dow Corning: DefendAir 200 at 15 mils thick (dry). www.buildabetterbarrier.com:
 - a. AIR BARRIER MATERIAL PROPERTIES:
 - 1) Air permeance for this material has been tested and reported as being 0.0010 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot ($0.0010 \text{ cfm}/\text{ft}^2 @ 1.57 \text{ psf}$), [0.0049 liters per square meter per second under a pressure differential of 75 Pa ($0.0049 \text{ L}/(\text{s}\cdot\text{m}^2) @ 75 \text{ Pa}$)] at 15 mils (dry), when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 1387.7 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential ($1387.7 \text{ ng}/(\text{Pa}\cdot\text{s}\cdot\text{m}^2)$ [24.26 US perms] at 15 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).

- b. AIR BARRIER ACCESSORY MATERIALS:
 - 1) Solvent-Based Primer: Dow Corning® DefendAir Primer
 - 2) Sealants: Dow Corning® 791 Silicone Weatherseal Sealant, Dow Corning® 756 SMS Silicone Sealant, Dow Corning® 795 Silicone Building Sealant, Dow Corning® 758 Silicone Weather Barrier Sealant
 - 3) Transition Membrane for details and terminations: Dow Corning® 778, Dow Corning® Silicone Transition Strip
 - 4) Flashing at Transition Membrane: Dow Corning® Silicone Transition Strip
 - 5) Counterflashing for Through-Wall Flashings: Dow Corning® Silicone Transition Strip
 - 6) Through-Wall Flashings or Shelf Angle Flashings: Dow Corning® 778 below the flexible through wall flashing system.
 - 7) Substrate Joint Treatment: Dow Corning® 791 Silicone Weatherseal Sealant
- 4. Dryvit Systems, Inc: Backstop NT at 12 mils thick (dry). www.dryvit.com:
 - a. AIR BARRIER MATERIAL PROPERTIES:
 - 1) Air permeance for this material has been tested and reported as being 0.000118 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.000118 cfm/ft² @ 1.57 psf), [0.0006 liters per square meter per second under a pressure differential of 75 Pa (0.0006 L/(s·m²) @ 75 Pa)] at 12 mils (dry), when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 1810 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1810 ng/(Pa·s·m²) [31.65 US perms] at 20 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
 - b. AIR BARRIER ACCESSORY MATERIALS:
 - 1) Transition Membrane for details and terminations: Dryvit AquaFlash and AquaFlash Mesh
 - 2) Reinforcing / Joint Tape: Dryvit Grid Tape
 - 3) Flashing at Transition Membrane: Dryvit AquaFlash
 - 4) Substrate Joint Treatment: Dryvit Grid Tape with Backstop NT
- 5. DuPont Building Innovations: Tyvek Fluid Applied WB at 25 mils thick (wet), 25 mils thick (dry). www.Weatherization.Tyvek.com:
 - a. AIR BARRIER MATERIAL PROPERTIES:
 - 1) Air permeance for this material has been tested and reported as being 0.0002 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0002 cfm/ft² @ 1.57 psf), at 25 mils (dry), when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 1384 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1384 ng/(Pa·s·m²) / 24.23 US perms) at 25 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
 - b. AIR BARRIER ACCESSORY MATERIALS:

- 1) Solvent Based Primer for Flashing, Transition Strip and Detail Membranes: 3M High Strength 90; Denso Butyl (used with self-adhered membranes only).
 - 2) Through-Wall Flashings or Shelf Angle Flashings: DuPont recommended through-wall flashing.
 - 3) Sealants, Mastics, Adhesives and Tapes: DuPont Sealant for Tyvek Fluid Applied System; DuPont Tyvek Flashing and Joint Compound; fiberglass mesh tape.
 - 4) Transition, Termination, and Detailing Membrane: DuPont StraightFlash, or DuPont Tyvek Flashing and Joint Compound (60mil).
 - 5) Penetrations and Termination Sealant: DuPont Sealant for Tyvek Fluid Applied System.
 - 6) Window Flashing Membrane: DuPont Tyvek Fluid Applied Flashing and Joint Compound, or DuPont Tyvek Fluid Applied Flashing – Brush Formulation, or DuPont StraightFlash with DuPont FlexWrap.
 - 7) Joint Treatment: None ($\leq 1/16$ " gaps); DuPont Tyvek Flashing and Joint Compound ($\leq 1/4$ " gaps); DuPont Tyvek Flashing and Joint Compound w/ fiberglass mesh tape ($\leq 1/2$ " gaps); DuPont StraightFlash (≤ 1 " gaps).
6. Grace Construction Products: Perm-A-Barrier VP, 90 mils thick (wet), 45 mils thick (dry). www.na.graceconstruction.com:
- a. AIR BARRIER MATERIAL PROPERTIES:
 - 1) Air permeance for this material has been tested and reported as being 0.0004 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0004 cfm/ft² @ 1.57 psf), at 69 mils (wet), when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 741.6 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (741.6 ng/(Pa·s·m²) / 12.9 US perms) at 40 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
 - b. AIR BARRIER ACCESSORY MATERIALS:
 - 1) Membrane for details and Terminations: Bituthene Liquid Membrane.
 - 2) Water-Based Primer for Flashing, Transition Strip and Detail Membrane: Perm-A-Barrier WB Primer or Perm-A-Barrier Primer Plus.
 - 3) Solvent-Based Primer for Flashing, Transition Strip and Detail Membrane: Bituthene Primer B-2 and Bituthene Primer B2 LVC or Bituthene Primer B2.
 - 4) Through-Wall Flashings or Shelf Angle Flashings: Perm-A-Barrier Wall Flashing below the flexible through wall flashing system.
 - 5) Sealants, Mastics, Adhesives and Tapes: As recommended by Grace Construction Products.
 - 6) Transition Membrane: Perm-A-Barrier Detail Membrane, Perm-A-Barrier Aluminum Flashing and Perm-A-Barrier Wall Flashing.
 - 7) Penetrations and Termination Sealant: Bituthene Liquid Membrane and as recommended by Grace Construction Products.
 - 8) Window Flashing and Detail Membrane: Perm-A-Barrier Detail Membrane, Perm-A-Barrier Aluminum Flashing and Perm-A-Barrier Wall Flashing.
 - 9) Joint Sealant: Refer to Technical Letter 1 for details on compatible waterproofing sealants.
7. Henry Company: Air Bloc 17MR at 48 mils (wet) - *Medium build option*. www.henry.com:
- a. AIR BARRIER MATERIAL PROPERTIES:

- 1) Air permeance for this material has been tested and reported as being 0.00024 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0001 cfm/ft² @ 1.57 psf), at 48 mils (wet) when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 28 US perms at 25 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
- b. AIR BARRIER ACCESSORY MATERIALS:
- 1) Liquid Applied Flashing: Air-Bloc LF.
 - 2) Transition Membrane: Blueskin SA and Blueskin SALT for low-temperature applications.
 - 3) Sheathing Joint Membrane: Blueskin VP160.
 - 4) Spray Adhesive: Blueskin Adhesive and Blueskin LVC Adhesive.
 - 5) Water-Based Primer for Transition Membrane: Aquatac Primer.
 - 6) Counterflashing for Metal Panel Through-Wall Flashing: Blueskin TWF.
 - 7) Sealant: HE 925 BES Sealant.
 - 8) Reinforcing Tape: HE 183 Yellow Glass Fabric.
 - 9) Insulation Adhesive: Air-Bloc 21.
8. Momentive Performance Materials, Inc.: GE Elemax 2600 at 17 mils (dry).
www.ge.com/silicones:
- a. AIR BARRIER MATERIAL PROPERTIES:
- 1) Air permeance for this material has been tested and reported as being 0.0006 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0006 cfm/ft² @ 1.57 psf), at 17 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 581 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (581 ng/(Pa·s·m²) / 10.16 US perms) at 17 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
- b. AIR BARRIER ACCESSORY MATERIALS:
- 1) Solvent-Based Primer: SS80.
 - 2) Sealants: Elemax 5000 Liquid Flashing; SilPruf SCS2000; SilPruf SCS9000; SilPruf SCS2700; SWS.
 - 3) Transition Membrane for details and terminations: Elemax 5000 Liquid Flashing; UltraSpan UST2200; UltraSpan USM pre-formed silicone molded corners parts.
 - 4) Substrate Joint Treatment: Elemax 5000 Liquid Flashing; SilPruf SCS2000; SilPruf SCS9000; SilPruf SCS2700; SWS.
 - 5) Reinforcing Fabric: RF100.
9. Pecora USA: Pecora XL-Perm ULTRA VP by Pecora USA at 9 – 12 mils (dry).
www.pecora.com:
- a. AIR BARRIER MATERIAL PROPERTIES:
- 1) Air permeance for this material has been tested and reported as being 0.00024 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00024 cfm/ft² @ 1.57 psf), 0.0012 liters per square meter per

- second under a pressure differential of 75 Pa (0.0012 L/(s·m²) @ 75 Pa)] at 12 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
- 2) Water vapor permeance for this material has been tested and reported as being 727.01 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (727.01 ng/(Pa·s·m²) (12.71 US perms) at 9 mils - dry when tested in accordance with ASTM E96 (water method – unmodified).
- b. AIR BARRIER ACCESSORY MATERIALS:
- 1) Sealants: 890NST Silicone Sealant, AVB Silicone Sealant
 - 2) Transition Membrane for details and terminations: XL Span
 - 3) Flashing at Transition Membranes: XL Flash Liquid Flashing & Joint Filler
 - 4) Counter-Flashing for Through-Wall Flashings: XL Flash Liquid Flashing & Joint Filler with Flexible Flashing.
 - 5) Through-Wall Flashings or Shelf Angle Flashings: XL Flash Liquid Flashing & Joint Filler below the flexible through wall flashing system.
 - 6) Substrate Joint Treatment: XL Flash Liquid Flashing & Joint Filler, 890 NST Silicone Sealant, AC-20 Latex Sealant, AVW-920 Latex Sealant, Dynatrol I-XL-345 Tru White STPU Sealant
10. PROSOCO, Inc.: Spray Wrap MVP at 10 mils (wet). www.prosoco.com:
- a. AIR BARRIER MATERIAL PROPERTIES:
- 1) Air permeance for this material has been tested and reported as being 0.00086 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00086 cfm/ft² @ 1.57 psf), when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 1430 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1430 ng/(Pa·s·m²) / 25 US perms) at 10 mils (wet) when tested in accordance with ASTM E96 (water method – unmodified).
- b. AIR BARRIER ACCESSORY MATERIALS:
- 1) Water-Based Primer: PROSOCO R-GUARD PorousPrep for cut gyp board edged in rough openings.
 - 2) Sealants: PROSOCO R-GUARD AirDam for interior perimeter seal in window installations.
 - 3) Transition Membrane for details and terminations: PROSOCO R-GUARD SureSpan EX
 - 4) Flashing at Transition Membrane: PROSOCO R-GUARD FastFlash
 - 5) Counter-flashing for Through-Wall Flashings: Combination of PROSOCO R-GUARD Joint & Seam Filler and PROSOCO R-GUARD FastFlash or FastFlash alone as a fill and flashing product.
 - 6) Through-Wall Flashings or Shelf Angle Flashings: Combination of PROSOCO R-GUARD Joint & Seam Filler and PROSOCO R-GUARD FastFlash or FastFlash alone as a fill product and flashing below the flexible through wall flashing system.
 - 7) Substrate Joint Treatment: PROSOCO R-GUARD FastFlash and / or PROSOCO R-GUARD Joint & Seam Filler.
 - 8) Rough Openings: PROSOCO R-GUARD Joint and Seam Filler followed by PROSOCO R-GUARD FastFlash.

11. PROSOCO, Inc.: Cat 5 at 12 - 15 mils (wet). www.prosoco.com:
- a. AIR BARRIER MATERIAL PROPERTIES:
 - 1) Air permeance for this material has been tested and reported as being 0.00018 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00018 cfm/ft² @ 1.57 psf), when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 1015 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1015 ng/(Pa·s·m²) / 17.71 US perms) at 12 – 15 mils (wet) when tested in accordance with ASTM E96 (water method – unmodified).
 - b. AIR BARRIER ACCESSORY MATERIALS:
 - 1) Water-Based Primer: PROSOCO R-GUARD GypPrime for cut gyp board edged in rough openings.
 - 2) Sealants: PROSOCO R-GUARD AirDam for interior perimeter seal in window installations.
 - 3) Counter-flashing for Through-Wall Flashings: PROSOCO R-GUARD Joint and Seam Filler followed by PROSOCO R-GUARD FastFlash.
 - 4) Through-Wall Flashings or Shelf Angle Flashings: PROSOCO R-GUARD Joint and Seam Filler followed by PROSOCO R-GUARD FastFlash below the flexible through wall flashing system.
 - 5) Substrate Joint Treatment: PROSOCO R-GUARD Joint & Seam Filler for sheathing seams, PROSOCO R-GUARD Joint & Seam Filler covered by PROSOCO R-GUARD FastFlash in rough opening.
12. Protecto Wrap: Protecto Wall Liquid Air Barrier VP by at 10 mils (dry). www.protectowrap.com:
- a. AIR BARRIER MATERIAL PROPERTIES:
 - 1) Air permeance for this material has been tested and reported as being 0.00086 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.000864 cfm/ft² @ 1.57 psf), 0.0043 liters per square meter per second under a pressure differential of 75 Pa (0.0043 L/(s·m²) @ 75 Pa)] at 10 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 660.8 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (660.8 ng/(Pa·s·m²) [11.5 US perms] at 22 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
 - b. AIR BARRIER ACCESSORY MATERIALS:
 - 1) Water-Based Primer: Universal Water Based Primer.
 - 2) Solvent-Based Primer: BT Primer.
 - 3) Solvent-Based Aerosol Primer: Protecto-Tak Spray Adhesive.
 - 4) Sealants: Protecto Wall Board to Board Joint Sealant.
 - 5) Transition Membrane for details and terminations: Protecto Wall Transition Tape.
 - 6) Solvent-Based Primer for Flashing, Transition Strip and Detail Membrane: BT Primer.

- 7) Water-Based Primer for Flashing, Transition Strip and Detail Membrane: Universal Water Based Primer.
 - 8) Substrate Joint Treatment: Protecto Wall Board to Board Joint Sealant.
13. Sika Corporation: Sikagard 530 Liquid Applied Vapor Permeable Air Barrier at 30 mils (dry). www.sika.com:
- a. AIR BARRIER MATERIAL PROPERTIES:
 - 1) Air permeance for this material has been tested and reported as being < 0.0001 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (< 0.0001 cfm/ft² @ 1.57 psf), at 20 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 661 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (661 ng/(Pa·s·m²) / 11.5 US perms) at 22 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
 - b. AIR BARRIER ACCESSORY MATERIALS:
 - 1) Water-Based Primer: Sikagard 530.
 - 2) Solvent-Based Primer: Sikagard 510.
 - 3) Termination Mastic: Sikaflex 11FC.
 - 4) Sealants: Sikaflex 11FC.
 - 5) Transition Membrane for details and terminations: SikaMultiSeal 515.
 - 6) Reinforcing/Joint Tape: SikaMultiSeal 515.
 - 7) Counterflashing for Through-Wall Flashings: SikaMultiSeal Plus with Flexible Flashing.
 - 8) Through-Wall Flashings or Shelf Angle Flashings: SikaMultiSeal Plus below the flexible through wall flashing system.
 - 9) Substrate Joint Treatment: Sikaflex 11FC.
14. Soprema: Sopraseal LM 202 VP at 10 mils (wet) www.soprema.us
- a. AIR BARRIER MATERIAL PROPERTIES:
 - 1) Air permeance for this material has been tested and reported as being 0.00004 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00004 cfm/ft² @ 1.57 psf), [0.0002 liters per square meter per second under a pressure differential of 75 Pa (0.0002 L/(s·m²) @ 75 Pa)] at 10 mils (wet) when tested in accordance with ASTM E 2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 1004 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1004 ng/(Pa·s·m²) [17.6 US perms] at 10 mils (wet) when tested in accordance with ASTM E96 (water method – unmodified).
 - b. AIR BARRIER ACCESSORY MATERIALS:
 - 1) Water Based Primer: Soprema Elastocol Stick H20 Primer
 - 2) Solvent-Based Primer: Soprema Sopraseal Stick primer
 - 3) Sealants: Soprema Sopraseal sealant
 - 4) Transition Membrane for details and terminations: Soprema Sopraseal Stick 1100T or Soprema Soprsolin HD
 - 5) Substrate Joint Treatment: Soprema Sopraseal Mesh

15. Sto Corp: Emerald Coat at 20 mils (dry). www.stocorp.com:
- a. AIR BARRIER MATERIAL PROPERTIES:
 - 1) Air permeance for this material has been tested and reported as being 0.000024 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00024 cfm/ft² @ 1.57 psf), [0.00020 liters per square meter per second under a pressure differential of 75 Pa (0.00020 L/(s·m²) @ 75 Pa)] at 20 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 797.94 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (797.94 ng/(Pa·s·m²) [13.95 US perms] at 12 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
 - b. AIR BARRIER ACCESSORY MATERIALS:
 - 1) Joint and Rough Opening Treatments: Sto Gold Fill with StoGuard Mesh, StoGuard Rapid Seal with StoGuard Mesh, Sto EmeraldCoat with SToGuard Fabric, StoGuard Tape
 - 2) Joint Reinforcements: StoGuard Mesh, StoGuard Fabric, StoGuard RediCorner
 - 3) Transition Membranes: Sto Gold Fill with StoGuard Mesh, StoGuard RapidSeal or StoGuard RapidSeal with StoGuard Mesh, Sto Emerald Cost with StoGuard Fabric, StoGuard Tape
 - 4) Water-Based Primer for use with Flashing Transition: StoGuard
16. STS Coatings: Wall Guardian FW-100-A (Acrylic-based component) 40 mils (wet), 20 mils (dry). www.wallguardian.com:
- a. AIR BARRIER MATERIAL PROPERTIES:
 - 1) Air permeance for this material has been tested and reported as being 0.0001 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0001 cfm/ft² @ 1.57 psf), at 20 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 661 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (661 ng/(Pa·s·m²) / 11.5 US perms) at 22 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
 - b. AIR BARRIER ACCESSORY MATERIALS:
 - 1) Water-Based Primer for Flashing, Transition Strip and Detail Membrane: None.
 - 2) Solvent-Based Primer for Flashing, Transition Strip and Detail Membrane: BP-40 Primer for use with UT-40 Universal Tape.
 - 3) Through-Wall Flashings or Shelf Angle Flashings: Gorilla Flash VF-1000.
 - 4) Mastics: None.
 - 5) Adhesives and Tapes: Universal Tape UT-40, a butyl based tape and Great Seal LT-100, a low voc elastomeric sealant for deflection joints and details.
 - 6) Transition Strip: Universal Tape, UT-40.
 - 7) Termination Mastic: Great Seal LT-100.
 - 8) Window Flashing and Detail Membrane: Universal Tape UT-40.
17. TK Products: TK-AirMax 2103 at 40+ mils (wet). www.tkproducts.com:

- a. AIR BARRIER MATERIAL PROPERTIES:
 - 1) Air permeance for this material has been tested and reported as being 0.00097 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00097 cfm/ft² @ 1.57 psf), 0.00492 liters per square meter per second under a pressure differential of 75 Pa (0.00492 L/(s·m²) @ 75 Pa)] at 40 mils (wet) when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 857 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (857 ng/(Pa·s·m²) [15.0 US perms] at 20 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
 - b. AIR BARRIER ACCESSORY MATERIALS:
 - 1) Through-Wall Flashings or Shelf Angle Flashings: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18 below the flexible through wall flashing system.
 - 2) Caulk: TK-Super Seal
 - 3) Adhesives and Tapes: TK-AirMax 2200 All Weather Flashing (TK Products), TK Air Max 2203 Caulk, TK-AirMax 2201 Red Sheathing Facing Tape (Venture Tape, a 3M Company), 3M All-Weather Flashing Tape 8067 (3M Company), VentureStop VB 400 (Venture Tape, a 3M Company), Venture-1585 CW-2 Red Sheathing Facing Tape (Venture Tape, a 3M Company)
 - 4) Transition Membranes: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18
 - 5) Reinforcing / Joint Tape: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18
 - 6) Termination of Caulk: TK-AirMax Caulk 2203 (TK Products), Manus-Bond 75AM (Manus Products, Inc.)
 - 7) Flashing (Counter) for at Through-Wall Flashings or Transition Membranes: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18
18. TK Products: TK-AirMax 2104 at 40+ mils (wet). www.tkproducts.com:
- a. AIR BARRIER MATERIAL PROPERTIES:
 - 1) Air permeance for this material has been tested and reported as being 0.0008 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0008 cfm/ft² @ 1.57 psf), at 40+ mils (wet) when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 1007 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1007 ng/(Pa·s·m²) / 17.6 US perms) at 14 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
 - b. AIR BARRIER ACCESSORY MATERIALS:
 - 1) Through-Wall Flashings or Shelf Angle Flashings: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18 below the flexible through wall flashing system.
 - 2) Caulk: TK-Super Seal.
 - 3) Adhesives and Tapes: TK-AirMax 2200 All Weather Flashing (TK Products), TK Air Max 2203 Caulk, TK-AirMax 2201 Red Sheathing Facing Tape (Venture

- Tape, a 3M Company), 3M All-Weather Flashing Tape 8067 (3M Company), VentureStop VB 400 (Venture Tape, a 3M Company), Venture-1585 CW-2 Red Sheeting Facing Tape (Venture Tape, a 3M Company).
- 4) Transition Membranes: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18.
 - 5) Reinforcing / Joint Tape: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18.
 - 6) Termination of Caulk: TK-AirMax Caulk 2203 (TK Products), Manus-Bond 75AM (Manus Products, Inc.)
 - 7) Flashing (Counter) for at Through-Wall Flashings or Transition Membranes: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18.
19. Tremco, Inc.: ExoAir 230 at 40 mils (wet) www.tremcosealants.com
- a. AIR BARRIER MATERIAL PROPERTIES:
 - 1) Air permeance for this material has been tested and reported as being 0.0003 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0003 cfm/ft² @ 1.57 psf), at 40 mils (wet) when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 1677 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1677 ng/(Pa·s·m²) at 29 mils (dry) when tested in accordance with ASTM E 96 (water method – unmodified).
 - b. AIR BARRIER ACCESSORY MATERIALS:
 - 1) Solvent Based Primer: ExoAir Primer
 - 2) Termination Mastic: ExoAir Termination Mastic
 - 3) Sealants: Tremflex 834, Dymonic 100, Spectrem 1
 - 4) Transition Membrane for Details and Terminations: ExoAir 110, ExoAir 111, ExoAir TWF, Dymonic 100
 - 5) Reinforcing / Joint Tape: Tremco 2011 mesh
 - 6) Flashing at Transition Membrane: ExoAir 111, ExoAir TWF, Dymonic 100
 - 7) Counterflashing for Through Wall Flashings: ExoAir TWF
 - 8) Through Wall Flashings or Shelf Angle Flashings: ExoAir TWF below the flexible through wall flashing system.
 - 9) Solvent Based Primer for Flashing, Transition Strip and Detail Membrane: ExoAir Primer
 - 10) Substrate Joint Treatment: Tremflex 834, Dymonic 100 depending on substrate.
20. W.R. Meadows, Inc.: Air-Shield LMP, at 60 mils (wet), 30 mils (dry). www.wrmeadows.com:
- a. AIR BARRIER MATERIAL PROPERTIES:
 - 1) Air permeance for this material has been tested and reported as being 0.000096 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.000096 cfm/ft² @ 1.57 psf), [0.00048 liters per square meter per second under a pressure differential of 75 Pa (0.00048 L/(s·m²) @ 75 Pa)] at 20 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 598 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (598 ng/(Pa·s·m²) [10.47

US perms] at 30 mils (dry) when tested in accordance with ASTM E 96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

- 1) Water-Based Primer: None required for Air Shield LMP.
- 2) Solvent-Based Primer: None required for Air Shield LMP.
- 3) Solvent-Based Aerosol Primer: None required for Air Shield LMP.
- 4) Termination Mastic: Pointing Mastic or BEM.
- 5) Transition Membrane for details and terminations: Air Shield.
- 6) Reinforcing / Joint Tape: Reinforcing Fabric HCR.
- 7) Flashing at Transition Membrane: Air Shield Thru-Wall Flashing.
- 8) Counter-flashing for Through-Wall Flashings: Air Shield Thru-Wall Flashing.
- 9) Through-Wall Flashings or Shelf Angle Flashings: Air Shield Thru-Wall Flashing below the flexible through wall flashing system.
- 10) Solvent-Based Primer for Flashing, Transition Strip and Detail Membrane: Mel-Prime VOC.
- 11) Water-Based Primer for Flashing, Transition Strip and Detail Membrane: Mel-Prime WB.
- 12) Substrate Joint Treatment: Air Shield Joint Filler.

2.2 AUXILIARY MATERIALS

- A. Transition Membrane Between Air and Vapor Barrier Membrane and Roofing and Other Adjacent Materials: Comply with both air barrier Manufacturer's recommendations and roofing material Manufacturer's recommendations.
- B. Provide primers, glass fabric scrim tape, mastic, and other materials not specifically described, but required for a complete and proper installation as instructed by the air barrier system Manufacturer or required to provide a continuous the air barrier assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. The ABAA Certified Air Barrier Contractor shall examine substrates, areas, and conditions under which the air barrier assembly will be installed, with ABAA Certified Installer present, for compliance with requirements.
 1. Confirm site access logistics and scheduling requirements, including but not limited to use of scaffolding, lifts and staging.
 2. Verify that surfaces and conditions are suitable prior to commencing work of this section. Do not proceed with installation until unsatisfactory conditions have been corrected.
 3. Ensure that the following conditions are met:
 - a. Surfaces are sound, dry, even, and excess mortar and / or other contaminants.
 - b. Inspect and confirm substrates to be smooth and without large voids or sharp protrusions. Inform General Contractor if substrates are not acceptable and need to be repaired by the substrate Subcontractor.
 - c. Inspect and confirm masonry joints to be reasonably flush and completely filled, and ensure all excess mortar accumulated on masonry ties has been removed. Inform General Contractor if masonry joints are not acceptable and need to be repaired by the masonry Subcontractor.
 - d. Masonry joints are flush and completely filled with mortar, and all excess mortar sitting on masonry ties has been removed.

4. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263 and take suitable measures until substrate passes moisture test.
5. Verify sealants are compatible with membrane proposed for use. Perform field peel-adhesion test on materials to which sealants are adhered.
6. Notify Architect in writing of anticipated problems using air and vapor barrier over substrate prior to proceeding.

3.2 SURFACE PREPARATION

- A. Clean, prepare, and treat substrate according to material Manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.
 1. Ensure that penetrating work by other trades is in place and complete.
 2. Prepare surfaces by brushing, scrubbing, scraping, grinding or compressed air to remove loose mortar, dust, oil, grease, oxidation, mill scale and other contaminants which will affect adhesion of the fluid-applied membrane.
 3. Wipe down metal surfaces to remove release agents or other non-compatible coatings using clean sponges or with a material chemically compatible with the primary air material.
- B. Prime substrate for installation of sheet membrane transition strips as recommended by material Manufacturer and as follows:
 1. Prime masonry, concrete substrates with conditioning primers.
 2. Prime glass-fiber surfaced gypsum sheathing an adequate number of coats to achieve required bond, with adequate drying time between coats.
 3. Prime wood, metal, and painted substrates with primer.
 4. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through air barrier at protrusions.
- C. Prime substrate for installation of fluid-applied air barrier if recommended by material Manufacturer based on project conditions.
- D. Protection from spray-applied materials as recommended by material Manufacturer and as follows:
 1. Mask and cover adjacent areas to protect from over-spray.
 2. Ensure any required foam stop or back up materials are in place to prevent over-spray and achieve complete seal.

3.3 INSTALLATION

- A. Fluid Applied Membrane Air Barrier: Install air barrier accessories and fluid-applied membrane air barrier material to provide continuity throughout the building envelope in a shingle fashion. Install materials in accordance with material Manufacturer's instructions and the following (unless Manufacturer recommends other procedures in writing based on project conditions or particular requirements of their recommended materials):
 1. Install veneer anchors as per air barrier Manufacturer installation sequencing.
 2. Apply treatment to exterior gypsum joints and screw heads as per air barrier material Manufacturer.
 3. Apply primer for transition material at the rate instructed by the air barrier material Manufacturer for 1 inch beyond terminating edge of transition membrane. Allow primer to set / cure completely before transition strip application.
 4. Position subsequent sheets of transition material so that membrane overlaps the membrane sheet below by a minimum of 2 inches, unless greater overlap is recommended

- by the material Manufacturer. Ensure transition membrane is securely sealed onto substrate with roller.
5. Overlap horizontally adjacent pieces of transition material a minimum of 2 inches, unless greater overlap is recommended by the material Manufacturer. Roll all areas of transition strip including seams with roller.
 6. Seal around all penetrations with termination mastic / sealant, membrane counterflashing or other procedure in accordance with material Manufacturer's instructions, ensuring chemical compatibility amongst adjoining materials.
 7. Connect air barrier in exterior wall assembly continuously to the air barrier of the roof, to concrete below-grade structures, to windows, curtain wall, storefront, louvers, exterior doors, other intersection conditions and transitions from wet cavity to dry cavity and seal penetrations using accessory materials in accordance with the material Manufacturer's instructions.
 8. Provide transition material at changes in substrate plane (with bead of sealant / mastic, membrane counter-flashing or other material recommended by material Manufacturer) under membrane to eliminate all sharp 90 degree inside corners and to make a smooth transition from one plane to another.
 9. Provide mechanically fastened non-corrosive metal sheet or other Manufacturer approved transition material to span gaps greater than 1 inch in substrate plane and to make a smooth transition from one plane to the other. Transition membrane shall be installed continuously from air barrier material onto sheet metal maintaining 2 inch overlap on both edges.
 10. Lap transition material over top edge of through-wall flashing and head-flashing.
 11. Provide backup for the membrane to accommodate anticipated movement or use other Manufacturer approved transition material at deflection and control joints.
 12. Provide transition material to joint assemblies at expansion and seismic joints.
 13. Provide backup for the fluid applied air barrier to accommodate anticipated movement at deflection and control joints as recommended by material Manufacturer.
 14. Apply a bead or trowel coat of mastic along membrane seams at reverse lapped seams, rough cuts, and / or as otherwise recommended by the material Manufacturer.
 15. Seal top edge of the self-adhered membrane to substrate with termination mastic at end of each working day.
 16. Inspect installation prior to enclosing assembly and repair punctures, damaged areas and inadequately lapped seams with a patch of membrane lapped as recommended by material Manufacturer.
 17. Install primer for fluid-applied air barrier if instructed by material Manufacturer.
 18. Install fluid-applied membrane using equipment and methods recommended by Manufacturer to achieve a dry film thickness as required by the material Manufacturer.
 19. Do not allow materials to come in contact with chemically incompatible materials.
 20. Do not expose membrane to sunlight / ultraviolet light longer than as recommended by the Manufacturer.
 21. Turn flashing membrane into window opening at sill, jambs and heads. Terminate just before interior sealant bead.

3.4 FIELD QUALITY CONTROL

- A. Owner's Inspection and Testing: Cooperate with Owner's testing agency as applicable. Allow access to work areas and staging. Notify Owner's testing agency in writing of schedule for Work of this Section to allow sufficient time for testing and inspection. Do not cover Work of this Section until testing and inspection is accepted.
- B. Manufacturer's Field Representative Review: Contractor is not to commence any work other than staging until contact and meeting with the Manufacturer's Field Representative on site. The Manufacturer's Field Representative is to visit the jobsite a minimum of four (4) times to review work processes and / or work completed prior to work commencement, at 10% completion, at 50% completion and prior to the work being covered by finish materials.

3.5 PROTECTING AND CLEANING

- A. Protect air barrier materials from damage during installation and the remainder of the construction period, according to material Manufacturer's written instructions.
 - 1. Coordinate with installation of materials which cover the air barrier assemblies, to ensure exposure period does not exceed that recommended by the air barrier Manufacturer.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by Manufacturer of affected construction and acceptable to the primary material Manufacturer.

END OF SECTION

SECTION 07 42 11 – FORMED METAL WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes: Requirements including but not limited to:
 - 1. Concealed fastened metal wall panels as part of the assembly.
 - 2. Accessories necessary for a complete installation.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, licensed in the State of Texas with experience in the design of metal composite wall panels as part of curtainwalls and aluminum storefront systems to design and coordinate the cladding assembly using performance requirements and design criteria indicated.

1.4 SYSTEM REQUIREMENTS

- A. Modular Metal Panel System: Rainscreen design consisting of dry seal joinery designed, attachment system components, and associated necessary to minimize water penetration and induce air circulation in the space behind the panel system. Moisture weeping trim at panel base details allows water to drain out of the system.

1.5 SUBMITTALS

- A. Product Data: Technical data including construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings: Provide shop drawings prepared by manufacturer or manufacturer's authorized dealer. Include full elevations showing openings and penetrations. Include details of each condition of installation and attachment. Provide details at a minimum scale 3-inch per foot of all required trim and extrusions needed for a complete installation.
 - 1. Include data indicating compliance with performance requirements.
 - 2. Indicate points of supporting structure that must coordinate with modular metal panel system installation.
- C. Samples:
 - 1. One (1) ft long sample of each listed panel, including clips (if applicable) & fasteners
 - 2. Minimum 2" x 4" chip of specified finish.
- D. Qualification Information: For Installer and Installer's field supervisor.
- E. Warranty: Manufacturer's sample warranty as specified.

1.6 DELIVERY AND STORAGE

- A. All panels shall be delivered with appropriate packaging to provide protection against transportation damage. Materials damaged in shipping or storage shall not be used.

- B. Store all materials and accessories above ground on well-skidded platforms. Store under waterproof covering. Provide proper ventilation to panels to prevent condensation build-up between panels.

1.7 COORDINATION

- A. Coordinate work with installation of associated metal flashings and manufactured roof panels.
- B. General contractor shall coordinate with all subcontractors including masonry, waterproofing membrane, sheathing work, and framing to ensure walls are plumb and ready to accept fasteners and panel systems.
- C. Pre-construction meeting required with owner and architect. Representatives from all associated trades shall attend to coordinate arrival, delivery, and installation of products and materials.

1.8 WARRANTY

- A. Warrant the work specified herein for five (5) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials or workmanship.
- B. Provide a manufacturer's twenty (20) year finish integrity warranty.
- C. Provide a manufacturer's twenty (20) year watertightness warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Manufacturer: Berridge Manufacturing Company. Other manufacturers may bid this project provided they comply with all requirements of this specification. Product listed is considered basis of design and owner shall not be responsible for any costs resulting from change of manufacturer including sizes, trim pieces, structural, or system components. Manufacturers listed below who produce equivalent products to those specified are approved for use on the Project. Other manufacturers must have a minimum of ten (10) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.
 - 1. Alucoil North America LLC.
 - 2. CENTRIA Architectural Systems.
 - 3. Citadel Architectural Systems, Inc.

2.2 MATERIALS

- A. Metal Wall Panel (**MP-1 & 3**):
 - 1. Materials:
 - a. Prefinished Sheet Material: 24 gauge thick Galvalume® steel sheet, minimum yield 50,000 PSI, roll formed in continuous lengths, ASTM A792.
 - b. Finish: Kynar 500 or Hylar 5000 Fluoropolymer coating, applied by the manufacturer on a continuous coil coating line, with a top side dry film thickness of 0.70 to 0.90 mil over 0.25 to 0.35 mil prime coat, to provide a total dry film thickness of 0.95 to 1.25 mil. Bottom side shall be coated with primer with a dry film thickness of 0.25 mil. Finish shall conform to all tests for adhesion, flexibility, and longevity as specified by the Kynar 500 or Hylar 5000 finish supplier. Color shall be as selected by Architect from manufacturer's available colors. Interior surface finish shall be manufacturer's full range of colors.

- c. Touch-up Paint: Paint burns, scars, welds, and damaged and rusted surfaces with cold galvanizing paint in accordance with ASTM A780. Acceptable Products include ZRC Cold Galvanizing Compound or Galvilite manufactured by ZRC Worldwide, Marshfield, MA; Galvax Zinc-rich Cold Galvanizing Coating manufactured by Alvin Products, Inc., Lawrence, MA; or paint complying with military specification MILP-21035A, Type I or II.
- d. Strippable Film: Shall be applied to the top side of the painted coil to protect the finish during fabrication, shipping and field handling. This strippable film must be removed before installation.
- e. Accessories:
 - 1) Sealant: As specified in Section 07 92 00.
 - 2) Cold Formed Metal Framing: As specified in Section 05 40 00.
 - 3) Girts, Sub-girts, purlins: 16 gauge minimum thickness (55,000 psi minimum yield thickness) galvanized steel, with Stainless Steel screws to meet application.
 - 4) Fasteners: long-life, corrosion resistant screws supplied or instructed by panel manufacturer to suit application spaced according to UL requirements, color matched to match metal panel color.
 - 5) Clips, miscellaneous fasteners: galvanized steel as supplied or instructed by panel manufacturer.
 - 6) Metal Trim, closures, and flashing: Exposed adjacent flashing shall be the same material and finish as panel system.
 - 7) Separate dissimilar metals with asphalt-saturated building felt or a bituminous coating to prevent galvanic action.
 - 8) Dampproofing: refer to section 07 11 00.
- 2. Profile/Dimensions: 7/8 inch thick panel 16 inch coverage width, in continuous length up to 40 feet-0 inches, with interlocking design with concealed fasteners.
- 3. Approved Product/Manufacturer: 'HR-16' Panel manufactured by Berridge Manufacturing Co., Houston, TX; (800) 231-8127, or Architect approved equal.

C. Metal Wall Panel (**MP-2**):

- 1. Materials:
 - a. Prefinished Sheet Material: 24 gauge thick Galvalume® steel sheet, minimum yield 50,000 PSI, roll formed in continuous lengths, ASTM A792.
 - b. Finish: Kynar 500 or Hylar 5000 Fluoropolymer coating, applied by the manufacturer on a continuous coil coating line, with a top side dry film thickness of 0.70 to 0.90 mil over 0.25 to 0.35 mil prime coat, to provide a total dry film thickness of 0.95 to 1.25 mil. Bottom side shall be coated with primer with a dry film thickness of 0.25 mil. Finish shall conform to all tests for adhesion, flexibility, and longevity as specified by the Kynar 500 or Hylar 5000 finish supplier. Color shall be as selected by Architect from manufacturer's available colors. Interior surface finish shall be manufacturer's full range of colors.
 - c. Touch-up Paint: Paint burns, scars, welds, and damaged and rusted surfaces with cold galvanizing paint in accordance with ASTM A780. Acceptable Products include ZRC Cold Galvanizing Compound or Galvilite manufactured by ZRC Worldwide, Marshfield, MA; Galvax Zinc-rich Cold Galvanizing Coating manufactured by Alvin Products, Inc., Lawrence, MA; or paint complying with military specification MILP-21035A, Type I or II.
 - d. Strippable Film: Shall be applied to the top side of the painted coil to protect the finish during fabrication, shipping and field handling. This strippable film must be removed before installation.
 - e. Profile/Dimensions: 12 inch coverage width, in continuous length up to 40 feet-0 inches, with interlocking design with concealed fasteners.

- f. Approved Product/Manufacturer: 'FW-12' Panel manufactured by Berridge Manufacturing Co., Houston, TX; (800) 231-8127, or Architect approved equal.
- D. All Cold-Formed Metal Framing for Metal Wall Panels to be designed by a Texas Licensed Profession Engineer per spec. Section 05 40 00 Professional Engineer
- E. Accessories:
- 1. Zees: 16 gauge minimum thickness galvanized steel, 2 inch rise minimum, or as required to align with existing conditions.
 - 2. Sub-Girt Fasteners: Stainless Steel screws to meet application.
 - 3. Concealed Fasteners: Stainless Steel screws supplied or recommended by panel manufacturer to suit application.
 - 4. Metal Trim at Siding Panels: 0.060 inch thick pre-finished aluminum sheet, matching finish type and color of siding panels.
 - 5. Closures: 0.060 inch thick aluminum sheet, mill finish.
 - 6. Separate dissimilar metals with asphalt-saturated building felt or a bituminous coating to prevent galvanic action.
 - 7. Air Barrier: High temperature air barrier. Re: 07 26 00.
 - 8. Polyisocynurate: Shall comply with NFPA 285 & ASTM G 2357 & ASTM E 331. Thickness shall be 2-inch.
 - 9. Access Panels: Refer to 08 31 13 Specification.

PART 3 - EXECUTION

3.1 EXAMINATION OF MODULAR METAL PANEL SYSTEM

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal composite material panel supports, and other conditions affecting performance of the Work.
 - 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal composite material wall panel manufacturer.
 - 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal composite material wall panel manufacturer.
 - a. Verify that air or water resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing in for components and assemblies penetrating metal composite material panels to verify actual locations of penetrations relative to seam locations of metal composite material panels before installation.
- C. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal composite material panel as required by manufacturer's written recommendations.

3.3 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal composite material wall panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m), nonaccumulative, on level, plumb, and location lines

as indicated, and within 1/8 inch (3 mm) offset of adjoining faces and of alignment of matching profiles.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing agency to perform field tests and inspections.
- B. Water Spray Test: After installation, test area of assembly directed by Architect for water penetration according to AAMA 501.2.
- C. Manufacturer Field Service: Engage a factory authorized service representative to test and inspect completed metal composite material wall panel installation, including accessories.
- D. Metal composite material wall panels are considered defective if they do not pass test and inspections.
- E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- F. Prepare test and inspection reports.

3.5 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films as metal composite material panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal composite material panel installation, clean finished surfaces as recommended by metal composite material panel manufacturer. Maintain in a clean condition during construction.
- B. After metal composite material panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal composite material panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 42 11

SECTION 07 42 13 - METAL COMPOSITE MATERIAL WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Metal composite material wall panels.
 - 2. Accessories necessary for a complete installation.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, licensed in the State of Texas with experience in the design of metal composite wall panels as part of curtainwalls and aluminum storefront systems to design and coordinate the cladding assembly using performance requirements and design criteria indicated.
- B. Structural Performance: Provide metal composite material panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 330:
 - 1. Wind Loads: Indicated on Drawings.
 - 2. Other Design Loads: Indicated on Drawings.
 - 3. Deflection Limits: For wind loads, no greater than 1/240 of the span.
- C. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E 283 at the following test-pressure difference:
 - 1. Test Pressure Difference: 1.57 lbf/sq. ft. (75 Pa) and 6.24 lbf/sq. ft. (300 Pa).
- D. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
 - 1. Test Pressure Difference: 2.86 lbf/sq. ft. (137 Pa) and 6.24 lbf/sq. ft. (300 Pa).
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.
- F. Fire Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from ULI *Fire Resistance Directory* or from the listings of another qualified testing agency.
- G. Fire Propagation Characteristics: Metal composite material wall panel system passes NFPA 285 testing.

1.4 SUBMITTALS

- A. Product Data: Technical data including construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

- B. Shop Drawings: Submit fabrication and installation layouts of metal composite material panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.
 - 1. Accessories: Include details of the flashing, trim and anchorage, at a scale of not less than 1-1/2 inches per 12 inches (1:10).
- C. Samples: Submit MCM panel samples, 12 inches (305 mm) long by actual panel width with fasteners, closures, and other metal composite material panel accessories.
- D. Qualification Data: Submit Installer's qualifications.
- E. Product Test Reports: Submit copy of required tests performed by a qualified testing agency within the past 36 months.
- F. Field quality control reports.
- G. Maintenance Data: Submit maintenance data for metal composite material panels for inclusion in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Building Code: Comply with applicable requirements of IBC for building cladding.
 - 2. Energy Code: Comply with applicable provisions of the IECC.
 - 3. Surface Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame Spread Index: 25 or less.
 - b. Smoke Developed Index: 450 or less.
 - 4. Fire Propagation Characteristics: Metal composite material wall panel system passing NFPA 285 testing.
 - 5. Welding Standards: Welding shall be performed by skilled and qualified mechanics. Welding shall be performed in accordance with the applicable provisions of AWS D1.1 *Structural Welding Code - Steel* and AWS D1.2 *Structural Welding Code - Aluminum*.
- B. Installer Qualifications: Entity having minimum 5 years documented experience that employs installers and supervisors who are trained and approved by manufacturer.
- C. Mockups: Build mockups to verify selections and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical metal composite material panel assembly shown on Drawings, including corner, soffits, supports, attachments, and accessories.
 - 2. Water Spray Test: Conduct water spray test of mockup of metal composite material panel assembly, testing for water penetration according to AAMA 501.2.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Conduct conference at site.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal composite material panels, and manufactured items to prevent damage or deformation. Package metal composite material panels for protection during transportation and handling.
- B. Unload, store, and erect metal composite material panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal composite material panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal composite material panels to ensure dryness, with positive slope for drainage of water. Do not store metal composite material panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal composite material panels during installation.

1.7 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation when existing and forecasted weather conditions permit assembly of metal composite material panels to be performed according to manufacturers' written instructions and warranty requirements.

1.8 COORDINATION

- A. Coordinate metal composite material panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.9 WARRANTY

- A. Written warranty signed by manufacturer in which manufacturer agrees to repair or replace components of metal composite material panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: Two (2) years from date of Substantial Completion.
 - 3. Watertightness Warranty: Twenty (20) years from date of Substantial Completion.
- B. Panel Finishes: Written warranty signed by manufacturer in which manufacturer agrees to repair finish or replace metal composite material panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: Twenty (20) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 METAL COMPOSITE MATERIAL WALL PANELS

- A. Metal Composite Material Wall Panel Systems: Provide factory-formed and -assembled, metal composite material wall panels fabricated from two metal facings that are bonded to a solid,

extruded thermoplastic core; formed into profile for installation method indicated. Include attachment assembly components, panel stiffeners, and accessories required for weathertight system.

1. Basis of Design (**ACM-1**): ALPOLIC Materials; Mitsubishi Plastics Composites America. Other manufacturers are subject to compliance with requirements.
 - a. Arconic Reynobond.
 - b. ALUCOBOND; 3A Composites USA, Inc.
 - c. Alucoil North America.
 - d. CENTRIA Architectural Systems.

- B. Aluminum Faced Composite Panels: Formed with 0.020 inch (0.50 mm) thick, anodized aluminum sheet facings.
 1. Panel Thickness: 0.157 inch (4 mm).
 2. Exterior Finish:
 - a. Color: Anodized Champagne.

- C. Attachment Assembly Components: Formed from material compatible with panel facing.

- D. Attachment Assembly: Subgirt and spline.

- E. Miscellaneous Materials:
 1. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold formed, metallic coated steel sheet ASTM A 653/A 653M, G90 (Z275 hot dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) aluminum zinc alloy coating designation unless otherwise indicated. Provide sections necessary for support and alignment of metal composite material panel system.
 2. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal composite material panels unless otherwise indicated.
 3. Flashing and Trim: Provide flashing and trim formed from same material as metal composite material panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal composite material panels.
 4. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal composite material panels by means of plastic caps or factory applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
 5. Panel Sealants: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal composite material panels and remain weathertight; and as recommended in writing by metal composite material panel manufacturer.

2.2 FABRICATION

- A. Fabricate and finish metal composite material panels and accessories at the factory, using procedures and processes necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

- B. Fabricate metal composite material panel joints with factory installed captive gaskets or separator strips that provide a weathertight seal and prevent metal to metal contact, and that minimize noise from movements.

- C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in *SMACNA Architectural Sheet Metal Manual* that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Aluminum: Fabricate nonmoving seams with flat lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: Recommended by *SMACNA Architectural Sheet Metal Manual* or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.3 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Finish:
 - 1. Architect to select finish from clear anodized, color anodized, two coat fluoropolymer, baked enamel, and powder coat. Architect to select color from manufacturer's full range of colors.
 - 2. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
 - 3. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 - 4. Baked Enamel or Powder Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, application, and baking.
 - 5. Two Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal composite material panel supports, and other conditions affecting performance of the Work.
 - 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal composite material wall panel manufacturer.

2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal composite material wall panel manufacturer.
 - a. Verify that air or water resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing in for components and assemblies penetrating metal composite material panels to verify actual locations of penetrations relative to seam locations of metal composite material panels before installation.
- C. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal composite material panel manufacturer's written recommendations.

3.3 METAL COMPOSITE MATERIAL PANEL INSTALLATION

- A. Install metal composite material panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor metal composite material panels and other components of the work securely in place, with provisions for thermal and structural movement.
 1. Shim or otherwise plumb substrates receiving metal composite material panels.
 2. Flash and seal metal composite material panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air or water resistive barriers and flashings that will be concealed by metal composite material panels are installed.
 3. Install screw fasteners in predrilled holes.
 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 5. Install flashing and trim as metal composite material panel work proceeds.
 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 7. Align bottoms of metal composite material panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 8. Provide weathertight escutcheons for pipe and conduit penetrating panels.
- B. Fasteners:
 1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal composite material panel manufacturer.
- D. Attachment Assembly, General: Install attachment assembly required to support metal composite material wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.
 1. Include attachment to supports, panel to panel joinery, panel to dissimilar material joinery, and panel system joint seals.
- E. Installation: Attach metal composite material wall panels to supports at locations, spacings, and with fasteners recommended by manufacturer to achieve performance requirements specified.

1. Wet Seal Systems: Seal horizontal and vertical joints between adjacent metal composite material wall panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Section 079200.
 2. Dry Seal Systems: Seal horizontal and vertical joints between adjacent metal composite material wall panels with manufacturer's standard gasket system.
 3. Rainscreen Systems: Do not apply sealants to joints unless otherwise indicated.
- F. Subgirt and Spline Installation: Install support assembly at locations, spacings, and with fasteners recommended by manufacturer. Use manufacturer's standard subgirts and splines that provide support and complete secondary drainage assembly, draining to the exterior at horizontal joints. Attach metal composite material wall panels by interlocking perimeter extrusions attached to panels with subgirts and splines. Fully engage integral subgirt and spline gaskets and leave horizontal and vertical joints with open reveal. Terminate edge of panels flush with perimeter extrusions.
1. Install wall panels to allow individual panels to free float and be installed and removed without disturbing adjacent panels.
 2. Do not apply sealants to joints unless otherwise indicated.
- G. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal composite material panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal composite material panel manufacturer; provide types recommended in writing by metal composite material panel manufacturer.
- H. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA *Architectural Sheet Metal Manual*. Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof performance.
 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (605 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

3.4 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal composite material wall panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m), nonaccumulative, on level, plumb, and location lines as indicated, and within 1/8 inch (3 mm) offset of adjoining faces and of alignment of matching profiles.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing agency to perform field tests and inspections.
- B. Water Spray Test: After installation, test area of assembly directed by Architect for water penetration according to AAMA 501.2.

- C. Manufacturer Field Service: Engage a factory authorized service representative to test and inspect completed metal composite material wall panel installation, including accessories.
- D. Metal composite material wall panels are considered defective if they do not pass test and inspections.
- E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- F. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films as metal composite material panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal composite material panel installation, clean finished surfaces as recommended by metal composite material panel manufacturer. Maintain in a clean condition during construction.
- B. After metal composite material panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal composite material panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 42 13

SECTION 07 42 23 – EXTERNAL CLADDING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Prefinished high-density panel with resin core exterior wall cladding product.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division Specification Sections, that apply to this Section.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
- B. Shop Drawings: Submit plan, section, elevation and perspective drawings necessary to describe and convey the layout, profiles and product components, including edge conditions, panel joints, fixture location, anchorage, accessories, finish colors, patterns and textures. Distinguish between factory-and field assembled Work.
- C. Samples: Two (2) complete sets of color swatches representing manufacturer's full range of available colors, grain patterns, vein contrast and materials for each panel finish specified.
- D. Engineering Calculations: Submit engineering calculations as required by the local building code, showing that the installed panels and attachments system meets the wind load requirements for the project.

1.4 QUALITY ASSURANCE

- A. Manufacturer: All primary panel products specified in this section will be supplied by a single manufacturer with a minimum of ten years' experience, manufactured in accordance with ISO 9001 and ISO 14001.
- B. Engineering: Preparation of necessary drawings, design calculations, and other structural data to be completed by a qualified professional engineer. The engineer must be legally qualified to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of panels that are similar to those indicated for this Project in material, design, and extent.
- C. Fabrication: A shop that employs skilled workers that custom fabricate to those required for this Project and whose finished products have a record of successful in-service performance.
- D. Installation: A firm experienced in the installation and that have experience installing products indicated for this Project. All products listed for this Section are to be installed by a single installer suitable for the execution of the Work.

- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup as shown on construction documents on one side of one building including supports, attachments, and accessories. a. Include four-way joint for wall panels.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
 - 4. Retain and maintain approved field sample during construction in an undisturbed condition as a standard for judging. An undamaged field sample may become part of the completed Work.

- F. Pre-Installation Conference: Conduct pre-installation conference originating at the project site prior to commencing construction of mock-up specified herein to verify project requirements.
 - 1. Review installation requirements including substrate surface preparation, environmental limitations, typical details and flashings, Manufacturer's recommended installation procedures, coordination with adjacent trades, testing and inspection procedures, protection and repair procedures.
 - 2. Ensure all sub-trades interfacing with or affected by the construction of the are participating, including Architect, General Contractor, Manufacturer, mock-up and commissioning testing agencies, air barrier installer, exterior insulation installer, structural substrate installer, plumbing installer, window installer, electrical installer and any other installer whose Work interfaces with or affects.
 - 3. Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays, including:
 - a. Methods and procedures related to panel installation, including manufacturer's written instructions and repair procedures after panel installation.
 - b. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 - c. Flashings, penetrations, openings, and condition of other construction that will affect panels.
 - d. Governing regulations and requirements for insurance, certificates, and testing and inspecting, if applicable.
 - e. Temporary protection requirements for panel assembly during and after installation.
 - f. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.9 PERFORMANCE REQUIREMENTS

- A. General Performance: Wall panel assemblies shall comply with performance requirements in project documents without failure due to defective manufacture, fabrication, installation, or other defects in construction.

- B. Design and Structural Performance: Wall panel assemblies and substructure shall be designed and installed to be capable of withstanding the effects of the following loads and stresses within limits and under conditions indicated, based on recognized test methods:
 - 1. Dead Load of Panel

2. Wind Loads: Provide exterior rainscreen wall panel system, including support structure, capable of withstanding wind loads calculated according to requirements of authorities having jurisdiction or as determined based on the specified minimum design wind pressures, based on the governing project documents:
 - a. Uniform pressure as indicated on Structural Drawings.
3. Deflection Limits: Support structure and cladding shall be designed in accordance with the Manufacturer's recommended maximum deflection when tested under positive and negative design wind gust loads and shall withstand wind gust loads with horizontal deflections no greater than the Manufacturer's allowable span.
4. Environmental Movements: Allow for environmental movements from ambient and surface condition changes by preventing buckling, joint movement, overstressing of components, failure of optional joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.
 - a. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, soffit panels, and other manufactured items so as not to be damaged or deformed. Package panels for protection during transportation and handling.
 1. Unload in a manner to prevent bending, warping, twisting, and surface damage.
- B. Maintain environmental conditions (temperature, humidity, and ventilation) within limits specified by manufacturer for optimum results. Do not install products when environmental conditions outside the manufacturer's specified limits are present.
- C. Storage:
 1. Store on a flat, stable horizontal surface, elevated above the ground, and protected from direct sunlight until panels are ready to install.
 2. Do not store cladding or fabricated panels vertically.
 3. Store to ensure dryness, with positive slope for drainage of water. Do not store panels in contact with other materials that might cause staining or other surface damage. Do not allow storage space to exceed 120 deg F.
- D. Handling:
 1. When moving panels, lift evenly to prevent dragging panels across each other and scratching the surface.
 2. Protective film should only be removed prior to installation. Installed product must have protective film, labels and stickers removed prior to installation.
- E. Protect strippable protective covering from exposure to sunlight and high humidity, except to extent necessary for period of panel installation.

1.11 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing weather conditions permit assembly of panels to be performed according to manufacturers' written instructions and warranty requirements.

- B. Field Measurements: Verify actual measurements/openings against field measurements performed by the installer prior to release for fabrication. Recorded measurements to be indicated on shop drawings based on field measurements provided by the installer. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.
- C. Comply with manufacturer's requirements of referenced standards and recommendations of material for environmental conditions before, during and after installation.
- D. Coordinate assemblies with rain drainage work, flashing, trim, and construction of studs, soffits, and other adjoining work to provide a leak-proof, secure, and non-corrosive installation.

1.12 WARRANTY

- A. Submit Manufacturer's standard limited ten (10) year warranty covering panel integrity and color fastness.
- B. Warranty only available when panels are fabricated and installed by a contractor that has been recognized by the manufacturer.

PART 2 – PRODUCTS

2.1 ACCEPTABLE PRODUCT / MANUFACTURER

- A. Basis of Design (**EGPL-1**): MEG Soffit Panel with Resin Core as manufactured by Abet Laminati, Inc. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions.

2.2 MATERIALS

- A. Material Description:
 - 1. Type: Single-sided Decorative as indicated on Drawings.
 - 2. Color: As selected by Architect from manufacturer's full range of colors.
 - 3. Finish: As indicated on Drawings.
 - 4. Thickness: 10 mm (3/8 in.)
 - 5. Panel Sizes: As indicated on drawings or governing project documents.
 - 6. Fasteners: Concealed fasteners.
- C. Fire Performance:
 - 1. Flame Spread: Less than 25 as per ASTM E 84.
 - 2. Smoke Development: Less than 450 as per ASTM E-84.
 - 3. Ignition Temperature: Greater than 650 deg F (350 deg C) above ambient, ASTM D1929.
 - 4. When required for compliance with local building codes, the wall cladding assembly shall show no degradation of the rating of Fire Resistant Assemblies, ASTM E119.
 - 5. When required for compliance with local building codes, the wall cladding assembly shall meet the performance requirements for Multi Story construction NFPA 285
 - 6. When required for compliance with local building codes, the wall cladding assembly shall not ignite when exposed to a radiant heat energy source, NFPA 268.
- D. Mounting System: Concealed fastened on fixed-depth sub-framing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and manufacturer's written recommendations.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed installation, including accessories.
- C. Remove and replace where tests and inspections indicate that they do not comply with specified requirements.
- D. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- E. Prepare test and inspection reports.

3.4 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, clean finished surfaces as recommended by manufacturer. Maintain in a clean condition during construction.
- B. After installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace cladding that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 42 23

SECTION 07 52 19 - MODIFIED BITUMEN "COOL ROOF" MEMBRANE ROOFING SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. The installer shall coordinate the work of the entire roofing assembly, including, but not limited to:
 - 1. Tapered edge strips, cant strips, and wood nailers. (Refer to this Section and Section 06 10 00)
 - 2. Curbs, (Refer to Section 07 72 00)
 - 3. Modified bitumen membrane roofing
 - 4. Flashings, including sheet metal perimeter edge (fascia) (Refer this Section and Section 07 62 00)
 - 5. Walkway pads, expansion joints, and other work incidental to, the complete and proper installation of a watertight modified bitumen membrane roofing system as shown on the drawings or specified herein, and in accordance with all applicable requirements of the Contract Documents.
- B. It is the intent of this Section that the Work shall:
 - 1. provide a watertight facility;
 - 2. conform to all applicable building code requirements and of authorities having jurisdiction;
 - 3. include Section 07 62 00, Sheet Metal Flashing, Downspouts, Gutters and Trim, and Section 07 72 00, Roof Accessories as part of the Work of this Section; and
 - 4. Provide Owner with a single source full system warranty as specified.

1.3 RELATED WORK

- A. All Sections of Work relating to the roofing system, including mechanical, plumbing and electrical items penetrating the roof system.

1.4 REFERENCES

- A. ASTM International (ASTM)
 - 1. C728, Standard Specification for Perlite Thermal Insulation Board
 - 2. C920, Standard Specification for Elastomeric Joint Sealants
 - 3. C1289, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
 - 4. D41, Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
 - 5. D312, Standard Specification for Asphalt Used in Roofing
 - 6. D4479, Standard Specification for Asphalt Roof Coatings - Asbestos-Free
 - 7. D4586, Standard Specification for Asphalt Roof Cement, Asbestos-Free
 - 8. D4897, Standard Specification for Specification for Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing
 - 9. D5147, Standard Specification for Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material
 - 10. D6163, (D5147 & D146) Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements

- B. ASCE-7 Wind uplifts requirements for geographical area.
- C. Federal Specifications (FS)
 - 1. TT-S-00230C
- D. National Roofing Installers Association (NRCA)
 - 1. Roofing and Waterproofing Manual - Latest Edition
- F. Sheet Metal and Air Conditioning Installers National Association, Inc. (SMACNA)
 - 1. Architectural Sheet Metal Manual - Latest Edition
- G. Underwriters' Laboratories (UL)
 - 1. Fire Hazard Classifications
- H. International Building Code

1.5 SUBMITTALS

- A. Product Data: Manufacturer's printed instructions, schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, fastener pattern layout, and accessories to be used in the Work.
- B. Certifications:
 - 1. Manufacturer's written certification that installer is approved and licensed to install specified roofing system. **(Submit a copy with Proposal Form)**.
 - 2. Manufacturer's affidavit that materials used in Project contain no asbestos.
 - 3. Installer shall submit resume and project experience list for proposed system for Project Manager and job site superintendent.
 - 4. Installer shall submit written certification that there are no undocumented workers being employed by them or by any subinstaller on this project and that all workers on this project are covered by workmen's compensation.
 - 5. Installer shall submit list of all subinstallers with evidence of subinstaller's insurance coverage in compliance with contract requirements.
 - 6. Manufacturer's written certification of approval / acceptance of these specifications and details.
- C. Referenced Standards: Two (2) copies of each referenced standard and retain approved copies at site.
- D. Project Registration "Pin" proving the project has been registered with Manufacturer.
- E. Shop Drawings: Furnish from copies of the manufacturer's literature or from copies of NRCA "Roofing and Waterproofing Manual", Latest Edition.
 - 1. Furnish for approval any proposed details which differ from those included with this proposal package. All proposed details shall first be approved in writing by roofing manufacturers prior to submitting to Architect for approval.
 - 2. Furnish detail project sequencing, staging, material loading, manpower plans, and project construction schedule for approval.
- F. Samples:
 - 1. Furnish copy of sample warranty that is to be issued upon project completion.
- G. Temperature Charts: Bitumen heating devices 24 hour temperature charts.

- H. Test Reports: Bitumen manufacturer's test reports relative to the following for each batch of bitumen furnished:
 - 1. Softening Point: ASTM D312.
 - 2. Flashpoint: ASTM D92.
 - 3. Acceptable Bitumen Temperature: As recommended by the bitumen manufacturer and EVT label on containers.
 - 4. Thermometers: Two (2) hand held, "8F" thermometers complying with ASTM E1 to Architect for his checking kettle temperature.
- I. Upon Substantial Completion of Work, submit the following to Architect for his submission to Owner:
 - 1. Manufacturer's Warranty: Manufacturer's written warranty as specified.
 - 2. Maintenance Procedures: Three (3) copies of Manufacturer's printed instructions for Owner's use regarding care and maintenance of roof.
- J. Certificate of Analysis: Provide manufacturer's printed certificate of analysis for all materials used. Attach copy with final warranty.

1.6 INSPECTIONS / TESTS

- A. The Owner's, Architect's, and Manufacturer's representative shall at all times have access to the job site and work areas. The installer will provide proper and safe facilities for such access and inspection.
 - 1. Architect Inspections:
 - a. The Architect will be providing periodic inspections throughout the duration of the project. Architect's Representative shall be required to inspect after completion of each major phase of construction for approval.
 - 2. Manufacturer Inspections:
 - a. An inspection shall be made by a representative of the material manufacturer at appropriate intervals during performance of Work to ensure that said project is installed in accordance with the manufacturer's specifications and illustrated details. Written reports by the manufacturer shall be turned over to the Architect, on each Monday following the prior week.
 - b. The authorized material Manufacturer's field representative shall be responsible for:
 - 1) Keeping the Architect's representative informed after periodic inspections as to the progress and quality of the work observed.
 - 2) Calling to the attention of the installer those matters observed which are considered to be in violation of the contract requirements.
 - 3) Reporting to the Architect's representative, in writing, any failure or refusal of the installer to correct unacceptable practices called to his attention.
 - 4) Confirming, after completion of the work and based on his observation and test, that he has observed no application procedures in conflict with these specifications. Final payment will not be released until the Architect has received all specified warranties.
- B. Any failure by the Owner's, Architect's or Manufacturer's Representative to detect, pinpoint, or object to any defect or noncompliance of these specifications of work in progress or completed work shall not relieve the installer, or reduce, or in any way limit, his responsibility of full performance of work required of him under these specifications.

- C. Architect may require tests and inspections as necessary to verify quality of roofing materials and workmanship. Laboratory tests will be performed in accordance with ASTM standard procedures.
1. Owner will select testing laboratory and will pay for Work required by testing laboratory.
 2. Retests for work which fail initial tests or inspections shall be paid by installer.

1.7 QUALITY ASSURANCE

A. Installer:

1. Installer shall have approval by manufacturer of accepted roofing system for application and issuance of specified warranty for a minimum of three (3) years. Proof of license agreement dated at least three years prior to date of bid opening.
2. Installer shall be an experienced single firm specializing in the type of roofing and sheet metal work specified, with a minimum of five (5) years of previous successful experience on projects similar in size and scope.
3. Installer shall be certified and approved by manufacturer and licensed to install specified roofing system.
4. No subcontracting of sheet metal fabrication or installation will be accepted. Installer must have a sheet metal shop on the company premises.
5. Installers shall have a competent Superintendent, who is not actually performing roofing work, on site at all time while work is in progress, with full authority to act on behalf of the Installer as his agent.
6. All workmen shall be covered by Workmen's Compensation insurance (verify upon request) and thoroughly experienced in the particular class of work upon which employed. Use of undocumented workers will not be tolerated - No Exceptions.
7. Installer shall ensure that base fastener pull out resistance tests on existing decks were performed and approved by Architect and coordinated with Roofing Consultant prior to starting roofing application.
8. Roofing installer must have reached the highest level of qualifications from the Manufacturer they are providing material for (i.e. Master Select installer).

B. Regulatory Requirements:

1. Classification by Underwriters' Laboratories, Inc. as a Class A roof covering.
2. Roofing system shall be installed in accordance with ASCE-7-16 wind uplift requirements for geographical location exposure C, 140 MPH 3-second gust wind speed zone and risk category III based on IBC building code requirements. Wind-resistance loads listed below have a safety factor of 2.0 incorporated into the calculation.
 - a. Zone 1' Field -57.8 psf or as otherwise indicated by Structural
 - b. Zone 1 Field -100.5 psf or as otherwise indicated by Structural
 - c. Zone 2 Perimeter -132.5 psf or as otherwise indicated by Structural
 - d. Zone 3 Corner -180.6 psf or as otherwise indicated by Structural
3. Follow local, state, and federal regulations of safety standards and codes. Refer to applicable building code or International Building Code for roofing system installation requirements and limitations.

C. Laboratory Testing and Samples:

1. Architect may require tests and inspections as necessary to verify quality of roofing materials and workmanship. Laboratory tests will be performed in accordance with ASTM procedures.
2. Owner will select testing laboratory and will pay for Work required by testing laboratory. Installer shall assume all costs for extraction and patch of all samples.

3. Re-tests for work which fail initial tests or installer shall pay inspections.
4. Installer shall correct all deficiencies in accordance with manufacturers recommended procedures at no cost to Owner.

D. Installation:

1. Unless otherwise indicated, the materials to be used in this specification are those specified and denote the type, quality, performance, etc. required. All proposals shall be based upon the use of the specified material.
2. Install materials in accordance with the manufacturer's current published application procedures and the general recommendations of the National Roofing Installer's Association.
3. It will be the installer's responsibility to obtain and/or verify any necessary dimensions by visiting the job site, and the installer shall be responsible for the correctness of it. Any drawings supplied are for reference only.
4. Installer shall plan and conduct the operations of the work so that each section started on one day is complete, details installed and thoroughly protected and in watertight condition before the close of work for that day.
5. Materials will be securely fastened in place in a watertight, neat and workmanlike manner. All workmen shall be thoroughly experienced in the particular class of work upon which employed. Work shall be performed in accordance with these specifications and shall meet the approval in the field of the Architect.
6. All waste materials, rubbish, etc., shall be removed from the Owner's premises as accumulated. Rubbish shall be carefully handled to reduce the spread of dust, and shall be deposited at an approved disposal site. At completion, all work areas shall be left broom clean and all installers' equipment and materials removed from the site.

1.8 PERFORMANCE REQUIREMENTS

- A. Fire Resistance: Meet Underwriter's Laboratory Class "A" fire rating.
- B. Installer shall ensure that base fastener pull out resistance tests on new lightweight insulating concrete fill were performed and approved by Architect and coordinated with Roofing Consultant prior to starting roofing application.

1.9 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13 – Project Coordination.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original unopened packaging with all tags and labels intact and legible. Carton and can labels shall indicate appropriate warnings, storage conditions, lot numbers, and usage instructions. Handle and store materials and equipment in such a manner as to avoid damage. The proper storage of materials is the sole responsibility of the installer. Materials damaged in shipping or storage shall not be used. Wet or damaged roofing materials shall be discarded, removed from job site, and replaced with new materials prior to application.
- B. Manufacturer's packaging and/or roll plastic is not acceptable for exterior storage. Tarpaulin with grommets shall be accepted minimum for exterior coverings. All stored materials, as mentioned above, shall be minimum of four (4) inches off the substrate and the tarpaulin tied off with rope.
- C. Products liable to degrade as a result of being frozen shall be maintained above 40° F in heated storage.

- D. Moisture sensitive products shall be maintained in dry storage areas or properly covered. Roofing insulation and felts must always be covered or stored in a dry area when not being used.
- E. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day. Any exception must be in written form. Do not place materials or equipment in such a manner as to overload structure.

1.11 WARRANTY / GUARANTEE

- A. Roofing Manufacturer: Warrant the roofing and associated Work for 20 years from date of Substantial Completion as follows:
 - 1. The warranty shall be a NDL "No Dollar Limit" / no penal sum type, with total replacement cost.
 - 2. The warranty shall guarantee the entire roof system and associated work against defective materials and workmanship of installation, with NO exclusion for ponding water.
 - 3. The roof system including roofing insulation, flashing, penetrations, wall flashings, metal work, labor, and material shall be guaranteed against failure of workmanship and materials. Repair of the system, including materials and labor, shall be done at no cost to the Owner.
 - 4. Submit four (4) original executed copies of the Warranty / Guarantee.
- B. Roofing Installer: Jointly with any subinstallers employed by him, shall guarantee the work required and performed under this contract will be free from defects in workmanship and materials, and that the building will be and remain waterproof for a five (5) year warranty period, after the Architect accepts the work as substantially complete. The warranty shall be in approved notarized written form, to obligate the Installer, and subinstallers, to make good the requirements of the warranty. The warranty will be held jointly with the Bonding Company for the first two (2) years and the manufacturer for the remaining three (3) years.
- C. Make arrangements with the materials manufacturer to provide the required warranty. Final warranty shall be submitted to Owner at time of Substantial Completion.
- D. Submit attached Installer's Warranty and Subinstaller's Guarantee forms at Project Closeout.

PART 2 - PRODUCTS

2.1 APPROVED PRODUCTS/MANUFACTURERS

- A. Unless noted otherwise, specifications are based on products of named manufacturers but should not preclude the Installer from using other manufacturers who produce products that meet or exceed the specifications. Manufacturers whose products meet or exceed the specifications, who have manufactured and installed roof materials and systems of the type specified for a minimum of ten (10) years, and who maintains a single source responsibility for the total roofing system, as described herein, may apply for approval as a substitution in accordance with Division 1 requirements regarding substitutions.
 - 1. All materials shall be manufactured, specified, or accepted in writing by membrane manufacturer issuing the warranty. Proposed materials shall ensure full system warranty from said manufacturer. Installer shall be an installer licensed by the manufacturer.

2. Samples of all materials used on the project, which are not supplied by the membrane manufacturer, shall be submitted to the membrane manufacturer for written approval prior to starting work.
3. All materials used on the project shall be asbestos free.

B. Approved Manufactures:

1. Siplast, Inc., Irving, Texas; (972) 869-0070
2. Soprema, Wadsworth, OH; (800) 356-3521
3. Firestone Building Products Company, Carmel, IN; (800) 428-4442
4. Johns Manville, Denver, CO; (800) 654-3103

2.2 ROOFING SYSTEM ASSEMBLY/PRODUCTS

A. Modified Base Sheet: A fiberglass reinforced, Styrene-Butadiene-Styrene (SBS) modified asphalt coated sheet, having an average weight of 28 pounds per square.

1. Approved Product:
 - a. Siplast Product: Para Base, base sheet
 - b. Soprema Product: Sopra-G, base sheet
 - c. JM Product: Perma Ply 28, base sheet
 - d. Firestone Product: MB Base, base sheet

B. Dry Sheathing Paper: (For use as a slip sheet) Rosin coated, 5 lbs. per 100 sq. ft.

2.3 ROOF MEMBRANE ASSEMBLY

A. System Description: A roof membrane assembly consisting of two (2) plies of a prefabricated, reinforced, homogeneous polymer modified asphalt membrane, secured to specified insulation or substrate. The assembly shall possess waterproofing capability, such that a phased roof application, with only the modified bitumen base ply in place, can be achieved for prolonged periods of time without detriment to the watertight integrity of the entire roof system. Installer option to install using hot asphalt "mopped", cold adhesive, torched, or any combination – confirm special membrane types with manufacturer. Provide components of the roof membrane assembly meeting the following physical and mechanical requirements.

1. **Hot Asphalt Applied Modified Bitumen Base Ply:** Approximately 90 mil high performance modified bitumen base ply consisting of a lightweight random fibrous glass mat impregnated and coated with high quality modified bitumen and having the following properties:
 - a. Approved Product:
 - 1) Siplast Product: Paradiene 20
 - 2) Soprema Product: Elastophene Sanded 2.2
 - 3) Firestone Product: SBS Base
 - 4) JM Product: DynaBase
2. **Torch Applied Modified Bitumen Base Ply:** Approximately 120 mil high performance modified bitumen base ply consisting of a lightweight random fibrous glass mat impregnated and coated with high quality modified bitumen and having the following properties:
 - a. Approved Product:
 - 1) Siplast Product: Paradiene 20 TG
 - 2) Soprema Product: Elastophene Flam
 - 3) Firestone Product: SBS Glass Torch Base
 - 4) JM Product: DynaWeld Base

3. **Hot Asphalt Applied Modified Bitumen Finish Ply:** Approximately 130 mil or better high performance modified bitumen “cool roof” reflective white finish ply consisting of a lightweight random fibrous glass mat impregnated and coated with high quality Styrene-Butadiene-Styrene (SBS) modified bitumen, and having the following properties:
 - a. Approvals: UL Approved, FM Approved (products shall bear seals of approval)
 - b. Surfacing: White ceramic chips
 - c. Solar Reflectance (avg.): greater than 3 year aged .75
 - d. Thermal Emittance (avg.): greater than 3 year aged .75
 - e. Solar Reflectance Index (avg.): greater than 3 year aged 64
 - f. Approved Product:
 - g. 1) Siplast Product: Paradiene 30 FR BW
 - h. 2) Soprema Product: Elastophene LS FR GR SG
 - i. 3) Firestone Product: SBS Glass FR Ultrawhite
 - j. 4) JM Product: DynaGlas FR CR G

4. **Torch Applied Modified Bitumen Finish Ply:** Approximately 140 mil or better high performance modified bitumen “cool roof” reflective white finish ply consisting of a lightweight random fibrous glass mat impregnated and coated with high quality Styrene-Butadiene-Styrene (SBS) modified bitumen, and having the following properties:
 - a. Approvals: UL Approved, FM Approved (products shall bear seals of approval)
 - b. Surfacing: White ceramic chips
 - c. Solar Reflectance (avg.): greater than 3 year aged .75
 - d. Thermal Emittance (avg.): greater than 3 year aged .75
 - e. Solar Reflectance Index (avg.): greater than 3 year aged 64
 - f. Approved Product:
 - 1) Siplast Product: Paradiene 30 FR TG BW
 - 2) Soprema Product: Elastophene Flam LS FR GR SG
 - 3) Firestone Product: SBS Glass FR Torch Ultrawhite
 - 4) JM Product: Dynaweld Cap FR CR

5. Stripping Ply: Same as roof system base ply.

2.4 FLASHING MEMBRANE ASSEMBLY

- A. A flashing membrane assembly consisting of two (2) plies of reinforced, polymer modified asphalt membrane (foil face flashing membrane can be used as substitute):
 1. Modified Bitumen Flashing Sheet: Same as roof system finish ply.

 2. Modified Bitumen Foil Faced Flashing Sheet (Substitute):
 - a. Siplast Product: “Aluminum” Veral
 - b. Soprema Product: Sopralast 50 TV “Alu”
 - c. Firestone Product: SBS Metal Flash AL
 - d. JM Product: DynaClad AL

 3. Reinforcing Ply: Same as roof system base ply.

2.5 ROUGH CARPENTRY

- A. All nailers, cants and wooden curbs shall be No. 2 or better treated lumber selected to meet design details and field dimensions and requirements of Section 06 10 00, Rough Carpentry. MCQ and MCA only.

2.6 ROOFING SHEET METAL

- A. Refer to Section 07 62 00, Sheet Metal Flashing, Gutters, Downspouts and Trim.

2.7 ROOF INSULATION

- A. Roofing Insulation:
 - 1. All insulation shall be approved in writing by the membrane manufacturer as to thickness, type, and manufacturer. All insulation must be approved for the specific application with UL and FM Global approval. Refer to Div. 3 for insulation in lightweight concrete.

2.8 ROOFING ACCESSORIES

- A. Roofing Adhesives:
 - 1. Mopping Asphalt: Asphalt that has been certified for full compliance with the requirements for Low Fume Type IV asphalt listed in Table I, ASTM D312. Each container or bulk shipping ticket shall indicate the equiviscous temperature EVT, the finished blowing temperature, FBT, and the flash point, FP.
 - a. Approved Product: Trumbull Low Fume asphalt or as required by membrane.
 - 2. Cold Adhesive (if applicable): An asphalt based adhesive formulated especially for adhering polymer modified asphalt roofing membranes and base plies. Adhere shall be UL & FM listed and approved.
 - a. Soprema Product: FMA
 - b. Siplast Product: PA-311 Adhesive
 - c. Firestone Product: MB Cold Adhesive
 - d. JM Product: MBR Cold Application Adhesive
- B. Bituminous Cutback Materials:
 - 1. Primer: A high flash, quick drying, asphalt solvent blend which meets or exceeds ASTM D41 requirements.
 - a. Approved Product: PA-1125 Asphalt Primer manufactured by Siplast.
 - 2. Mastics: An asphalt cutback mastic, reinforced with non-asbestos fibers, used as a base for setting metal flanges and conforming to ASTM D4586 Type II requirements.
 - a. Approved Product: PA-1021 Plastic Cement manufactured by Siplast.
- C. Caulking and Sealants:
 - 1. VOC Content: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Nonmembrane Roof Sealants: 300 g/L; single component, high performance, elastomeric sealants conforming to ASTM C920 requirements.
 - b. Modified Bituminous Sealants: 500 g/L
 - c. Other sealants: 420 g/L
- D. Ceramic Granules: No. 11 Grade Specification Ceramic granules of color scheme matching the granule surfacing of the finish ply.

- E. Metallic Dust: A finely graded metal dust as supplied or approved by the membrane manufacturer, used for covering of bitumen overruns over the foil surfaced membrane.
- F. Fasteners:
1. Shall be Factory Mutual approved and as recommended by the manufacturer for the specific application.
 2. Fastener for Brick: Shall be 1/4 inch x 2 inches, stainless steel nail, one piece unit, flat head, as manufactured by Rawl Zamac Nailin, or approved equal.
 3. Fastener for Wood: Shall be a #14 Factory Mutual approved fastener, fluorocarbon coated, with CR-10 coating. A minimum 0.200 inch diameter shank and 0.250 inch diameter thread. To be used with Factory Mutual approved, round pressure plates or bar, and having a fluorocarbon CR-10 coating, when subjected to 30 Kesternich cycles (DIN 50018) shows less than ten percent (10%) red rust which surpasses Factory Mutual Approval Standard 4470 as manufactured by Olympic Manufacturing Group, Inc., or pre-approved equal.
 4. Lightweight Insulating Concrete Base Sheet Fasteners: Shall be approved by the fastener manufacturer, membrane manufacturer and FM for use with lightweight insulating concrete as follows:
 - a. Fastener shall be a single unit, precision formed, of electro zinc coated steel having a 2.7 inch diameter rib reinforced cap and 1.7 inch long rectangular legs, designed to expand when fully driven into the lightweight insulating concrete. Fasteners for lightweight insulating concrete shall meet FM Standard 4470 requirements for corrosion resistance.
 - 1) Approved Product: "Zono-tite" Base Sheet Fasteners.
 5. Roofing Nails: Stainless steel, 316, type, size as required to suite application, minimum 11 gauge with 3/8 inch diameter head, minimum 1-1/2 inches in length.
 6. Dual Prong Fastener: Coated Steel tube with stainless steel Locking Staple.
- G. Walkway Pads: A prefabricated, puncture resistant polyester core reinforced, polymer modified bitumen sheet material topped with a ceramic-coated granule wearing surface meeting the following physical and mechanical requirements:
1. Thickness: 0.217 inch
 2. Weight: 1.8 lb./ft²
 3. Width: 30 inches
 4. Approved Product: Paratread Roof Protection Material
- H. Liquid Flashings: One-Part Liquid Flashing is a one-component polyurethane / bitumen resin that provides a liquid flashing solution for asphaltic roofing systems. Utilize fabric in three part system at all penetrations.

2.9 ROOF INSULATION

- A. Roofing Insulation:
1. All insulation shall be approved in writing by the membrane manufacturer as to thickness, type, and manufacturer. All insulation must be approved for the specific application with UL and FM Global approval.
 2. Polyisocyanurate Roof Insulation: Shall comply with ASTM C1289 and Federal Specification Type 2 Class 2, with a 20-psi minimum compressive strength. Insulation shall be surfaced on both sides with a double coated non-asphaltic Non-Organic coated fiberglass facers. Thickness shall be a minimum of 4.4" (divided in two layers of 2.2") over all conditioned air space, see drawings for details. Board sizes shall be 48" x 96" x 1/2" for mechanically attached and 48" x

- 48" x 1/2" for adhered. Approved product shall be RESISTA as manufactured by Firestone or pre-approved equal.
3. Recover Board (Unless noted otherwise): Glass-Faced Gypsum Roof Board equal to UL rated Type X "Dens Deck Prime" as produced by Georgia-Pacific. Board sizes shall 48" x 48" x 1/2" for adhered or as indicated on drawings for roof assembly. Provide as required by manufacture recommendation primer for Roof System. Approved substitute, SECUROCK by USG.
 4. Tapered ISO. Insulation: Factory cut 48 inches x 48 inches polyisocyanurate board cut to 1/4 inch per foot slope; thickness varies; ASTM C1289, UL Class A, Type 2 Class 2 with a 20-psi minimum compressive strength. Approved product shall be Tapered RESISTA manufactured by Firestone or pre-approved equal. Provide 1/2-inch recovery board similar to that specified above over tapered polyisocyanurate board insulation if used.
 5. Tapered Edge Strip: 1-1/2 inches to 0 inches (or as required, field verify), 18 inches x 48 inches, install at all expansion joints, curbs, projections, crickets, saddles and base flashings. Approved material shall be as manufactured by Cant Products or pre-approved equal.

2.10 MISCELLANEOUS MATERIALS AND ACCESSORIES

- A. Other materials shall be as shown, specified or required and be of the best grade for the proposed use as recommended by the manufacturer.
 1. Expansion Joint: As detailed on drawings and outlined in NRCA and SMACNA manuals.
 2. Low Level expansion joints, as noted on the drawings, to be fabricated similar to Situra Inc. "Red Line" Low level expansion joint details. Install as per manufactures recommendations and included in system warranty.
 - a. Approved Substitute Soprema's "Sopra Joint". Install as per manufacturer's recommendations.
 3. Sealant Backer Rod: Provide compressible rod stack of polyethylene foam, polyurethane foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable, non-absorptive material as recommended by sealant manufacturer for back-up of and compatibility with sealant. Where used with hot-applied sealant, provide heat-resistant type which will not be deteriorated by sealant application temperature as indicated.
 4. Pipe Hangers and Supports: Provide and install all necessary supports for gas lines, conduit, chilled water lines, duct work, condensate lines, etc. Refer to Section 07 72 00, Roof Accessories.
 5. Relief vents, lead and other sheet metal materials shall be as specified in Section 07 62 00, Sheet Metal Flashing, Gutters, Downspouts and Trim.
 6. Cant Strips: Shall be wood fiber where used for non-structural purposes. Shall be treated solid wood where used for structural purposes meeting NRCA, Factory Mutual and Underwriters Laboratory guidelines. If solid wood cant is used where insulation exists, cant is to be toe nailed into treated solid wood nailer the same height as insulation.

PART 3 - EXECUTION

3.1 SITE CONDITIONS

- A. Environmental Requirements:
 1. Apply roofing in dry weather.
 2. Do not apply roofing when ambient temperature is below 45 degrees F.
 3. Refer to manufacturers recommendations.

- B. Field Tests:
1. Deck Dryness Test: Test for dryness before applying roofing. Should rain occur during application, retest for dryness before continuing application.
 2. Foaming: Heat one Pt. of specified bitumen to 350 degrees F; pour on surface to receive roofing felts. If bitumen foams, deck is dry enough to roof.
 3. Stripability: Cool bitumen poured on deck to ambient temperature and strip from surface. If any portion strips clean from deck, surface is not dry enough to roof.

3.2 ROOFING AND FLASHING - GENERAL

- A. Membrane Application: Install roofing in accordance with roofing system manufacturer's current published instructions and the following requirements. Application of roofing membrane components shall immediately follow application of base sheet as a continuous operation.
- B. Aesthetic Considerations: An aesthetically pleasing overall appearance of the finished roof application is a standard requirement for this Project. Make necessary preparations, utilize recommended application techniques, apply the specified materials (i.e. granules, metallic powder, etc.) and exercise care in ensuring that the finished application is acceptable to the Owner.
- C. General Installation:
1. Protect adjacent areas with tarpaulin or other durable materials.
 2. Installer shall prevent overspray, and be responsible for parking lot areas and/or adjoining areas not part of this contract.
 3. Installer shall provide three (3) hour firewatch after use of torch. A fire extinguisher shall be present on roof at all times during use of a torch.
 4. Installer shall be responsible for sealing, as required, all openings that may allow bitumen migration or drippage, i.e. pitch dams, envelopes, and filler strips.
 5. Prepare surfaces according to manufacturer's or installer's published instructions. All metal that is to receive bitumen, or come in contact with bitumen or adhesive, shall be first primed with appropriate primer. Use cleaning materials or primers necessary to render a clean and dry surface/substrate.
 6. Prior to application of felts and membrane, all foreign matter, gravel, etc., shall be removed from the substrate. Gravel or debris between the substrate and plies is not acceptable.
 7. Bitumen kettles or tankers shall have a visible thermometer and thermostatic control to provide positive monitoring of the bitumen temperature when it is heated in accordance with manufacturer's instructions. Circulate bituminous materials; do not allow bituminous materials to stand in luggers for long periods. Use insulated hot transport lines and luggers. Kettle shall be kept a minimum of 30 feet away from building, placed so that fumes, odors, and smoke, do not enter building through windows, doors, fresh air vents or similar entrances; are not directed towards freshly painted or anodized surfaces, glass or other glazing materials. Do not place kettle under trees or near vegetation. The assigned kettle man shall remain in close attendance, within 25 feet of ground level, while burners are lit. Kettle lids are to remain closed except for loading. Level of bitumen shall be kept within eight (8) inches from top of kettle.
 8. Asphalt Bitumen Heating: Heat and apply bitumen in accordance with equiviscous temperature method ("EVT Method") as recommended by the manufacturer. Discard bitumen that has been held at temperature, exceeding finished blowing temperature (FBT) for a period exceeding three hours. Do NOT heat bitumen to a temperature higher than 25 degrees F (14 degrees C) below flash point.

9. Asphalt Temperatures: If the EVT information is not provided, the following asphalt temperature shall be observed. Maximum heating temperature shall be 525 degrees F. Minimum application temperature shall be 400 degrees F.
10. Asphalt Moppings: Ensure that all moppings do not exceed a maximum of 25 pounds per square. Mopping shall be total in coverage, leaving no breaks or voids.
11. Membrane Adhesive Application (If applicable): Apply cold adhesive in a smooth, even, continuous layer without breaks or voids at the rate of 1-1/2 gallons per square per ply. (The porosity of some substrates may require a heavier application to ensure full adhesion.) Refer to manufacturer's requirements.
12. Bitumen Consistency: Cutting or alterations of bitumen, primer, and sealants will not be permitted.
13. Wrinkles, buckles, kinks, fishmouths, and dry voids of felt on felt are not acceptable when laying felt and membrane.
14. Primed cant strips shall be installed at the intersection of the deck and the vertical surfaces.
15. All flashings shall be mechanically top-fastened with a termination bar a minimum of six (6) inches on center at the top leading edge, and be a minimum of eight (8) inches in height from finished membrane.
16. On slopes greater than one (1) inch in 12 inches, refer to NRCA and/or manufacturer's guidelines for backnailing procedures and follow the more stringent guidelines for all specified materials.
17. Correct all errors in application the same work day they occur, including voids, fishmouths, dry laps or spots, wrinkles, ridges, blisters, bare spots, improper application, physical damage and all work not meeting specifications.

3.3 NAILERS

- A. Wooden nailers shall be installed at perimeter edges or drip edges on outside perimeter of building.
- B. All Construction: Nailers shall be the same height as the new lightweight insulating concrete deck or insulation being installed. Nailers shall be anchored to resist a pull-out force of 175 pounds per foot. Fasteners shall be no less than two (2) per nailer and be spaced at two (2) feet on center maximum. Provide nailers at all penetrations. Raise all curbs, flashing, etc, a minimum of ten (10) inches above the deck.
- C. Provide additional nailer at all curbs to provide positive drainage away from curb.

3.4 SUBSTRATE PREPARATION

- A. Lightweight Insulating Concrete Deck Systems: Nailable fills shall receive base sheet properly fastened with suitable FM approved fasteners and installed in accordance with ASCE 7 wind uplift pressure calculations.
 1. Damaged lightweight fill decks shall be removed back to solid material. Fill holes, bird baths, etc., in deck using Zonopatch as manufactured by Siplast; or equal by approved manufacturer.

3.5 APPLICATION OF BASE SHEET

- A. Lightweight concrete deck shall be covered with a base sheet, mechanically fastened as follows:
 1. Install in accordance with manufacturer's current published application instructions and to meet ASCE-7 wind uplift requirements. Fasteners and fastening patterns shall be determined by building height, pull out values from lightweight insulating

concrete decks (more stringent applies), location and geographical area of the United States. It is the installer's responsibility to consult current ASCE-7 publications, literature, and bulletins that are in effect at the time of this project. Submit perimeter, field and corner fastening patterns and cite all ASCE-7 data pertaining to the fastening pattern to the Architect for review.

3.6 ROOF ASSEMBLY INSTALLATION

- A. Membrane Application: Install roofing in accordance with roofing system manufacturer's current published instructions and the following requirements. Application of roofing membrane components shall immediately follow application of insulation as a continuous operation.
- B. Aesthetic Considerations: An aesthetically pleasing overall appearance of the finished roof application is a standard requirement for this Project. Make necessary preparations, utilize recommended application techniques, apply the specified materials (i.e. granules, metallic powder, etc.) and exercise care in ensuring that the finished application is acceptable to the Owner.
- C. Adhesive Application: Apply cold adhesive with a spray equipment or squeegee in a smooth even, continuous layer without breaks or voids at the rate of 1 ½ to 2 gallons per square per ply. (The porosity of some substrates may require a heavier application to ensure full adhesion. Refer to manufacturer's requirements.)
- D. Bitumen Consistency: Cutting or alterations of bitumen, primer, and sealants will not be permitted.
- E. Roofing Application:
 - 1. Apply all layers of roofing free of wrinkles, creases or fishmouths. Exert sufficient pressure on the roll during application to ensure prevention of air pockets. Lap seams between the base ply layer and the finish ply layer shall not coincide. Stagger the courses to ensure this.
 - a. Apply all layers of roofing perpendicular to the slope of the deck so that water flows over or along lap seams, but never against laps.
 - b. Fully bond the base ply to the base sheet or recover board with cold adhesive, torch, hot asphalt or mechanically attached-(Installer's option). Each sheet shall have minimum three (3) inch side laps and six (6) inch end laps. Each sheet shall be applied directly behind the adhesive installer. Stagger end laps a minimum of three (3) feet.
 - c. Fully bond the finish ply to the base ply (Installer's option). Each sheet shall have a minimum of three (3) inch side and end laps. Each sheet shall be applied directly behind the asphalt installer. Stagger end laps of the finish ply a minimum of three (3) feet. Stagger side laps of the finish ply a minimum of 12 inches from side laps in the underlying base ply. Stagger end laps of the finish ply a minimum of three (3) feet from end laps in the underlying base ply.
 - d. Maximum sheet lengths and special fastening of the specified roof membrane system may be required at various slope increments where the roof deck slope exceeds 1/2 inch per foot. The manufacturer shall provide acceptable sheet lengths and the required fastening schedule for all roofing sheet applications to applicable roof slopes. Cold process adhesives shall be used on slopes over 1/2 inch per foot up to and including six (6) inches per foot.
 - e. Lap Treatment: A 20-pound roller shall be used on all side and end laps, following immediately behind application, apply uniform pressure across

lap area to achieve a continuous visible bleed out. Strictly follow manufacturers guidelines on bleedout.

- F. Granule Embedment: Broadcast mineral granules over all bitumen overruns on the finish ply surface, while the bitumen is still hot, to ensure a monolithic color.

3.7 ROOF ASSEMBLY FLASHING INSTALLATION

- A. Flashing - General:
1. Flashings shall be installed using the manufacturer's Veral flashing membrane, with length of run not to exceed manufacturer's recommendations.
 2. Wooden nailers or curbs shall be installed at all edges and openings in the roof, mechanically fastened to the deck. The nailers should be of exterior grade treated timber, and of the same thickness as any insulation to be used on the roof.
 3. Cant strips shall be installed at the intersection of the deck and / or all vertical surfaces. Prime all cants.
 4. The roofing field membrane shall extend up over and to the top of cant strips at all vertical intersections or out to the roof's edge.
 5. All substrates receiving flashing membrane shall be clean and primed with asphalt primer, prior to application.
 6. All flashings shall be mechanically fastened with a termination bar a maximum of six (6) inches on center, be a minimum of eight (8) inches above finished roof height, extend a minimum of nine (9) inches onto the field of horizontal roof membrane, and not exceed ten (10) linear feet of run in length.
 7. Install flashing membrane in accordance with drawings and / or material manufacturer's guarantee requirements, whichever is the most stringent.
- B. Flashing Application - Masonry Surfaces: Flash masonry parapet walls and curbs using the reinforcing sheet and the metal foil flashing membrane. After the base ply has been applied to the top of the cant, fully adhere the reinforcing sheet, utilizing minimum three (3) inch side laps and extend a minimum of three (3) inches onto the base ply surface and three (3) inches up the parapet wall above the cant. After the final roofing ply has been applied to the top of the cant, prepare the surface area that is to receive flashing coverage by torch heating granular surfaces or by application of asphalt primer; allowing primer to dry thoroughly. Torch apply the metal foil-faced flashing into place using three (3) foot widths (cut off the end of roll) always lapping the factory selvage edge. Stagger the laps of the metal foil flashing layer from lap seams in the reinforcing layer. Extend the flashing sheet a minimum of four (4) inches beyond the toe of the cant onto the prepared surface of the finished roof and up the wall to the desired flashing height. Exert pressure on the flashing sheet during application to ensure complete contact with the wall / roof surfaces, preventing air pockets; this can be accomplished by using a damp sponge or shop rag. Check and seal all loose laps and edges. Nail the top edge of the flashing on nine (9) inch centers. (See Manufacturer's schematic for visual interpretation.)
- C. Flashing Application - Wood Surfaces: Flash wood or plywood parapet walls and curbs using the reinforcing sheet and metal foil flashing membrane. The reinforcing sheet shall have minimum three (3) inch side laps and extend a minimum of three (3) inches onto the base ply surface and to the top of the parapet wall, curb, etc. Nail the reinforcing sheet through the field of the sheet to the vertical wood surface on 12 inch centers from the top of the cant to top of wall curb, etc. Fully adhere the remainder of flashing reinforcing sheet that extends over the cant and roof level. After the finish ply has been applied to the top of the cant, prepare the surface area that is to receive flashing coverage by torch heating granular surfaces or application of asphalt primer; allowing primer to dry thoroughly. Torch apply the metal foil-faced flashing into place using three (3) foot widths (cut off the end of

roll) always lapping the factory selvage edge. Extend the flashing sheet a minimum of four (4) inches beyond the toe of the cant onto the prepared surface of the finished roof and up the wall to the desired flashing height. Exert pressure on the flashing sheet during application to ensure complete contact with the wall / roof surfaces, preventing air pockets; this can be accomplished by using a damp sponge or shop rag. Check and seal all loose laps and edges. Nail the top edge of the flashing on nine (9) inch centers. (See manufacturer's schematic for visual interpretation.)

D. Projection Flashings:

1. Plumbing Vents: Soil vent stack pipes shall receive lead flashings installed in accordance with practices set forth in the NRCA Roofing Manual. The lead shall be carried up and over the top of the stack, and crimped down into the pipe to form a watertight seal. Projections shall be flashed as recommended by the roof membrane Manufacturer. Provide tapered edge strips around base. Strip-in flange with specified stripping ply.
2. Square Projections: Strip in all flanges on square projections with specified stripping ply. Prime all flanges prior to setting in a bed of mastic. Install to Manufacturer's specifications. Provide tapered edge strips around base. Cricket up-side slope.
3. Round Projections: Strip in all flanges on round projections with specified stripping ply. Prime all metal prior to setting in mastic. Install to Manufacturer's specifications. Provide tapered edge strips around base.
4. Liquid Flashings: One-Part Liquid Flashing is a one-component polyurethane / bitumen resin that provides a liquid flashing solution for asphaltic roofing systems. Utilize fabric in three part system at all penetrations.

E. Wall and Curb Flashings:

1. The flashing substrate shall be free of all dirt and loose material.
2. $\frac{3}{4}$ " plywood is to be used at all parapets that receive wall flashings.
3. The underlayment ply or plies shall be brought to the top of the cant strip and adhered.
4. Starting on the roof at least six (6) inches from the roofside edge of the cant strip, adhere two (2) plies of flashing extending over the cant and up the vertical a minimum of eight (8) inches. Each lap of the ply sheet shall be a minimum of three (3) inches.
5. Starting two (2) inches past the flashing plies, install one (1) ply of SBS flashing membrane in hot asphalt. Laps shall not coincide with previously installed plies. The top of the SBS flashing shall be one (1) inch past the previously installed plies above the cant strip.
6. Fasten the top edge of the flashings on six (6) inch centers using approved termination bar and fasteners.
7. An NRCA-approved metal counterflashing shall extend down over the flashing a minimum of four (4) inches.
8. Cricket the up-side slope at all curb projections.

F. Use of Metallic Powder: Broadcast metallic powder over all bitumen overruns on the metal foil membrane surface while the bitumen is still hot to ensure a monolithic surface color.

G. Overnight Seal / Water Cut-Off:

1. Over Night Seal: Shall be performed according to accepted roofing practice as outlined in the NRCA Roofing Manual.
2. Water Cut-Off: At the end of day's work or when precipitation is imminent, construct a water cut-off at all open edges. Cut-offs can be built using asphalt or

plastic cement and roofing felts, constructed to withstand protracted periods of service. Cut-offs must be completely removed prior to resumption of roofing.

3.8 ROOF SYSTEM INTERFACE WITH RELATED COMPONENTS

- A. The following is a list of descriptions for correct installation of components integrated into the roof membrane assembly. In all cases, unless otherwise approved, incorporate flanged components into the system between the application of the base ply and finish ply. The flange must be primed with a uniform coating of approved ASTM D41 asphalt primer and allowed to dry thoroughly; all flanges must be set in approved mastic.
- B. Walkway Pads:
 - 1. Provide around all roof hatches, A/C units (if applicable) and at top and bottom of all roof access ladders.
 - 2. Cut the material into maximum five (5) foot lengths and allow to relax until flat.
 - 3. Adhere the sheet using the specified plastic cement. Apply the specified cement in a 3/8 inch thickness to the back of the product in five (5) inch by five (5) inch spots in accordance with the pattern as supplied by the material Manufacturer.
 - 4. Install the walkway pad. Use a minimum spacing of two (2) inches between sheets to allow for proper drainage.
 - 5. Walk-in each sheet after application to ensure proper adhesion.
- C. Sealant: Seal all exposed finish ply edges at gravel stops, waste stacks, pitch pans, vent stacks, etc., with a smooth continuous bead of Manufacturer's approved sealant.
- D. Piping / Conduit: Provide hangers and supports as specified in Section 07 72 00, Roof Accessories. Coordinate locations with Architect.
- E. Sheet Metal: Refer to Section 07 62 00, Sheet Metal Flashing, Gutters, Downspouts and Trim.

3.9 FIELD QUALITY CONTROL AND INSPECTIONS

- A. Roof cuts shall be performed and repaired at installer's expense. Cuts shall be made in the areas as indicated by the Architect's representative. Send required roof cuts to roof membrane Manufacturer for laboratory examination. Roof cuts required by the Architect's representative shall be furnished to the Architect's representative for testing.
- B. Remove not more than one (1) 12 inch by 12 inch cut per 5,000 square feet of roof area or fraction thereof.
- C. Field audit will follow criteria outlined in current roof membrane Manufacturer's Reference Manual.
- D. Repair sampled areas with "feathered in" patch consisting of same number of plies as in the roof specification.
- E. Correct deficiencies in roof as prescribed in current roof membrane Manufacturer's Reference Manual and as approved by Architect's Representative.

3.10 CLEANING AND PROTECTION

- A. Leave all areas around job site free of trash, debris, roofing materials, equipment, and related items after completion of job.

- B. Remove bitumen stains from walls, walkways and driveways.
- C. Finished roof areas shall be protected from damage by the installer during construction.

END OF SECTION

SECTION 07 62 00 - ROOF RELATED SHEET METAL

PART I – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. It is the intent of this Section that the Work shall:
 - 1. conform to all applicable building code requirements and of authorities having jurisdiction;
 - 2. include all shop and field formed sheet metal work shown on drawings, specified or required, including, but not limited to:
 - a. Roof penetration sleeves and hood and umbrella counterflashing
 - b. Metal counterflashing
 - c. Expansion joint
 - d. Roof drains
 - e. Scuppers
 - f. Metal perimeter edge
 - g. Gutters, Downspouts, Splash Blocks and Splash Pans
 - h. One-way roof moisture relief vents
 - i. Metal gravity vents
 - j. Metal heat exhaust vents
 - k. Sanitary vent pipes
 - l. Pipe box
 - m. Copings, trim and miscellaneous sheet metal accessories.
 - 3. be part of the Work of the Roofing System; and
 - 4. be performed by a single source contractor.

1.3 RELATED WORK

- A. Section 07 31 13 – Asphalt Roofing Shingles
- B. Section 07 41 13 – Prefinished Metal Roofing
- C. Section 07 52 19 - Modified Bitumen “Cool Roof” Membrane Roofing System
- D. Section 07 72 00 – Roof Accessories
- E. All Sections of Work relating to or affecting the roofing system, including mechanical, plumbing and electrical items.

1.4 REFERENCES

- A. ASTM International (ASTM)
 - 1. A525, Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
 - 2. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
 - 3. B32, Standard Specification for Solder Metal
 - 4. C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

- B. ASCE 7
- C. Federal Specifications (FS)
 - 1. QQ-L-201 for lead
- D. FM Global
 - 1. FM Global Property Loss Prevention Data Sheets: 1-49, Perimeter Flashing
- E. National Association of Architectural Metal Manufacturers (NAAMM)
- F. National Roofing Contractors Association (NRCA)
 - 1. Roofing and Waterproofing Manual
- G. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
 - 1. Architectural Sheet Metal Manual
- H. ANSI / SPRI ES-1

1.5 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Shop Drawings: Indicating sizes, configurations, details of attachment to related and adjacent work, materials, and finishes.
- C. Samples:
 - 1) Full range of finish colors for Architect's selection.
 - 2) 12 inch long sample of each specified item with approved finish.
 - 3) Provide full size mockup of all shop built assemblies.
 - 4) Documentation of Wind uplift requirements for Roof Edge for specific project location
 - a. Wind Calculator available online

1.6 QUALITY ASSURANCE

- A. Single Source Responsibility: Fabricator and installer of roof-related flashing, installer of prefabricated edge metal and accessories shall be the same as the membrane roof installer.
- B. Comply with governing codes and regulations of authorities having jurisdiction.
- C. ANSI / SPRI ES-1: Install sheet metal edge flashings and copings to comply with requirements of ANSI / SPRI ES-1 / FM 1-49 for minimum of up to 140 MPH wind speed zone and wind resistance loads.

1.7 INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13, Project Coordination.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver, handle and store materials in accordance with manufacturer's instructions.

- B. Handle and store materials and equipment in such a manner as to avoid damage.
- C. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day. Any exception must be in written form. Do not place materials or equipment in such a manner as to overload structure.

1.9 WARRANTIES

- A. Manufacturer's Product Warranty:
 - 1) Manufacturer's standard 30 year Kynar 500 or Hylar 5000 Finish warranty signed by the manufacturer, with guarantee covering any failure of the fluoropolymer finish during the warranty period.
 - 2) Failure is defined to include, but not be limited to:
 - a. Deterioration of finish, such as fading, discoloring, peeling, cracking, corroding, etc.
 - 3) Wind Warranty
 - a. Non Coastal: up to 160 MPH Blow Off Resistance, 20 Year
 - 4) Correction may include repair or replacement of failed product as outlined in Warranty Documents
 - 5) Finish warranty and wind warranty shall be delivered by Roofing Contractor to Owner at the conclusion of project as part of project closeout documents.
- B. Roofing Contractor's Warranty:
 - 1. Contractor shall warrant the installation and related work to be free from defects in workmanship and materials, and that the metal flashings will be and remain watertight and secure, for a period of five (5) years from date of Substantial Completion.
 - 2. Defects shall include, but not be limited to:
 - a. Leaking water on the exterior of the building, causing staining or discoloration of wall / exterior surface.
 - b. Leaking water or bitumen within building or construction.
 - c. Becoming loose from substrate / blocking.
 - d. Loose or missing parts.
 - e. Finish failure as defined above.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Metal Era, Inc., which is located at: 1600 Airport Rd.; Waukesha, WI 53188; Toll Free Tel: 800-558-2162; Tel: 262-549-6900; Fax: 800-373-9156; Email:[request_info \(info@metalera.com\)](mailto:request_info@metalera.com); Web:www.metalera.com
- B. Substitutions: Before proposal date upon roof consultant approval.
- C. Requests for substitutions will be considered in accordance with provisions of Section 012513.
- D. Manufacturers named within specification are approved for use on the Project providing:
 - 1. their products meet or exceed the specifications;
 - 2. company has a minimum of five (5) years' experience manufacturing products of the type specified;
 - 3. products have been tested in conjunction with roofing membrane system as an assembly and as such has obtained the same approval and rating as the roofing membrane system; and

4. products are approved for use by the roofing membrane manufacturer.

2.2 SHEET METAL MATERIALS

- A. General Requirements: Roofing sheet metal system shall have been tested in conjunction with roofing membrane system as an assembly and have the same approval and rating as the roofing membrane system.
- B. Prefinished Aluminum Sheet:
 1. Precoated type, aluminum conforming to Fed. Spec. QQ-A-250, ASTM B209.
 2. Thickness: Minimum 0.040 inch, except as otherwise indicated. SMACNA recommendations shall govern.
 3. Finish: Kynar 500, color as selected by Architect from manufacturer's full range of standard and premium colors.
- C. Prefinished Galvanized Sheet Steel:
 1. Commercial quality ASTM A527 G-90 hot-dip galvanized coating designation.
 2. Thickness: Except as otherwise indicated, minimum 24 gauge. SMACNA recommendations shall govern.
 3. Finish: Kynar 500 or Hylar 5000 in color as selected by Architect from manufacturer's full range of standard and premium colors.
- D. Membrane Clad Sheet Steel:
 1. Commercial quality ASTM A527 with G-90 hot-dip galvanized coating designation.
 2. Thickness: Except as otherwise indicated, minimum 24 gauge. SMACNA recommendations shall govern.
 3. Finish: PVC / TPO coating as per Membrane Manufacturer's requirements.
- E. Sheet Lead:
 1. Comply with FS QQ-L-201, Grade B
 - a. Four (4) pound minimum for use at roof drains and soil stacks.
- F. Stainless Steel: ASTM A167, Type 302 / 304 Soft Temper, No. 2D finish. Minimum thickness 24 gauge, except as otherwise noted.

2.3 FASTENERS

- A. Same metal as flashing / sheet metal or other non-corrosive metal or as noted below.
- B. Exposed fasteners shall be self-sealing and gasketed (ZAC type) for weathertight installation.
- C. Match finish of exposed heads with material being fastened.
- D. Mechanical Fasteners:
 1. Nails: Ring shank, minimum 1-1/2 inches in length with 1/2 inch diameter head.
 2. Washers: Steel washers with bonded rubber sealing gasket.
 3. Screws: Self-tapping sheet metal type of stainless steel or compatible with material being fastened, with hooded integral EPDM washers (ZAC type).
 4. Rivets: Stainless steel and cadmium plated material, closed end type of sizes recommended by sheet metal manufacturer to suit application.
- E. Clips:
 1. Cleat (coping / fascia): Minimum 22 gauge or .050 aluminum, G-90 galvanized, stainless steel, or aluminum. Match material of coping / fascia and provide one (1) gauge heavier.

2.4 RELATED MATERIALS

- A. Solder: ASTM B32, alloy grade 58, 50 percent tin, 50 percent lead.
- B. Flux:
 - 1. Phosphoric acid type, manufacturer's standard.
 - a. For Use with Steel or Copper: Rosin flux
 - b. For Use with Stainless Steel: Acid-chloride type flux, except use rosin flux over tinned surfaces.
- C. Underlayment:
 - 1. 40 mil minimum, non-reinforced, homogeneous, waterproof, impermeable elastomeric sheeting: Grace Ice and Water Shield HT, Soprema HT underlayment, Carlisle WIP 300 HT underlayment or similar product.
 - 2. At wood blockings: Self-Adhered Flexible Flashing: 40-mil, rubberized asphalt adhesive reinforced flashing with a high density cross laminated polyethylene film. Provide compatible substrate primer as instructed by manufacturer and coordinate with specification 07 65 00.
- D. Adhesives: Type recommended by flashing sheet manufacturer seaming and adhesive application of flashing sheet to ensure adhesion and watertightness.
- E. Metal Accessories: Sheet metal clips, straps, anchoring devices, clamps and similar accessories required for the complete installation of work, matching or compatible with material being installed, non-corrosive, size and gauge recommended by installer to suit application and performance.
- F. Sealant:
 - 1. Type A:
 - a. Type: One-part, non-sag, moisture-curing polyurethane sealant.
 - b. Approved Products / Manufacturers: "Chem-Calk 900" manufactured by Bostik Construction Products Division, "Vulkem 921" manufactured by Mameco International, Inc., "Dynatrol I" manufactured by Pecora Corporation, "MasterSeal NP 1" manufactured by BASF, or approved equal.
 - 2. Type B:
 - a. Type: One-part, neutral-curing, medium-modulus silicone sealant for sealing metal to metal surfaces, i.e. metal edge, cover plates, etc.
 - b. Approved Products / Manufacturers: "Chem-Calk 1200" manufactured by Bostik Construction Products Division, "795 Silicone Building Sealant" manufactured by Dow Corning Corporation, "895 Silicone" manufactured by Pecora Corporation, "Omniseal" manufactured by Sonneborn Building Products, "Spectrem 2" manufactured by Tremco Incorporated, or approved equal.
- G. Grout - Pitch Pans:
 - 1. Type: Quick-setting, non-shrink, non-metallic, high strength formula complying with ASTM C1107.
 - 2. Approved Products / Manufacturers: "Sure Grip High Performance Grout" manufactured by Dayton Superior Corporation, "Premier Quick-Trim" manufactured by L & M Construction Chemicals, Inc., "MasterFlow" manufactured by BASF, or approved equal.
- H. Pitch Pan Filler:
 - 1. Type: Pourable polyurethane sealer, approved by roofing system manufacturer.

2. Approved Products / Manufacturers: "Quick Pitch Sealer" manufactured by U.S. Intec, "SPM Pourable Sealer" manufactured by Johns Manville, or approved equal.
- I. Termination Bar:
 1. Material: Stainless steel or extruded aluminum bar with lipped profile.
 2. Size: 1/8 inch thick by one (1) inch wide with factory punched 1/4 inch x 3/8 inch oval holes spaced six (6) inches on center.
 3. Approved Product / Manufacturer: "TB 125" manufactured by TruFast Corp., or approved equal.
- J. Pipe Hangers and Supports: Refer to Section 07 72 00, Roof Accessories.
- K. Splash Blocks: Concrete type, of size and profiles indicated; minimum 3,000 psi compressive strength at 28 days, with minimum five (5) percent air entrainment. Use at locations where roof drainage discharges on ground.
- L. Splash Pans: 22 gauge stainless steel, of size and profiles indicated. Use at locations where roof drainage discharges over adjoining, lower roof level(s).
- M. Ventilated Roof Airflow Products USED IF VENTED DECK IS REQUIRED Hi-Perf Vented Fascia by Metal-Era, Inc.
Hi-Perf Vented Fascia:
 - (1) Construction:
 - (a) Metal:
 - (i) .040 inch (1.01 mm) aluminum.
 - (ii) .050 inch (1.27 mm) aluminum.
 - (b) Aluminum Finish:
 - (i) Kynar-500 color as selected by the Architect from roof edge manufacturer's full range of standard and premium colors.
 - (c) Perforated Support Screen: 24 gauge formed steel with 54 percent free openings.
 - (d) Roof Flange and Backer Material: G90 Galvanized Steel with Formed Aluminum Studs.

2.5 FABRICATION

- A. Except as otherwise indicated, fabricate work in accordance with SMACNA Architectural Sheet Metal Manual and other recognized industry practices and reviewed shop drawings. Form all flashings, receivers and counterflashings in accordance with standards set forth in the NRCA roofing manual and SMACNA.
- B. Comply with manufacturer's installation instructions and recommendations.
- C. Shop fabricate Thru-wall, counterflashings, expansion joint metal and wind clips to greatest extent possible.
- D. Fabricate items to size and dimensions as indicated on the drawings. Limit single-piece lengths to twelve (12) feet for prefabricated pieces and ten (10) feet for shop fabricated pieces.
- E. Face of any fabricated vertical metal fascia or coping shall not exceed 8" without stiffener band or birds beak. If stiffener band or birds beak cannot be fabricate, contractor to use multiple pieces of metal to achieve overall distance without going over the 8" maximum per piece.

- F. Fabricate for waterproof and weather-resistant performance; with expansion provisions for running work sufficient to permanently prevent leakage, damage or deterioration of the work.
- G. Integrate flashing in a manner consistent with membrane waterproofing detailing. Form work to fit substrates.
- H. Make angle bends and folds for interlocking metal with full regard for expansion and contraction to avoid buckling or fullness in metal after installation.
- I. Fabricated items will have straight lines, sharp angles, smooth curves, and true levels. Avoid tool marks, buckling, and oil canning.
- J. Fold back edges on concealed side of exposed edge to form hem.
- K. Unless noted otherwise, lap joints minimum three (3) inch. Lap joints to have sealant installed as per details, to maintain watertight condition, inside and outside corners and elevation changes to be riveted and soldered.
- L. Seams:
 - 1. Wherever possible, fabricate non-moving seams in sheet metal with flat-lock seams and end joints.
 - 2. Pre-finished Galvanized Steel: Seal pre-finished metal seams with rivets and silicone sealant.
 - 3. Metal Other than Aluminum: Tin edges to be seamed, form seams, and solder.
- M. On Kynar 500 or Hylar 5000 pre-finished metal, surface sand metal flanges prior to applying any primers. Prime all metal in contact with bituminous material.
- N. Backpaint all concealed metal surfaces with bituminous paint where expected to be in contact with cementitious materials or dissimilar metals.
- O. Expansion Provisions: Where lapped or bayonet type expansion provisions in work cannot be used or would not be sufficiently waterproof or weatherproof, form expansion joints of intermeshing hooked flanges, not less than one (1) inch deep filled with mastic sealant concealed within joints.

2.6 FABRICATED ITEMS

- A. Metal Flashings:
 - 1. Through Wall Receiver Tray: Minimum 24 gauge stainless steel formed in maximum ten (10) foot lengths, through wall receivers shall not extend past the face of the exterior veneer more than $\frac{3}{4}$ ".
 - 2. Counterflashings: Minimum 24 gauge stainless steel, formed in maximum ten (10) foot lengths.
- B. Wind Clips: Minimum 24 gauge stainless steel (or match material of counterflashing), one (1) inch wide by length to engage counterflashing a minimum of 1/2 inch. To be installed at all wall flashings and at curb flashing lengths longer than 5 feet.
- C. Roof Penetrations:
 - 1. Umbrella Counterflashing: Two-piece construction of minimum 22 gauge stainless steel, fabricated in accordance with drawings or project requirements.
 - 2. Flashing Pans:
 - a. 24 gauge stainless steel.

- b. Fabricate to provide installed minimum clear inside perimeter dimension of two (2) inches on each side of penetrating element.
- c. Fabricate pans to at least six (6) inches above the finished roof membrane and with 1/4 inch hem at top edge and with four (4) inch flanges. Round all corners of flange.
- d. Fabricate metal bonnets for all pans, NO EXCEPTIONS. Fabricate bonnets with metal compatible with metal to which bonnet is to be attached. On beams and other steel, weld in place bonnets fabricated from 1/4 inch steel plate. Draw band bonnets fabricated from 22 gauge stainless steel may be used on circular projections.

D. Metal Edge / Fascia:

- 1. Anchor-Tite Fascia: Decorative metal fascia with continuous extruded aluminum bar and perforated 'L' angle at joints.
 - 1) Construction:
 - a. Fascia metal gauge:
 - 1) .040 inch (1 mm) thick formed aluminum.
 - 2) 24 gauge galvanized steel.
 - b. Finish:
 - 1) Kynar-500 color as selected by the Architect from roof edge manufacturer's full range of standard and premium colors.
 - c. Fascia: Standard 12'-0" lengths.
 - d. Extruded bar: Shall be continuous 6063-T6 alloy aluminum at 12'-0" standard lengths with pre-punched slotted holes. All bar miters are welded.
 - 1) Injection Molded EPDM Bar Splice to allow thermal movement expansion of extruded aluminum anchor bar.
 - 2) Fasteners: 2" stainless steel with driver.
 - e. Performance:
 - 1) 215 MPH Wind Warranty for Lifetime of Roof
 - 2) Tested per ANSI / SPRI ES-1 / FM4435 to comply with the International Building Code.
- 2. Edge Systems One "One Gravel Stop" for Modified Bitumen Roof Systems: Features a continuous cleat with pre-slotted fastening holes and staggered openings in 40% of the roof flange.
 - 1) Metal:
 - a) .040 inch (1.01 mm) aluminum.
 - b) 24 gauge galvanized steel.
 - 2) Finish:
 - a) Kynar-500 color as selected by the Architect from roof edge manufacturer's full range of standard and premium colors.
 - 3) Fascia: Standard 12'-0" lengths with matching concealed joint splice plates.
 - 4) Splice Plates and 22 gauge galvanized continuous cleats with slotted holes are included
 - 5) Performance:
 - a) 20 Year, 160 mph Wind Warranty.
 - b) Tested per ANSI / SPRI ES-1 / FM4435 Standard to a design pressure of 276 lbs./ft² to comply with the International Building Code.
 - c) Factory Mutual approved I-285 for wind up lift protection.
- 3. Edge Systems One "One Drip Edge" for Thermoplastic Roof Systems: Features a

continuous cleat with pre-slotted fastening holes.

- 1) Metal:
 - a) .040 inch (1.01 mm) aluminum.
 - b) 24 gauge galvanized steel.
- 2) Finish:
 - a) Kynar-500 color as selected by the Architect from roof edge manufacturer's full range of standard and premium colors.
- 3) Fascia: Standard 12'-0" lengths with matching concealed joint splice plates. 1/4" face height.
- 4) Splice Plates and 22 gauge galvanized continuous cleats with slotted holes are included.
- 5) Performance:
 - a) 20 Year, 160 mph Wind Warranty.
 - b) Tested per ANSI / SPRI ES-1 / FM4435 Standard to a design pressure of 276 lbs./ft² to comply with the International Building Code.
 - c) Factory Mutual approved I-285 for wind up lift protection.

E. Metal Coping

1. Perma-Tite Coping

- 1) Construction:
 - a) Metal:
 - 1) .040 inch (1.01 mm) aluminum.
 - 2) 24 gauge galvanized steel.
 - b) Finish:
 - 1) Kynar-500 color as selected by the Architect from roof edge manufacturer's full range of standard and premium colors.
- 2) Coping Cap: Length of 12'-0", widths to 24" manufactured to job requirements. True radii may be built to template.
- 3) Coping Vertical Face and Back Leg: 2 1/4" to 12 1/2" manufactured to job requirements.
- 4) Concealed Splice Plates: 8" wide. Finish to match finish of coping cap with factory applied dual non-curing sealant strips.
- 5) Anchor / Support Cleat: 20 gauge pre-punched galvanized cleat with stainless steel spring mechanically locked to cleat normally 12" wide at 4'-0" on center. Mechanically fastened as indicated and detailed.
- 6) Fasteners: 1 1/2" stainless steel with driver.
- 7) Performance:
 - a) 20 Year, 160 mph Wind Warranty
 - b) Tested per ANSI / SPRI ES-1 / FM4435 Standard to comply with the International Building Code.
 - c) Factory Mutual 1-90 approved for wind up lift protection.
 - d) Miami-Dade Approved (No. 13-0419.03 12/11/18) to comply with the "High Velocity Hurricane Zone of the Florida Building Code".

2. Creative Design Reveal Coping

- 1) Construction:
 - a) Coping Cap: Length of 4'-0", widths to 24" manufactured to job requirements. True radii may be built to template.
 - b) Coping Vertical Face and Back Leg: 2 1/4" to 12" manufactured to job requirements.
 - c) Concealed Splice Plates: 8 inch wide. Finish to match finish of coping cap with factory applied dual non-curing sealant strips.
 - d) Anchor / Support Cleat: 20 gauge pre-punched galvanized cleat

with stainless steel spring mechanically locked to cleat normally 12" wide at 4'-0" on center. Mechanically fastened as indicated and detailed.

- 2) Fasteners: 1½" Stainless Steel with driver.
- F. Continuous Cleats (where applicable): Continuous strips, same material and profile, minimum one gauge heavier of item which cleats attach.
- G. Vent Hoods, Sleeves, Penetration Flashings, and Accessories: Minimum 24 gauge stainless steel, or as shown or directed otherwise.
- H. Angle Termination Bar: Aluminum pressure bar 1/8 inch x one (1) inch.
- I. Vent Pipe Flashing: Four (4) pound lead. Provide proper size to fold down inside of pipe a minimum of one (1) inch.
- J. Vent Pipe Flashing: Unreinforced, pre-molded thermoplastic membrane pipe boot to suit flashing condition and pipe size. Provide stainless steel pipe clamp and sealant between pipe boot and clamp. Provide sheet metal umbrella flashing with sealant and pipe clamp above top of membrane pipe boot clamp and seal.
- K. Gutters / Downspouts / Collector Heads: Seal-Tite Industrial Gutter System by manufacturer.
1. Minimum 0.040 inch thick prefinished aluminum formed in maximum twelve (12) foot lengths.
 2. Match dimension of existing. Verify gutter and downspout meets rainfall data as outlined in SMACNA.
 3. Seal-Tite Industrial Gutter, including 2" Wide Gutter Straps 24" o.c., Wind Straps 6'-0" o.c., 1/8" Stainless Steel Pop Rivets, and #10 x 2" Stainless Steel Fasteners to be manufactured and supplied to suit profile and dimension of gutter and downspout by manufacturer.
 4. Supply Drip Edge at gutter.
 5. For Modified Bitumen Systems: Include FlashThrough Drip Edge without Continuous Cleat.
 6. 24 gauge galvanized steel with membrane manufacturer's coating (specify)
 7. For Single Ply roofing systems: Drip Edge with Factory Applied Flashing (TPO or PVC).
 8. End Caps, Downspout Outlets, Gutter and Downspout Straps, Support Brackets and joint fasteners to be manufactured to suit profile and dimension of gutter and downspout.
 9. Install all anchoring devices as outlined in manufacturer literature.
 10. Expansion Joints: Style 1 per manufacturer, locate every 50 linear feet.
 11. Gutter Straps and Supports: Minimum 3 per 12'-0" length, .100 inch thick downspout straps: Strap type, like metal, match color.
 12. Downspouts: Minimum 0.040 inch thick prefinished aluminum (match color).
 13. Downspout straps: Strap type, like metal, match color.
 14. Gutter Screen: .050" Aluminum with ¼" dia. perforations
 15. Collect Heads: Minimum 0.040 inch thick prefinished aluminum (match color). As outlined in SMACNA; Refer to Figure 1-25F and Figure 1-28 with alternate Section A-A.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify substrates are smooth and clean to extent required to perform sheet metal work.

- B. Verify roof openings, curbs, pipes, sleeves, ducts or vents through roof are solidly set in place.
- C. Verify that reglets, nailers, cants, and blocking to receive sheet metal are in place and free of concrete and soil.
- D. Do not start work until conditions are satisfactory.

3.2 PREPARATION

- A. Field measure site conditions prior to fabrication work.
- B. Install starter and edge strips and cleats before starting installation.

3.3 INSTALLATION

- A. Install sheet metal with lines, arises, and angles sharp and true, and plane surfaces free from objectionable wave, warp, or buckle. Exposed edges of sheet metal shall be folded back to form 1/4 inch hem on concealed side from view. Finished work shall be free from water retention and leakage under all weather conditions. Prefabricated corners or transitions are required at changes in direction, elevation, or plane and at intersections. Locate field joints not less than 12 inches, nor more than three (3) feet from actual corner. Laps shall be one (1) inch, riveted and soldered at following locations:
 - 1. Prefabricated corners;
 - 2. transitions;
 - 3. changes in direction, elevation, and plane; and
 - 4. at intersections.
- B. Anchor units of work securely in place to prevent damage or distortion from wind or buckling. Provide for thermal expansion of metal units; conceal fasteners wherever possible; and set units true to line and level as indicated. Install work with laps, joints, and seams which are permanently watertight and weatherproof.
- C. Install fabricated sheet metal items in accordance with manufacturer's installation instructions and recommendations and with SMACNA Architectural Sheet Metal Manual.
 - 1. Ensure approved fasteners are used throughout the project.
 - 2. Ensure fasteners are installed in manufacturer pre-punched holes on rails, extrusions, clips and cleats.
 - 3. Ensure sufficient amount of waterblock is applied where appropriate to prevent leaking under rails/extrusions. **Contractor is responsible for cleaning stained brick and remedying for total length of workmanship warranty if waterblock is not installed appropriately.**
- D. Separations: Provide for separation of metal from dissimilar metal or corrosive substrates by coating concealed surfaces with zinc chromate, bituminous coating, or other permanent separation at locations of contact as recommended by manufacturer or fabricator. Do not use materials which are incompatible with roofing system.
- E. Cleat: At exposed edges of perimeter edge, fascias, cap flashings, and where required, attach cleat with appropriate fasteners supplied by roof edge manufacturer. Install cleat so fascia extends a minimum of 1 inch below top of exterior wall finish.
- F. Counterflashing:
 - 1. Do not use surface mount counterflashing except as noted in drawings.

2. Set in through wall with receiver and spring lock counterflashing, as detailed in drawings and to NRCA roofing manual, SMACNA standards.
 3. Coordinate installation of through-wall flashing with the masonry contractor.
 4. Seal through-wall in conjunction with masonry wall waterproofing.
 5. Install wind clips 30 inches o.c. at all counterflashing over five (5) feet in length.
- G. Pitch Pans, Metal Flanges (As Required):
1. Apply mastic under pitch pan or metal flashing flange at least 1/2 pound per linear foot.
 2. Prime all metal flanges with asphalt primer prior to flashing installation.
 3. Clean all projections enclosed in pitch pans in any manner suitable and coated with a rust inhibitive coating as approved by the Architect. Coating shall be allowed to dry prior to pitch pan fill.
 4. Fill base of pitch pans with grout or cementitious binder and allow to cure.
 5. Top Finish Fill: Self-leveling, one-part urethane; at least two (2) inches to top of pitch pan sides.
 6. Strip in pitch pan flanges with two strips of specified stripping plies set in hot bitumen extending three (3) inches from the outer edge of the flange to at least three (3) inches inward toward base of pitch pan. Provide finish stripping ply of SBS modified bitumen membrane in hot bitumen extending six (6) inches from the outer edge of the flange and butt to base of pitch pan.
- H. Sanitary Vent Stacks (As Required):
1. Prime top and bottom flanges of lead flashing sleeve. Set flange in uniform troweling of plastic roof cement. Prime top side of flange to receive strip-in membrane.
 2. Fold lead sleeve down inside of pipe a minimum of one (1) inch. Apply a continuous bead of sealant on inside of pipe prior to folding lead sleeve.
- I. Gutters / Downspouts:
1. Install gutters prior to edge metal and otherwise as detailed.
 2. Install downspouts plumb and level, attached to columns or wall with straps located at top and bottom of downspout and maximum ten (3) feet on center (note: 3 per 12' lengths supplied by manufacturer).
 3. Install splash pad or block under discharge port of downspouts (if non exist). Install splash pan over a protection (walkway) pad for downspouts located at roof level.

3.4 CLEANING AND PROTECTION

- A. Remove flux and residual acid immediately by neutralizing with baking soda and washing with clean water. Leave work clean of stains.
- B. Remove scraps and debris and leave work area clean.
- C. Clean exposed metal surfaces, removing substances which might cause corrosion of metal or deterioration of finishes. Paint areas where finish is damaged on pre-finished metal by painting with a compatible paint in color to match undamaged finish.
- D. Prime soldered area of phosphatized metal after cleaning to prevent rusting.
- E. Paint metal flashings that have been soiled with bitumen with aluminized paint.
- F. Clean other work damaged or soiled by Work of this Section.
- G. Protect finished work from damage.

END OF SECTION

SECTION 07 65 00 - FLEXIBLE FLASHING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Provide flexible flashing where shown on drawings or required.

1.3 RELATED SECTIONS

- A. Section 03 30 00 – Cast-In-Place Concrete
- B. Section 04 20 00 – Unit Masonry
- C. Section 07 27 26 – Fluid Applied Air Barrier System
- D. Section 07 52 19 – Modified Bitumen “Cool Roof” Membrane Roofing System
- E. Section 09 21 16 – Gypsum Wallboard Systems (Exterior Sheathing)

1.4 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer’s specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer’s installation instructions.
- B. Certification: Manufacturer’s affidavit that materials used in Project contain no asbestos.
- C. Compatibility: Submit letter from primary Fluid Applied Air Barrier System Manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use. Submit letter from Manufacturer stating that cleaning materials used during installation are chemically compatible with adjacent materials proposed for use.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Flexible flashing materials used shall be compatible with and not void any warranties of the air barrier system used. Other manufacturers must have a minimum of five (5) years’ experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

2.2 MATERIALS

- A. Flashing:
 - 1. Copper Laminated Flashing (Contractor’s Option – in lieu of asphalt-free copper fabric flashing):
 - a. Flashing: A full sheet of copper weighing five (5) ounces per square foot coated or bonded on both sides with one (1) of the following:
 - 1) Modified asphalt compound coated.
 - 2) Asphalt saturated, waterproof glass fiber laminated fabric.

- b. Approved Manufacturers:
 - 1) Advanced Building Products, Inc.
 - 2) Hohmann & Barnard, Inc.
 - 3) Sandell Manufacturing Company, Inc.
 - 4) York Manufacturing, Inc.
- c. Mastic: Manufacturer recommended asphalt troweled mastic for sealing copper laminated flashings
- 2. Asphalt-free Copper Fabric Flashing (Contractor's Option – in lieu of copper laminated flashing):
 - a. Glass fabric scrim bonded to a full sheet of copper for general through wall flashing as an alternative to asphalt coated copper specified above and where sealant compatibility is required. Provide manufacturers approved sealant or seam tape.
 - b. Approved Product / Manufacturer: Multi-flash 500 as manufactured by York Manufacturing, Inc.; or Copper-Fabric NA or Copper-Fabric SA as manufactured by Hohmann & Barnard, Inc. (No substitutions).
- 3. Asphalt-free Stainless Steel Flexible Flashing (Contractor's Option – in lieu of copper laminated or asphalt-free copper fabric flashing):
 - a. Flexible minimum 2 mil thickness, Type 304 steel sheet with factory applied adhesive with a release liner on one side for general through wall flashing as an alternative to asphalt coated copper specified above and where sealant compatibility is required. Provide manufacturers approved sealant or seam tape.
 - b. Approved Product / Manufacturer: York 304 as manufactured by York Manufacturing, Inc.; or Mighty-Flash-SA as manufactured by Hohmann & Barnard, Inc. (No substitutions).
- 4. Membrane Flashing:
 - a. Self-Adhered Flexible Flashing: 40-mil, rubberized asphalt adhesive reinforced flashing with a high density cross laminated polyethylene film. Provide compatible substrate primer as instructed by Manufacturer.
 - b. Approved Products / Manufacturers:
 - 1) "CCW-705 TWF" manufactured by Carlisle Coatings and Waterproofing
 - 2) "Perm-A-Barrier" manufactured by W. R. Grace & Co.
 - 3) "Blueskin TWF" manufactured by Henry Co.
 - 4) "Air-Shield Through wall flashing" manufactured by W.R. Meadows, Inc.
 - 5) "TW-Thru Wall Flashing" manufactured by Tamko Waterproofing.
 - 6) AquaFlash 500" manufactured by Fiberweb.
- 5. Substrate Primer: Provide as instructed by Membrane Manufacturer.
- 6. Termination Bar: 14 ga. minimum thick by 1" minimum wide stainless steel, with pre-punched holes and ¼" minimum shouldered top flange. Provide with self-tapping screws.
- 7. Weathering Flange at Door / Window Openings: Provide a 20 gauge (0.040") stainless steel or .040 aluminum 2"x3" weathering flange at head, jamb and under sill pan of storefront window and hollow metal door systems. Screw attach into wood blockings or substrate walls and strip into air barrier system.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Flashing:
 - 1. Follow manufacturer's instructions for mechanically fastened installation with a termination bar.

2. Application Guidelines - Install flashing at the following locations:
 - a. Membrane Flashing: material transitions inside exterior cavity walls, roof edge / exterior wall transitions, masonry joints (control/expansion) inside exterior cavity walls, exterior door and window frame perimeters, roof deck / exterior wall transitions, exterior wall penetrations (i.e. pipe, conduit, ducts, etc.). Provide membrane at all joints, holes, gaps, or openings to ensure a continuously sealed building envelope. Utilize primer on substrates as instructed by manufacturer.
 - b. Copper Flashing: At all horizontal wall flashing, including (but not limited to) exterior wall sill / weep conditions, exterior door and window head / weep conditions, intermediate and / or shelf angles, masonry wall cap flashing and masonry wall base flashing.
3. Apply substrate primer as instructed by membrane manufacturer to suit condition.
4. Provide drip edge flashing at weep conditions with membrane flashing. Cut $\frac{1}{4}$ " to $\frac{1}{2}$ " behind with outside edge of brick over top of drip edge flashing to alleviate exposure to UV degradation and deterioration of asphalt membrane.
5. On Horizontal Surfaces: The flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. The flashing shall be cut $\frac{1}{4}$ " to $\frac{1}{2}$ " behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall, turned up where possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of six (6) inches. Flashing will then be secured in back wall with termination bar.
6. On Vertical Surfaces: Surfaces receiving the flashing shall be sufficiently spotted with asphalt mastic to hold in place until masonry is set. Secure in back wall with termination bar.
7. Foundation Sill Dampproofing: The flashing for foundation sills shall be laid in a slurry of fresh mortar or in a full bed of mastic and topped with a fresh full bed of mortar. The flashing shall be cut $\frac{1}{4}$ " to $\frac{1}{2}$ " behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be sloped across the cavity and turned up the wall a minimum of ten (10) inches and secured to back wall with termination bar. Where sill and column meet, flashing shall be brought up a minimum of ten (10) inches up the column.
8. Thru-Wall Flashing: Shall be cut $\frac{1}{4}$ " to $\frac{1}{2}$ " behind the exterior face of the wall after being left exposed for inspection purposes only. Carry flashing through the wall, turned up where possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of six (6) inches, unless noted otherwise, and secure in back wall with termination bar.
9. Lintel: Premolded or field molded end dams must be provided at each end of all lintels.
10. Cavity Wall: Flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall be cut $\frac{1}{4}$ " to $\frac{1}{2}$ " behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and upward across the cavity a minimum of six (6) inches, unless noted otherwise, and secured in the back wall with termination bar. Vertical membrane joints shall be secured with termination bar as instructed by membrane manufacturer.
11. Heads, Jambs and Sills: Flashing for heads and sills shall be cut $\frac{1}{4}$ " to $\frac{1}{2}$ " behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and upward across the cavity a minimum of six (6) inches, unless noted otherwise. Head flashing shall be carried six (6) inches beyond both end of the steel lintel. Both head and sill flashing shall be turned up at the sides to form a pan. All corners shall be folded,

- NOT CUT. Jambs are to be turned into the buildings to complete seal perimeter of window or door. Install weepholes.
12. Windows: wrap all heads, sills and jambs into opening with flexible flashings.
 13. Wood blockings: Flexible flashings are to cover wood blockings in their entirety.
 14. Spandrels: Spandrel flashing shall start from the outside toe of the shelf angle, go up the face of the beam and then through the wall, turned up on the inside not less than two (2) inches. Install weepholes.
 15. Parapet or Coping: Flashing for parapets or coping sills shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall be cut $\frac{1}{4}$ " to $\frac{1}{2}$ " behind the exterior face of the wall after being left exposed for inspection purposes only. Weepholes shall be installed immediately on top of the flashing.
 16. Lengths: Install flashings without longitudinal joints within walls, if possible. If required materials are not available in a single width, join by lapping material minimum two (2) inches and seal joint throughout its length with adhesive.
 17. End Joints: Avoid end joints in flashing. When end joints are necessary, lap flashing minimum six (6) inches and seal joint continuously with adhesive.
 18. Penetrations: Where anchors, pipes, and inserts penetrate flashing, make opening in flashing snug and seal with adhesive.
 19. Reglet Termination: Insert wedge into place and seal carefully with adhesive.
 20. Termination Bar: Install flashing with termination bars in accordance with manufacturer's instructions. Provide 3 coursing at all termination bars, typical.
 21. Top Coat: After flashing material is in place (except in masonry joints where bond and mortar is required) trowel full $\frac{1}{8}$ inch protective coating or mastic on all flashing faces.
 22. Lintels: Provide pre-molded end dams at all lintel ends.
- B. Bed Joints: Coordinate work with Division 4, Masonry. Install thru-wall flashings between two (2) thin layers of masonry mortar without increasing thickness of mortar joint. Keep outer edge of flashing material back $\frac{3}{4}$ inch from face of masonry.

3.2 APPLICATION

- A. Protect membrane from overexposure to direct sunlight.
- B. Follow manufacturer's recommendations for installation.
- C. Adjacent Work: Protect work by masking, covering, or other precautionary methods. Remove protection when no longer necessary.

END OF SECTION 07 65 00

SECTION 07 22 00 - ROOF ACCESSORIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 INSTALLATION RESPONSIBILITY

- A. In addition to the items normally a part of this Section, coordinate the installation of roof accessory curbs and pipe flashings and equipment supports that may be specified elsewhere.
- B. Coordinate the Work specified herein with the following Work:
 - 1. Roofing
 - 2. Roofing sheet metal
 - 3. Mechanical equipment
 - 4. Plumbing
 - 5. Electrical

1.3 REFERENCES

- A. Federal Specifications (FS)
 - 1. TT-S-00227E
- B. National Roofing Contractors Association (NRCA)
- C. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
 - 1. Architectural Sheet Metal Manual

1.4 SUBMITTALS

- A. Product Data: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.
- B. Shop Drawings: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.
- C. Contractor to provide proof of membrane material compatibility for roof bracing and supports.(Refer to section 2.6)

1.5 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13 – Project Coordination.

1.6 WARRANTY

- A. Warranty the Work specified herein for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to, the following:
 - 1. Noticeable deterioration of finish
 - 2. Water infiltration into the building or within the construction.

- C. Rooftop supports – 5 year limited warranty.
- D. Roof bracing – 20 year limited warranty included in roofing warranty.
 - 1. Water infiltration into the building or within the construction.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specifications are based on products of named manufacturers. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

2.2 PREFABRICATED ROOF CURBS

- A. Frames:
 - 1. Material: ASTM A 653 G90 hot-dipped galvanized steel.
 - a. Minimum 18 gauge, and as engineered by manufacturer.
 - b. Minimum 18 gauge for curbs supporting HVAC units
 - c. Minimum 20 gauge for expansion joint curbs.
 - 2. Corners: Mitered and welded (welds are micro sealed and prime painted after fabrication). Bolted connections not accepted.
 - 3. Base Plates: Integral to frame and welded.
 - 4. Internally reinforced with galvanized 1 inch by 1 inch by 12 gauge angles for curbs exceeding 3 foot length. Reinforce internal bulkhead at equipment curbs to support lateral loads.
 - 5. Wood Nailers: Factory installed, pressure treated. Size and width as suitable for support of items installed on curbs.
- B. Insulation: Factory installed 1-1/2 inch thick three-pound density fiberglass insulation.
- C. Curb Height: Minimum 8 inch above finished roof.
 - 1. Construct curbs to match roof slope with plumb and level top surface for mounting mechanical equipment.
- D. Gasketing: 1/4 inch thick, one (1) inch wide at roof top units.
- E. Counterflashing: 24 gauge stainless steel
- F. Counterflashing Cap: Stainless steel.
- G. Cants:
 - 1. Non-canted curb style installs either under or on top of metal decks with insulation.
 - 2. Cants shall be provided under Section 07 52 19 – Roofing
- H. All insulated roof curbs shall be structural and shall include calculations signed and sealed by a registered Structural Engineer. Refer to installation drawings for any additional structural requirements. If curbs do not span a minimum of two bar joists, only two angles will be required. Coordination mechanical equipment weight loading on the roof with Structural Engineer.
- I. Approved Manufacturers:

1. Custom Curb, Inc.
2. Roof Products, Inc.

2.3 PIPE SUPPORTS (Contractor built supports are not allowed)

- A. Gas Pipe Supports:
1. Provide pipe roller type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (10" x 16" x 3"; 5.5 lbs. each) and stainless steel rods, washers and nuts; Basis of design, PHP Systems / Design Model PP10-R with roller for gas pipe 3" O.D. and smaller.
 2. Provide hanger type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (12" x 12" x 3"; 3 lbs. each or 18" x 18" x 3"; 7 lbs. each or 18" round; 10.5 lbs. each) and stainless steel rods, washers and nuts; Basis of design, PHP Systems / Design Model PS-1-2 with hanger for gas pipe larger than 3" O.D.
 3. Acceptable Manufacturers: Miro Industries Inc.; MAPA Products; Advanced Support Products, nVent Caddy or Architect approved equal.
- B. Electrical Conduit / Condensate Pipe Supports:
1. Provide channel / strut type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (10" x 16" x 3"; 5.5 lbs. each) and stainless steel channel, rods, washers and nuts; Basis of design, PHP Systems / Design Model PP10-C with channel for condensate pipe or conduit 3" O.D. and smaller.
 2. Provide hanger type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (12" x 12" x 3"; 3 lbs. each or 18" x 18" x 3"; 7 lbs. each or 18" round; 10.5 lbs. each) and stainless steel rods, washers and nuts; Basis of design, PHP Systems / Design Model PS-1-2 with hanger for condensate pipe or conduit larger than 3" O.D. Contractor to provide channel clamp at each support. Provide dissimilar metal protection as required.
 3. Acceptable Manufacturers: Miro Industries Inc.; MAPA Products; Advanced Support Products, nVent Caddy or Architect approved equal.
- C. Chilled Water Pipe Supports:
1. Provide hanger type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (18" x 18" x 3"; 7 lbs. each or 18" round; 10.5 lbs. each) and stainless steel rods, washers and nuts; Basis of design, PHP Systems / Design Model PS-1-2 or Model PS-2-2 or Model PSE Custom as required with hanger(s) for chilled water pipe of any diameter.
 2. Acceptable Manufacturers: Miro Industries Inc.; MAPA Products; Advanced Support Products, nVent Caddy or Architect approved equal.
- D. Crossover / Steps Pipe Supports:
1. Provide channel / strut type support with bases of high density / high impact injection molded polypropylene with UV inhibitors and stainless steel channel, rods, washers and nuts; Basis of design, PHP Crossover.
 2. Acceptable Manufacturers: Miro Industries Inc.; MAPA Products; Advanced Support Products, nVent Caddy or Architect approved equal.
- E. Installation:
1. Provide pipe supports at no greater than 8'-0" o.c. or as otherwise indicated in Manufacturer's Shop Drawings.
 2. Provide pipe supports spaced so deflection of piping does not exceed 1/240 of span. If deflection exceeds 1/240 of span, decrease support spacing to 6'-0" o.c.
 3. Provide complete and adequate support of all piping, ducts and conduit.

4. Provide protective isolation pads adhered to the roof system below each pipe support using Roof System Manufacturer's approved adhesive.
5. Provide each pipe support adhered to the protective isolation pads using Roof System Manufacturer's approved adhesive.

2.4 ROOF TO ROOF EXPANSION JOINT

- A. Stainless Steel expansion joint covers on new wood curbs, as detailed on drawings and outlined the NRCA and SMACNA manual.

2.5 RETROFIT ROOF DRAINS

- A. Retrofit Roof Drains: "Hercules RetroDrain" as manufactured by OMG, Inc. or Architect approved equal.
 1. Size: To match existing roof drain sizes. [3 inches] [4 inches] [5 inches] [6 inches] [Indicated on the Drawings].
 2. Compliance:
 - a. ANSI / SPRI RD-1.
 - b. ULC / ORD-C790.4.
 3. Drain Body:
 - a. Material: 1-piece, 11-gauge (0.125-inch) spun aluminum.
 - b. Flange: 17-1/2-inch diameter.
 4. Drain Stem Length: 12 inches
 5. Flange Includes: Six 2-1/2-inch-long aluminum studs.
 6. Sump Area: Depressed.
- B. Strainer Dome:
 1. Material: Cast aluminum.
 2. Height: 7.25 inches.
 3. Outside Base Diameter: 9.77 inches.
- C. Clamping Ring:
 1. Material: Cast aluminum.
 2. Gravel Stop Height: 1.2 inches.
 3. Drainage Slots: 18 V-shaped.
 4. Bosses: 6, to accept studs on flange.
- D. Backflow Seal:
 1. Compression Seal: Watertight, "U-Flow" mechanical seal.
 2. Material: Polyamide and EPDM rubber.
 3. Required for Activation: "U-Flow" screwdriver.
- E. Hardware:
 1. Locknuts: 6, stainless steel, for studs.
 2. Screws: 3, stainless steel, to attach strainer to clamping ring.
- F. Overflows:
 1. At overflow locations; provide overflow collar extension
 2. Constructed of spun aluminum

2.6 MISCELLANEOUS ROOF BRACING AND SUPPORT SYSTEMS

- A. Provide U-Anchors made of 304 stainless steel with 3/8" bolt and galvalume plate. Utilize same membrane as roofing manufacturer to be inclusive in 20 YEAR NDL warranty

- B. As manufactured by Anchor Products Model U-anchor 2000 Series as required for condition or nVent Caddy Pyramid Anchor system

2.7 ROOF PENETRATION HOUSING

- A. Provide rain-proof four-piece configuration consisting of a removable vandal resistant lid, middle housing, insulation extension (ICE) and wide flanged curb that is light weight and water tight. To be used with our exclusive two-piece aluminum and / or stainless steel flanged Exit Seal with SilX14TM gasket. Provide 20 Year insured warranty.
- B. As manufactured by Roof Penetration Housing Model AWI Series Vault as required for condition or Architect approved equal.

2.8 ROOF DRAIN / DOWNSPOUT WALL NOZZLE

- A. Downspout Wall Nozzle at Concealed Roof Drain Leader / Discharge: Josam 25010 Series cast bronze Downspout Nozzle with loose flange and inlet threaded connection or Architect approved equal. Diameter appropriate to downspout size.

2.9 PLUMBING PEDESTAL HYDRANT

- A. Provide freeze-proof pedestal hose station / hydrant with stainless steel shroud, welded stainless steel flange, black powder coated cast aluminum dome handle, mail hose fitting and vacuum breaker. Provide powder coated under-deck support flange with hardware. Provide for dissimilar metal protection.
- B. As manufactured by MAPA Products Model MPH-24D:24/9 Pedestal Hydrant as required for condition or Architect approved equal.

2.10 ELECTRICAL PEDESTAL DISCONNECT / OUTLET

- A. Provide rain-proof pedestal disconnect with stainless steel square tubing and welded stainless steel flange. Provide powder coated under-deck support flange with hardware. Provide for dissimilar metal protection.
- B. As manufactured by MAPA Products Model MPD-(XX) Pedestal Disconnect as required for condition or Architect approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install roof accessories in accordance with manufacturer's printed instructions and approved shop drawings. Installation of Portable Pipe Hangers shall not exceed six (6) feet on center.
- B. Coordinate with roofing operation for watertight integrity.
- C. Finished installation shall be water and air tight. Install sealant conforming to FS TT-S-00227E, Type II, Class A.

END OF SECTION

SECTION 07 22 33 - ROOF SCUTTLE (HATCHES)

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 RELATED WORK

- A. Section 03 32 16- Lightweight Insulating Concrete Deck System
- B. Section 05 31 00 - Metal Deck
- C. Section 05 50 00 - Miscellaneous Metals
- D. Section 06 10 00 - Rough Carpentry
- E. Section 07 52 19 – Modified Bitumen Membrane Roofing System

1.3 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a watertight installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.4 SUBMITTALS

- A. Product Data: Submit schedules, charts, literature and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.
- B. Shop Drawings: Include materials, opening sizes, fabrication details, hardware, attachments, related and adjacent work, and finishes.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Miami-Dade County, FL Approved NOA
 - a. TAS 201 Impact test
 - b. TAS 202 Uniform Static Air Pressure
 - c. TAS 203 Cyclic Wind Pressure Loading
 - 2. OSHA 29 CFR 1910.23 Guarding floor and wall openings and holes
 - 3. OSHA 29 CFR 1926.502 Fall protection systems criteria
 - 4. International Building Code (IBC) Section 1013.6 Roof Access
 - 5. International Building Code (IBC) Section 1009.11 Means of Egress, Stairways, Stairway to Roof
 - 6. International Building Code for venting requirements
 - 7. IBC Section 410 for Stages and Platforms
 - 8. IBC Section 910 for Factory and Storage occupancies
 - 9. IBC Section 1207 Sound Transmission
 - 10. Underwriters Laboratories Inc, UL 793 Listed for Heat and Smoke Vents
 - 11. FM Global, Factory Mutual, FM 4430 Heat and Smoke Vents for Roofs

12. Reference NFPA 204 for general maintenance of Heat and Smoke vents
13. ASTM E 90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to Project site ready use.
- B. Exercise proper care in handling of Work so as not to disrupt finished surfaces.
- C. Store materials under cover in a dry and clean location off the ground.

1.7 WARRANTY

- A. Warrant the work specified herein for five (5) years, against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to, the following:
 1. Faulty, improper or inadequate attachment or installation.
 2. Difficult or noisy operation.
 3. Noticeable deterioration of finish.
 4. Leakage of water into the building or within the construction.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Basis of Design Product: Subject to compliance with requirements: The Bilco Company.
- B. Manufacturers listed below whose products are equivalent to those specified are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
 1. SafePro products
 2. Acudor Products Inc.
 3. Babcock-Davis Hatchways, Inc.
 4. Dur-Red Products
 5. J. L. Industries, Inc.
 6. Karp Associates, Inc.
 7. Nystrom Building Products

2.2 ROOF SCUTTLES (HATCHES)

- A. Size: 2'-6" x 3'-0" unless shown otherwise.
- B. Finish: Mill Finish Aluminum.

- C. Thermally Broken Cover: Shall be 11 gauge aluminum with 3" concealed polyisocyanurate insulation, 5" beaded, overlapping flange, fully welded at corners, and internally reinforced for 40 psf live load., fully covered and protected by an aluminum liner. No water standing on top of the cover will be permitted.
- D. Thermally Broken Curb: Shall be 12 inches in height above finished roof surface and constructed of 11 gauge aluminum. It shall be formed with a 5-1/2 inch flange with holes provided for securing to the roof deck. Curb shall be equipped with an integral metal capflashing of the same gauge and material as the curb, full welded at the corners for weathertightness. Capflashing shall be equipped with the Bilclip™ flashing system, including stamped tabs and Pak-Rope. Insulation on the exterior of the curb shall be rigid fiber board three (3) inches in thickness.
- E. Thermally Broken Scuttle (Hatch): Shall be completely assembled with heavy pintle hinges, positive snap latch with turn handles, padlock hasps inside and outside, and a mechanically retained thermoplastic rubber gasket. Compression spring operators enclosed in telescopic tubes shall be provided for smooth, easy and controlled door operation throughout the entire arc of opening and closing. Operation shall not be affected by temperature. Cover shall be equipped with an automatic hold-open arm complete with red vinyl grip handle to permit easy release and one-hand control of the cover to its closed and latched position. All hardware shall be stainless steel. Gasket shall be extruded EPDM adhesive back seal and continuous around cover.
- F. Approved Model / Manufacturer: Type No. "S-50TB" Roof Scuttles (Hatches) for ladder access, or Architect approved equal.
- G. Roof Access Ladder: As specified in Section 05 50 00, Miscellaneous Metals. Ladder shall be oriented and mounted along the short dimension of the hatch.
- H. Fall Protection Safety Rail: 30"x36" Model SP 3036 [36"x36" Model SP 3036] [30"x72" Model SP-3072] manufactured by **SafePro L.C.** Guardrail height shall be 42" above finished roof surface. Color shall be powder coated safety yellow.
- I. Folding Fall Protection Safety Rail: Aluminum guardrail system [30"x36"] [36"x36"] [36"x72"] Model by Precision Ladders LLC. Guardrail height shall be 42" above finished roof surface. Color shall be powder coated safety yellow.
- J. Telescoping Ladder Safety Post: Model ER-1 Extend-A-Rail Ladders Safety Post as manufactured by Precision Ladders LLC. 1.62" OD Schedule 40 anodized aluminum pipe post and 16"x4"x1/4" aluminum mounting plate. Provide with locking slot and knob. All mounting hardware shall be Type 316 stainless steel.

2.3 HEAT AND SMOKE VENTS

- A. Size: 4 feet-0 inches x 4 feet-0 inches unless shown otherwise.
- B. Finish: Mill Finish Aluminum
- C. Thermally Broken Cover: Shall be 11 gauge aluminum with three (3) inch beaded flange and formed reinforcing members welded to support a minimum live load of 40 lb/sq.ft. Insulation shall be of glass fiber, one (1) inch in thickness, fully covered and protected by a 18 gauge aluminum cover liner. No water standing on top of the cover will be permitted.
- D. Thermally Broken Curb: Shall be of 11 gauge aluminum, 12 inches in height above the finished roof surface on hinge sides with a five (5) degree pitch to the fixed center channel. Curb shall be formed with a 3-1/2 inch flange with holes for securing to the roof deck and

with an integral metal capflashing of the same gauge and material as the curb, full welded for weathertightness. Capflashing shall be equipped with the Bilclip™ flashing system, including stamped tabs and Pak-Rope. Insulation on the exterior of the curb shall be rigid fiberboard three (3) inches in thickness. All hardware shall be zinc plated and chromate sealed.

- E. Vent: Shall be completely assembled with a Thermolatch^(R) positive hold/release mechanism designed to hold the covers in the closed position against 90 lb/sq.ft.) wind uplift forces without overstressing the fusible link. Each cover shall have a minimum of three (3) heavy pintle hinges, a mechanically retained thermoplastic rubber gasket, heavy duty shock absorbers and pull handles for inside and outside operation. Vent shall open automatically when heat breaks the 165 degrees F fusible link and shall be labeled as being FM Approved or UL Listed. Gasket shall be extruded EPDM adhesive back seal and continuous around cover.
- F. Approved Model / Manufacturer: Fire Vent Type DSH4896 Double Leaf Fire Vents *confirm size with arch*, or Architect approved equal.
- G. Certification: Smoke vent to have official UL label for testing to UL 793 Smoke and Heat Vents.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate installation of sealant and roofing cement with Work of this Section to ensure water tightness.
- B. Coordinate installation of components of this Section with installation of roof deck, roof structure, roofing membrane, and base flashing.
- C. Roof hatches and heat / smoke vents shall be welded to structural steel frame of building.
- D. Install hatches and heat / smoke vents in accordance with details on drawings, approved shop drawings, and manufacturer's instructions.
- E. Set units plumb, level, and true to line without warp or rack. Separate metal from incompatible metal or corrosive substrates, including wood, by coating concealed surfaces, at locations of contact, with bituminous coating or providing other permanent separation.
- F. Flange Seals: Unless otherwise indicated, set flanges of accessory units in a thick bed of roofing cement to form a watertight and airtight seal.

3.2 FIELD QUALITY CONTROL

- A. Smoke Vent Testing: Test for proper operation after installation by one or all of the operational methods.
- B. Melting fusible link for inside at smoke vent level recommend using handheld propane tank torch. Replace fusible link, then close vents from the exterior at the roof top level.
- C. Pull internal and / or external manual pull handles and then close vents from the exterior at the roof top level.

- D. Do not paint the internal mechanisms, especially moving parts such as spring, dampers, rotary latches and especially the fusible links. Painting any of these components may damage the vents and will void the warranty.

3.3 ADJUSTING

- A. Adjust movable parts for smooth operation.
- B. Operational Units: Test-operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation

3.4 CLEANING

- A. Clean exposed surfaces per manufacturer's written instructions. Touch up damaged metal coatings.

END OF SECTION 07 72 33

SECTION 07 81 00 - APPLIED FIREPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 1. Sprayed fire resistive materials.
 2. Accessories necessary for a complete installation.

1.3 RELATED DOCUMENTS

- A. Section 07 21 00 – “Thermal Insulation.”

1.4 DEFINITIONS

- A. SFRM: Sprayed fire resistive materials.

1.5 PERFORMANCE REQUIREMENTS

- A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.
- B. Fire Resistance Design: Indicated on Drawings, tested according to ASTM E 119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Steel members shall be considered to be unrestrained unless specifically noted otherwise.
 2. UL design listings must state that the loading was determined by Allowable Stress Design Method or Load and Resistance Factor Design Method. UL design listings requiring a load restriction factor are not allowed.
- C. Asbestos: Provide products containing no detectable asbestos.
- D. Dry mix inorganic spray-applied fire resistive material containing mineral slag wool and Portland-cement are not permitted.

1.6 SUBMITTALS

- A. Product Data: Technical data, installation instructions, and UL listing for each type of product.
- B. Shop Drawings: Framing plans or schedules, or both, indicating the following:
 1. Extent of fireproofing for each construction and fire resistance rating.
 2. Applicable fire resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
 3. Minimum fireproofing thickness necessary to achieve required fire resistance rating of each structural component and assembly.
 4. Treatment of fireproofing after application.

- C. Samples: Submit for each exposed product and for each color and texture specified, 4 inches (102 mm) square in size.
- D. Product Certificates and Reports:
 - 1. Certificates: Submit manufacturer's precut certificates for each type of SFRM.
 - 2. Evaluation Reports: Submit ICC-ES evaluation report.
 - 3. Compatibility and Adhesion Test Reports: From SFRM manufacturer indicating:
 - a. Materials have been tested for bond with substrates.
 - b. Materials have been verified by SFRM manufacturer to be compatible with substrate and coatings.
 - c. Interpretation of test results and written recommendations for substrate preparation needed for adhesion.
 - 4. Preconstruction test reports.
 - 5. Field quality control reports.

1.7 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Building Code: Comply with applicable provisions of the IBC for fire protection.
 - 2. Surface Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame Spread Index: 10 or less.
 - b. Smoke Developed Index: 10 or less.
- B. Installer Qualifications: A firm or individual having minimum 5 years documented experience who is certified or licensed and qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.
- C. Source Limitations: Obtain fireproofing for each fire resistance design from single source.
- D. Preconstruction Adhesion and Compatibility Testing: Test for compliance with requirements for specified performance and test methods.
 - 1. Bond Strength: Test for cohesive and adhesive strength according to ASTM E 736. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
 - 2. Density: Test for density according to ASTM E 605. Provide density indicated in referenced fire-resistance design, but not less than minimum specified.
 - 3. Verify that manufacturer, through its own laboratory testing or field experience, attests that coatings are compatible with fireproofing.
 - 4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 5. For materials failing tests, obtain applied-fireproofing manufacturer's written instructions for corrective measures.
- E. Preinstallation Conference: Conduct conference at site.
 - 1. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, shelf life, and fire resistance ratings applicable to Project.

- B. Use materials with limited shelf life within period indicated. Remove from site and discard materials whose shelf life has expired.
- C. Store materials inside, under cover, and aboveground; keep dry until ready for use. Remove from site and discard wet or deteriorated materials.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 44 degrees F (7 degrees C) or lower unless temporary protection and heat are provided to maintain temperature at or above this level during, and for 24 hours after product application.
- B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

1.10 COORDINATION

- A. Sequence and coordinate application of sprayed fireproofing with related work to comply with requirements:
 - 1. Provide temporary enclosure as required to confine spraying operations and protect the environment.
 - 2. Provide temporary enclosures for applications to prevent deterioration of fire resistive material due to exposure to weather and to unfavorable ambient conditions for humidity, temperature, and ventilation.
 - 3. Avoid unnecessary exposure of fire resistive material to abrasion and damage likely to occur during construction operations subsequent to its application.
 - 4. Do not apply fire resistive material to metal roof deck substrates until concrete topping, if any, has been completed. For metal roof decks without concrete topping, do not apply fire resistive material to metal deck substrates until roofing has been completed; prohibit roof traffic during application and drying of fire resistive material.
 - 5. Do not apply fire resistive material to metal floor deck substrates until concrete topping has been completed.
 - 6. Do not begin applying fire resistive material until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
 - 7. Defer installing ducts, piping, and other items that would interfere with applying fire resistive material until application of fire protection is completed.
 - 8. Do not install enclosing or concealing construction until after fire resistive material has been applied, inspected, and tested and corrections have been made to defective applications.

1.11 WARRANTY

- A. Written warranty signed by installer, and Contractor in which manufacturer agree to repair or replace fireproofing materials that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Cracking, flaking, spalling, or eroding in excess of specified requirements; peeling; or delaminating of SFRM from substrates.
 - b. Not covered under the warranty are failures due to damage by occupants and Owner's maintenance personnel, exposure to environmental conditions other than those investigated and approved during fire response testing, and other causes not reasonably foreseeable under conditions of normal use.
 - 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Basis of Design: Isolatek International. Other manufacturers are subject to compliance with requirements.
1. Grace Construction Products.
 2. Carboline Company; a subsidiary of RPM International.
 3. Southwest Fireproofing Products Co.
- B. Non-Exposed, Sprayed Fire Resistive Material: Factory mixed, lightweight, dry formulation, complying with indicated fire resistance design, and mixed with water at site to form a slurry or mortar before conveyance and application.
1. Application: Interior locations not exposed to damage or moisture.
 2. Bond Strength: Minimum 150 lbf/sq. ft. (7.18 kPa) cohesive and adhesive strength based on field testing according to ASTM E 736.
 3. Density: Not less than density specified in the approved fire resistance design, according to ASTM E 605.
 4. Thickness: As necessary required for fire resistance design indicated, measured according to requirements of fire resistance design or ASTM E 605, whichever is thicker, but not less than 0.375 inch (9 mm).
 5. Compressive Strength: Minimum 1,400 psf (68.9 kPa) according to ASTM E 761.
 6. Corrosion Resistance: No evidence of corrosion according to ASTM E 937.
 7. Deflection: No cracking, spalling, or delamination according to ASTM E 759.
 8. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E 760.
 9. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. (0.270 g/sq. m) in 24 hours according to ASTM E 859.
 10. Fungal Resistance: Treat products with antimicrobial formulation to result in no growth on specimens per ASTM G 21 or rating of 10 according to ASTM D 3274 when tested according to ASTM D 3273.
 11. Finish: Spray textured finish unless otherwise indicated.
 12. Basis of Design: CAFCO 300 Series as manufactured by Isolatek or comparable product.
- C. Exposed, Sprayed Fire Resistive Material: Factory mixed, lightweight, dry formulation, complying with indicated fire resistance design, and mixed with water at site to form a slurry or mortar before conveyance and application.
1. Application: Designated for exterior use by qualified testing agency acceptable to authorities having jurisdiction.
 2. Bond Strength: Minimum 150 lbf/sq. ft. (7.18 kPa) cohesive and adhesive strength based on field testing according to ASTM E 736.
 3. Density: Not less than density specified in the approved fire resistance design, according to ASTM E 605.
 4. Thickness: As necessary required for fire resistance design indicated, measured according to requirements of fire resistance design or ASTM E 605, whichever is thicker, but not less than 0.375 inch (9 mm).
 5. Combustion Characteristics: ASTM E 136.
 6. Compressive Strength: Minimum 1,400 psf (68.9 kPa) according to ASTM E 761.
 7. Corrosion Resistance: No evidence of corrosion according to ASTM E 937.
 8. Deflection: No cracking, spalling, or delamination according to ASTM E 759.
 9. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E 760.
 10. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. (0.270 g/sq. m) in 24 hours according to ASTM E 859.

11. Fungal Resistance: Treat products with antimicrobial formulation to result in no growth on specimens per ASTM G 21 or rating of 10 according to ASTM D 3274 when tested according to ASTM D 3273.
 12. Finish: Spray textured finish unless otherwise indicated.
- D. Auxiliary Materials: Provide auxiliary materials compatible with fireproofing and substrates and approved by UL for use in fire resistance designs indicated.
1. Bonding Agent: Product approved by fireproofing manufacturer and complying with requirements in UL *Fire Resistance Directory*.
 2. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required, according to fire resistance designs indicated and fireproofing manufacturer's written instructions. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive fireproofing.
 3. Reinforcing Fabric: Glass or carbon fiber fabric of type, weight, and form required to comply with fire resistance designs indicated; approved and provided by fireproofing manufacturer.
 4. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire resistance design indicated; approved and provided by fireproofing manufacturer. Include pins and attachment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for substrates and conditions affecting performance of the work and according to each fire resistance design.
1. Verify substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
 2. Verify objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
 3. Verify substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.
 4. Verify concrete work on steel deck is complete before beginning fireproofing work.
 5. Verify roof construction, installation of rooftop HVAC equipment, and related work are complete before beginning fireproofing work.
 6. Conduct tests according to fireproofing manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.
 7. Prepare written report listing conditions detrimental to performance of the work.
 8. Proceed with installation after correcting unsatisfactory conditions.
- B. Conduct tests according to fireproofing manufacturer's written recommendations to verify substrates are free of substances capable of interfering with bond.
- C. Prepare written report listing conditions detrimental to performance of the work.
- D. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

- A. Cover adjacent work subject to damage from fallout or overspray of fireproofing materials during application. Clean substrates of substances that could impair bond of fireproofing.
- B. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless in satisfactory condition to receive fireproofing.

- C. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION

- A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, sealers, topcoats, finishing, and other materials and procedures affecting fireproofing work.
- B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.
 - 1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
 - 2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.
- D. Metal Decks:
 - 1. Do not apply fireproofing to underside of metal deck substrates until concrete topping, if any, is completed.
 - 2. Do not apply fireproofing to underside of metal roof deck until roofing is completed; prohibit roof traffic during application and drying of fireproofing.
- E. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.
- F. Spray apply fireproofing to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer. Extend fireproofing in full thickness over entire area of each substrate to be protected.
- G. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.
 - 1. For applications over encapsulant materials, including lockdown (post removal) encapsulants, apply fireproofing that differs in color from that of encapsulant over which it is applied.
 - 2. Where sealers are used, apply products that are tinted to differentiate them from fireproofing over which they are applied.
- H. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.
 - 1. Cure fireproofing according to fireproofing manufacturer's written instructions.
- I. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.
- J. Cure fireproofing according to fireproofing manufacturer's written instructions.

- K. Finishes: Where indicated, apply fireproofing to produce the following finishes:
1. Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.
 2. Spray Textured Finish: Finish left as spray applied with no further treatment.
 3. Rolled, Spray Textured Finish: Even finish produced by rolling spray applied finish with a damp paint roller to remove drippings and excessive roughness.
 4. Skip Troweled Finish: Even leveled surface produced by troweling spray applied finish to smooth out the texture and neaten edges.
 5. Skip Troweled Finish with Corner Beads: Even, leveled surface produced by troweling spray applied finish to smooth out the texture, eliminate surface markings, and square off edges.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
1. Test and inspect as required by the applicable building code.
- B. Perform the tests and inspections of completed work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire resistance design.
- C. Fireproofing will be considered defective if it does not pass tests and inspections.
1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
 2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.
- D. Prepare test and inspection reports.

3.5 CLEANING, PROTECTING, AND REPAIRING

- A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.
- B. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing is without damage or deterioration at time of Substantial Completion.
- C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.
- D. Repair fireproofing damaged by other work before concealing it with other construction.
- E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel applied product.

END OF SECTION 07 81 00

SECTION 07 84 00 - FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 1. Penetration firestop systems.
 2. Fire resistive joint systems.
 3. Repair of firestop assemblies disturbed by the work.
 4. Smoke barriers.
 5. Accessories necessary for a complete installation.

1.3 PERFORMANCE REQUIREMENTS

- A. Penetration Fire Resistance Systems:
 1. For penetrations through vertical and horizontal fire resistance rated constructions, including both empty openings and openings containing penetrating items, provide firestop systems produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and gases, and maintain original fire resistance rating of construction penetrated.
 2. Rated Systems: Provide penetration firestop systems with ratings determined in accordance with UL 1479 for C-AJ, C-BJ, C-BK, F-A, F-B, F-C, W-J, W-K, and W-L classified systems.
 - a. F Rated Systems: Provide penetration firestop systems with F ratings indicated, but not less than that equaling or exceeding fire resistance rating of constructions penetrated.
 - b. T Rated Systems: For specified conditions, provide penetration firestop systems with T ratings indicated, as well as F ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas.
 - c. L Rated Systems: Where penetration firestop systems are indicated in smoke barriers, provide penetration firestop systems with L ratings of not more than 3.0 cfm/sq. ft (0.01524cu. m/s x sq. m) at both ambient temperatures and 400 degrees F (204 degrees C).
 - d. For penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to conditions both during and after construction.
 - e. For piping penetrations for plumbing and wet pipe sprinkler systems, provide moisture resistant penetration firestop systems.
 - f. For penetrations involving insulated piping, provide penetration firestop systems not requiring removal of insulation.
 3. For penetration firestop systems exposed to view, provide products with flame spread and smoke developed indexes of less than 25 and 450, respectively, determined in accordance with ASTM E 84.
- B. Fire Resistive Joint Systems: System produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and gases, and maintain original fire resistance rating of assembly in which fire resistive joint systems are installed.

1. Joint Systems in and between Fire Resistance Rated Constructions: Provide systems with assembly ratings equaling or exceeding fire resistance ratings of construction that are join, with movement capabilities and L ratings] indicated determined by UL 2079.
2. Perimeter Fire Resistive Joint Systems: For joints between edges of fire resistance rated floor assemblies and exterior curtain walls, provide systems of type and with ratings indicated determined by NFPA 285 and UL 2079.
3. For fire resistive systems exposed to view, provide products with flame spread and smoke developed indexes of less than 25 and 450, respectively determined in accordance with ASTM E 84.

1.4 SUBMITTALS

- A. Product Data: Technical data including installation recommendations, construction conditions, applicable UL assemblies.
- B. Shop Drawings: For each penetration firestop or fire resistive joint system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetration. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.
 1. Submit documentation, including illustrations, from qualified testing and inspecting agency, applicable to each firestop system configuration for construction and penetrating items.
- C. Product Certificates: For penetration firestop system products, signed by product manufacturer.
- D. Product Test Reports: From a qualified testing agency indicating penetration firestop system complies with requirements, based on comprehensive testing of current products.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 1. Building Code: Comply with applicable requirements of the IBC and the fire code.
 2. Fire Test Response Characteristics: Provide firestop systems complying with requirements:
 - a. Penetration Firestopping: Penetration firestop systems are identical to those tested in accordance with UL. Provide rated systems complying with requirements.
 - 1) Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2) Penetration firestop system products bear classification marking of qualified testing and inspecting agency.
 - 3) Penetration firestop systems correspond to those indicated by reference to penetration firestop system designations listed by UL in its *Fire Resistance Directory* and FM Global in its *Building Materials Approval Guide*.
 - b. Fire Resistive Joints: Perform fire resistance tests by UL with follow up inspection services for fire resistive joint systems acceptable to authorities having jurisdiction.
 - 1) Fire resistive joint system products bear classification marking of qualified testing and inspecting agency.
 - 2) Fire resistive joint systems correspond to those indicated by reference to penetration firestop system designations listed by UL in its *Fire Resistance Directory*.
- B. Installer Qualifications: A firm experienced in installing firestop systems and who has been approved by FM Global according to FM Global 4991 *Approval of Firestop Contractors* or been evaluated by UL and found to comply with UL *Qualified Firestop Contractor Program Requirements* and has minimum 5 years documented experience in installing firestopping assemblies

1. Manufacturer's willingness to sell its penetration firestop system products to Contractor or to Installer engaged by Contractor does not qualify buyer/installer.
- C. Installation Responsibility: Assign installation of penetration firestop systems and fire resistive joint systems to a single qualified installer.
- D. Source Limitations: Obtain firestop systems, for each kind of penetration and construction condition indicated, one source from a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver firestop system products to site in original, unopened containers or packages with intact and legible manufacturer labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials for penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install firestop systems when ambient or substrate temperatures are outside limits permitted by firestop system manufacturer or when substrates are wet due to rain, frost, condensation, or causes.
- B. Install and cure fire resistive joint systems in accordance with manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced air circulation.
- C. Ventilate firestop systems per manufacturer's written instructions by natural means or, where inadequate, forced air circulation.

1.8 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that firestop resistive joint systems are installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core drilled holes, or cut openings to accommodate penetration firestop systems.
- C. Joint System: Coordinate sizing of joints to accommodate fire resistive joint systems.
- D. Do not cover up penetration firestop system or fire resistive joint system installations that will become concealed behind other construction until building inspector of authorities having jurisdiction have examined each installation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Manufacturer: Subject to compliance with requirements, provide firestop systems by one of the following for each application required:
 1. Hilti, Inc.
 2. Nelson Firestop Products.
 3. RectorSeal Corporation (The).
 4. Specified Technologies Inc.

5. 3M; Fire Protection Products Division.
 6. USG Corporation.
 7. Tremco Commercial Sealants and Waterproofing.
- B. Compatibility: Provide firestop systems compatible with each other; with substrates forming openings; and with items penetrating penetration firestop systems, under conditions of service and application, demonstrated by penetration firestop system manufacturer based on testing and field experience.
- C. Accessories: Provide components for each firestop system necessary to install fill materials. Use components specified by penetration firestop or fire resistive joint system manufacturer and UL. Accessories include, but are not limited to:
1. Penetration Firestop Systems: Provide penetration firestopping produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and gases, and maintain original fire resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with substrates forming openings, and with penetrating items if any.
 2. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
 - a. Permanent forming/damming/backing materials, including the following:
 - 1) Slag wool fiber or rock wool fiber insulation.
 - 2) Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
 - 3) Fire rated form board.
 - 4) Fillers for sealants.
 - b. Temporary forming materials.
 - c. Substrate primers.
 - d. Collars.
 - e. Steel sleeves.
- D. Fill Materials: Penetration firestop systems containing types of fill materials indicated. Fill materials are those referenced in directories of referenced testing and inspecting agencies as *fill*, *void*, or *cavity* materials.
1. Cast in Place Firestop Devices: Factory assembled devices for use in cast in place concrete floors and consisting of an outer metallic sleeve lined with intumescent strip, radial extended flange attached to one end of sleeve for fastening to concrete formwork, and neoprene gasket.
 2. Latex Sealants: Single component latex formulations that after cure do not reemulsify during exposure to moisture.
 3. Firestop Devices: Factory assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
 4. Intumescent Composite Sheets: Rigid panels consisting of aluminum foil faced elastomeric sheet bonded to galvanized steel sheet.
 5. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
 6. Intumescent Wrap Strips: Single component intumescent elastomeric sheets with aluminum foil on one side.
 7. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at site to form nonshrinking, homogeneous mortar.
 8. Pillows/Bags: Reusable heat expanding pillows/bags consisting of glass fiber cloth cases filled with combination of mineral fiber, water insoluble expansion agents, and fire retardant additives.

9. Silicone Foams: Multicomponent, silicone based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
 10. Silicone Sealants: Single component, silicone based, neutral curing elastomeric sealants of grade indicated.
 - a. Grade: Pourable (self-leveling) formulation for openings in floors and horizontal surfaces, and nonsag formulation for openings in vertical and surfaces requiring nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.
- E. Fire Resistive Joint Systems: Sealants complying with UL 1479 including F, T, and L ratings.
- F. Fire Safing Insulation:
1. Semirefractory Blanket: Semirigid blankets designed for use as fire stops at openings between edge of slab and exterior wall panels, glass mat faced, low density; having nominal density of 4 lb/cu. ft. (64 kg/cu. m); complying with ASTM C 612, Type 1A and 1B and ASTM E 136 for combustion characteristics; thermal resistivity of 4 degrees F x h x sq. ft./Btu x in. at 75 degrees F (27.7 K x m/W at 24 degrees C).; with maximum flame spread and smoke developed values of 10 and 5. Use for floor perimeter fire and smoke containment. Install blanket with 20 gauge impaling clips recommended by manufacturer.
 2. Caulking Compound: Material approved by manufacturer of safing insulation for sealing joint between foil backing of safing insulation and edge of concrete floor slab against penetration of smoke.
 3. Safing Clips: Galvanized steel safing clips approved by manufacturer of safing insulation for holding safing insulation in place.
- G. Duct Wrap for Ducts: Materials listed in the UL Fire Resistance Directory under File R8418, Category CAJ7009, File R14229 Categories CAJ 7013, CAJ 7015, CAJ 7020, CAJ 7022, YYET, and Grease Duct Enclosures and having minimum 2 hour fire resistive rating for grease or air duct enclosure materials.
- H. Composition Edge Banding: Materials listed in UL Fire Resistance Directory UL 10c standard.

2.2 FIRE STOPPING SYSTEMS

- A. Penetration System:
1. Penetrations in Fire Resistance Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
 - a. Fire resistance rated walls include fire walls, fire barrier walls, smoke barrier walls, and fire partitions.
 - b. F Rating: Minimum fire resistance rating of constructions penetrated.
 2. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
 - a. Horizontal assemblies include floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.
 - b. F Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
 - c. T Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
 3. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.
 - a. L Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at 0.30 inch wg (74.7 Pa) at both ambient and elevated temperatures.

- b. W Rating: Provide penetration firestopping showing no evidence of water leakage when tested according to UL 1479.
 4. Exposed Penetration Firestopping: Provide products with flame-spread and smoke developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- B. Joint Resistive Systems:
 1. Joints in Smoke Barriers: Provide fire resistive joint systems with ratings determined per UL 2079.
 - a. L Rating: Not exceeding 5.0 cfm/ft (0.00775 cu. m/s x m) of joint at 0.30 inch wg (74.7 Pa) at both ambient and elevated temperatures.
 2. Exposed Fire Resistive Joint Systems: Provide products with flame-spread and smoke developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
 3. Exposed Fire-Resistive Joint Systems: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

2.3 MIXING

- A. For products requiring mixing before application, comply with penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for opening configurations, penetrating items, substrates, and conditions affecting performance of work. Proceed with installation after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing penetration firestop systems complying with firestop system manufacturer's written instructions and with the following requirements:
 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestop systems.
 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestop systems. Remove loose particles remaining from cleaning operation.
 3. Remove laitance and form release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by penetration firestop system manufacturer complying with manufacturer's recommended. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of work and that would be permanently stained or damaged by contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 INSTALLATION

- A. Penetration Firestop System: Install penetration firestop systems to comply with requirements and with firestop system manufacturer written installation instructions and published drawings for products and applications indicated.
1. Install forming/damming/backing materials and accessories of types required to support fill materials during application and in the position needed to produce cross sectional shapes and depths required to achieve fire ratings indicated. After installing fill materials and allowing them to fully cure, remove combustible forming materials and accessories not indicated as permanent components of firestop systems.
 2. Install fill materials for firestop systems by proven techniques to produce results:
 - a. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire resistance ratings indicated.
 - b. Apply materials for full contact and adhere to substrates formed by openings and penetrating items.
 - c. For fill materials that remain exposed after completing work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.
- B. Fire Resistive Joint System: Install fire resistive joint systems to comply requirements and manufacturer's written installation instructions for products and applications indicated.
1. Install forming/packing/backing materials and accessories of types required to support fill materials during application and in position needed to produce cross sectional shapes and depths required to achieve fire ratings indicated.
 2. Install fill materials for joint systems by proven techniques to produce the following results:
 - a. Fill voids and cavities formed by openings and forming/packing/backing materials required to achieve fire resistance ratings indicated.
 - b. Apply fill materials to contact and adhere to substrates formed by joints.
 - c. For fill materials remaining exposed after completing work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Identify firestop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of edge of the firestop systems so labels are visible at removal.
1. Use mechanical fasteners for metal labels. For plastic labels, use self adhering type with adhesives capable of permanently bonding labels to surfaces and, in combination with label material, resulting in partial destruction of label if removal is attempted. Include information on labels:
 - a. The words *Warning - Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage.*
 - b. Contractor's name, address, and phone number.
 - c. Firestop system designation of applicable testing and inspecting agency.
 - d. Date of installation.
 - e. Penetration firestop system manufacturer's name.
 - f. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Where deficiencies are found or fire resistive joint systems are damaged or removed due to testing, repair or replace fire resistive joint systems so they comply with requirements.

- C. Proceed with enclosing fire resistive joint systems with construction after inspection reports are issued and installations comply with requirements.

3.6 CUTTING AND PATCHING

- A. Cut, patch, and repair firestopping to accommodate work. Repair cracks and indented surfaces. Repair surfaces around items built into or penetrate surfaces. Repair and replace work to eliminate blister, buckles, dry outs, and similar imperfections. Repair and replace work required to comply fire resistance ratings.
- B. After completion of work in and around the areas of firestopping, repair and replace damaged firestopping.

3.7 CLEANING AND PROTECTION

- A. Clean excess fill materials adjacent to openings as work progresses by methods and with cleaning materials approved in writing by penetration firestop system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation ensuring penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestop systems immediately and install new materials to produce systems complying with requirements.

END OF SECTION 07 84 00

SECTION 07 92 00 – JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 1. Control and expansion joints on exposed surfaces.
 2. Perimeter joints between wall surfaces and frames of doors and openings.
 3. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 4. Joints indicated or as necessary.
 5. Accessories necessary for a complete installation.

1.3 RELATED SECTIONS

- A. Section 04 20 00 – Unit Masonry.
- B. Section 08 80 00 – Glazing.
- C. Section 09 21 16 – Gypsum Board Assemblies
- D. Section 09 30 13 – Ceramic Tiling.
- E. Division 23 – Mechanical Sections.

1.4 REFERENCES

- A. ASTM International (ASTM)
 1. C717, Standard Terminology of Building seals and Sealants.
 2. C793, Standard Test Method for Effects of Accelerated Weathering on Elastomeric Joint Sealants.
 3. C794, Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
 4. C834, Standard Specification for Latex Sealants.
 5. C920, Standard Specification for Elastomeric Joint Sealants.
 6. C1193, Standard Guide for Use of Joint Sealants.
- B. Sealant, Waterproofing and Restoration Institute (SWRI)
 1. The Professional's Guide.

1.5 SUBMITTALS

- A. Product Data: Technical data for each joint sealant product. Submit written certification from manufacturers of sealants attesting products are suitable for use indicated, verified through in house testing laboratory.
 1. Written certification from manufacturers of joint sealants attesting that products comply with specification requirements and suitable for use indicated verified through manufacturers testing laboratory within the past 36 months or since most recent reformulation, whichever is most recent.

- a. Complete instructions for handling, storage, mixing, priming, installation, curing and protection of each type of sealant.
 - b. Manufacturer's letter, clearly indicating proposed lot numbers of each sealant supplied and expiration date sequence.
 - c. Instructions for handling, storage, mixing, priming, installation, curing, and protection of each type of sealant.
2. Recycled Content:
- a. Indicate recycled content; indicate percentage of preconsumer and postconsumer recycled content per unit of product.
 - b. Indicate relative dollar value of recycled content product to total dollar value of product included in project.
 - c. If recycled content product is part of an assembly, indicate the percentage of recycled content product in the assembly by weight.
 - d. If recycled content product is part of an assembly, indicate relative dollar value of recycled content product to total dollar value of assembly.
3. Local/Regional Materials:
- a. Sourcing location(s): Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.
 - b. Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.
 - c. Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.
 - d. Product Component(s) Value: Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weight of each component per unit of product.
4. VOC Data: Submit manufacturer's product data for sealants. Indicate VOC limits of the product. Submit MSDS highlighting VOC limits.
5. Submit environmental data in accordance with Table 1 of ASTM E2129 for products provided under work of this Section.
- B. Certificates and Reports:
1. Product Certificates: Manufacturer's product certificate for each kind of joint sealant and accessory.
 2. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.
 3. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
 4. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - a. Materials forming joint substrates and sealant backings have been tested for compatibility and adhesion with sealants.
 - b. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
 5. Preconstruction Field Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified.
 6. Field Adhesion Test Reports: For each sealant application tested.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Firm having minimum 5 years documented experience and specializing in the installation of sealants.
1. Exposed sealant work (sealants used for air and weatherseals external to curtain wall systems at perimeter, metal panel to panel joints) shall be performed by a single (i.e. one) firm specializing in the installation of sealants who has successfully produced work comparable to project.
 2. Concealed sealant work (sealants which are internal to metal framed curtain wall systems, skylights, and providing an air seal) shall be the responsibility of the subcontractor providing erection of the respective system.
- B. Source Limitations: Obtain each type of joint sealant from a single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
 2. Pre-construction Field Adhesive Testing: Prior to installation of building sealants, field test their adhesion to joint substrates in accordance with manufacturer's instructions. Perform test in locations indicated by Architect. Perform test for each type of building sealant and each substrate as required by Architect. If required by Architect, arrange for tests to be performed with sealant manufacturer's representative present. Follow-up review by Architect and manufacturer may be required to observe sealant performance over time and may result in re-application of sealant or replacement.
 3. Test according to SWRI Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion in peel, and indentation hardness.
- D. Environmental Requirements:
1. Toxicity/IEQ: Comply with applicable regulations regarding toxic and hazardous materials.
 - a. VOC Content of Interior Sealants: Sealants and sealant primers complying with limits for VOC content for SCAQMD when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1) Sealants: 250 g/L.
 - 2) Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3) Sealant Primers for Porous Substrates: 775 g/L.
 - b. Sealants containing aromatic solvents, fibrous talc, formaldehyde, halogenated solvents, mercury, lead, cadmium, chromium and their compounds, are not permitted.
- E. Cleaning: Facade sealants that have collected dirt at the time of Substantial Completion shall be cleaned over the entire facade prior to acceptance by the Owner. 11 months after final completion of the building, if the sealant joints show dirt, they shall again be cleaned over the entire façade.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials in compliance with manufacturer written instructions to prevent deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 degrees F (4.4 degrees C).
 - 2. When joint substrates are wet. Should joints or backing materials become wet, remove and replace backing material with new.
- B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
- C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.9 PRE-INSTALLATION CONFERENCES

- A. Refer to Section 01 31 00 – Project Management and Coordination.
- B. In addition, refer to information above concerning Field Adhesive Testing.

1.10 WARRANTY

- A. Installer's Warranty: Written warranty, signed by Installer agreeing to repair or replace elastomeric joint sealant work which has failed to provide a weathertight system within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- B. Warranties: Written warranties (weatherseal and stain resistance), signed by sealant manufacturer agreeing to furnish joint sealants to repair or replace those that fail to provide airtight and watertight joints, or fail in adhesion, cohesion, abrasion resistance, stain resistance, weather resistance, durability, or appear to deteriorate in manner not specified in the manufacturer's data as an inherent quality of the material within specified warranty period.
 - 1. Warranty Period: 5 years from date of Substantial Completion.
- C. Warranties specified exclude deterioration or failure of sealants from:
 - 1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Compatibility: Provide joint sealants, backings, and related materials compatible with one another and with joint substrates under conditions of service and application, as stated by sealant manufacturer's published data, and as substantiated by the manufacturer for each application through testing.

- B. Liquid Applied Sealants: Comply with ASTM C 920 and requirements indicated for each liquid applied sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- C. Stain Test Response Characteristics: For sealants in contact with porous substrates, provide nonstaining products that have undergone testing according to ASTM C 1248 and do not stain porous joint substrates.
- D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- E. Colors: For fully concealed joints, provide standard color of sealant that has the best overall performance characteristics for the application shown. For exposed joints, match adjacent surface. For exposed joints, submit color samples to architect for approval, from manufacturer's full line of standard colors.
- F. Manufacturer's Representative: Use sealant produced by manufacturer who agrees to send a qualified technical representative to site upon request for the purpose of rendering advice concerning the recommended installation of manufacturer's materials.
- G. Sealants: Self leveling compounds for horizontal joints in pavements and nonsag compounds elsewhere except as shown or specified.
- H. Silicone Sealant: Comply with ASTM C920, Type M, Grade NS, Class 25; use NT, M, A and O.
 - 1. Use: Precast Concrete Joints between metals, glass and plastics (Two part silicone sealants).
 - 2. Properties: Performance: Nonstain, nonbleed, nonstreaking to sealed and adjacent substrates. The minimum pli value after 7 day immersion shall not be less than 13 when tested in strict accordance with ASTM C794 Adhesion and Peel.
 - 3. Cure System and Oil Content: Neutral Cure System specifically manufactured with controlled oil content to eliminate oil migration into sealed substrates and residue rundown over and onto adjacent substrates.
 - 4. Product and Manufacturer:
 - a. Dow Corning; 756 Silicone Building Sealant - HP with Additive or comparable product by BASF or Sika Corporation approved by Architect.
- I. Silicone Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.
 - 1. Use: Precast Concrete Joints between metals, glass and plastics (Single component sealants).
 - 2. Properties: Performance: Nonstain, nonbleed, nonstreaking to sealed and adjacent substrates.
 - 3. Cure System and Oil Content: Neutral Cure System specifically manufactured with controlled oil content to eliminate oil migration into sealed substrates and residue rundown over and onto adjacent substrates.
 - 4. Product and Manufacturer:
 - a. BASF Building Systems; Omniseal 50.
 - b. Dow Corning Corporation; 756 SMS, 791, 795, 995 as applicable.
 - c. GE Advanced Materials, Silicones; SilGlaze II SCS2800, SilPruf NB SCS9000, SilPruf SCS2000, or UltraPruf II SCS2900 as applicable.
 - d. Sika Corporation, Construction Products Division; SikaSil-C995.
- J. Polyurethane Sealants: ASTM C920, Type M, Grade NS, Class 25; use NT, M, A and O.
 - 1. Use: Typical Wall and Floor Joints (Two part polyurethane sealants).
 - 2. Properties: Performance: Nonstain, nonbleed, nonstreaking to sealed and adjacent substrates.
 - 3. Products and Manufacturers:

- a. BASF Building Systems; MasterSeal NP 2.
 - b. Pecora Corporation; Dynatred.
 - c. Sika Corporation, Construction Products Division; Sikaflex 2c NS or Sikaflex 2c NS TG as applicable.
- K. Two Part Polyurethane Sealants: ASTM C920, Type M, Grade NS, Class 50; use NT, M, A and O.
1. Use: Typical Wall and Floor Joints (Two Part Polyurethane Sealants).
 2. Properties: Performance: Nonstain, nonbleed, nonstreaking to sealed and adjacent substrates. The minimum pli value after 7 day immersion shall not be less than 13 when tested in strict accordance with ASTM C794 Adhesion in Peel.
 3. Products and Manufacturers: One of the following:
 - a. Schnee-Morehead, Inc.; Permthane SM 7200.
 - b. Sika Corporation, Inc.; Sikaflex - 2c NS TG.
 - c. BASF Construction Chemicals; NP 2.
- L. Mildew Resistant Silicone Sealant: ASTM C920, Type S, Grade NS, Class 25, Use NT, Substrate uses G, A, and O; and containing fungicide for mildew resistance; acid curing.
1. Use: Joints at toilet fixtures, toilet room countertops and vanities, wet areas, and janitor closet mop receptor to wall transition.
 2. Products: Provide one of the following:
 - a. BASF Building Systems; Omniplus.
 - b. Dow Corning; 786 Mildew Resistant Silicone Sealant.
 - c. GE Silicones; Sanitary SCS 1700.
- M. Latex Sealant: Nonelastomeric, one part, nonsag, paintable latex sealant that is recommended for exposed applications on the interior. Complying with ASTM C 834, Type OP (opaque sealants):
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pecora Corporation; AC-20 + Silicone.
 - b. BASF; MasterSeal.
- N. Acoustical Joint Sealant: Nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pecora Corporation; AC-20 FTR or AIS-919.
 - b. USG Corporation; SHEETROCK Acoustical Sealant.
- O. Sealant Backing: Provide sealant backings that are nonstaining; compatible with joint substrates, sealants, primers, and joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
1. Cylindrical Sealant Backings: Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding backings of flexible plastic foam complying with ASTM C 1330, and of type indicated below. Select shape and density of cylindrical sealant backings in consultation with the manufacturer for proper performance in specific condition of use in each case.
 2. Type C: Closed cell polyethylene foam material with surface skin, nonabsorbent to liquid water and gas, nonoutgassing in unruptured state; one of the following:
 - a. HBR Closed Cell Backer Rod; Nomaco, Inc.
 - b. MasterSeal 920 Closed-Cell Backer-Rod; BASF Construction Chemicals.
- P. Weep and Vent Tubes: Clear plastic (PVC) tubing, minimum 1/4 inch (6.35 mm) inside diameter, and length required to extend between exterior face of sealant and open cavity behind. At window and curtain wall systems, where required by system designer, provide gutter termination of tube with preformed nipples suitable for sealing to gutter.

- Q. Miscellaneous Materials:
1. Primer: Material recommended, as verified through compatibility and adhesion testing, by joint sealant manufacturer for the substrates indicated to be sealed.
 2. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants with joint substrates.
 3. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and which will not stain nor mar the finish of surface adjacent to joints to which it is applied.
 4. Cork Joint Filler: Resilient and nonextruding, ASTM D1752, Type II.
 5. Bond Breaker Tape: Polyethylene, TFE fluorocarbon, or plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants for compliance with requirements for joint configuration, installation tolerances, and conditions affecting sealant performance. Proceed with installation after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with the recommendations of joint sealant manufacturer and requirements:
1. Remove foreign material from joint substrates interfering with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), existing joint sealants, oil, grease, water, surface dirt, and frost.
 2. Clean concrete, masonry, unglazed surfaces of tile and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil free compressed air.
 3. Remove laitance and form-release agents from concrete.
 4. Clean metal, glass, porcelain enamel, glazed surfaces of tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming (Elastomeric Sealants Only): Prime joint substrates where recommended in writing by joint sealant manufacturer, based on prior testing and experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION

- A. Silicone Glazing Sealants: Refer to Section 08 80 00.

- B. Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- C. Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants applicable to materials, applications, and conditions indicated.
- D. Sealant Backings: Install sealant backings to support sealants during application and at position necessary to produce cross sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings. Trim for tight fit around obstructions or elements penetrating the joint.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that become wet before sealant application and replace with dry sealant backings.
 - 4. Install bond breaker tape behind sealants where backings are not used between sealants and back of joints.
- E. Weeps and Vents: Install weeps and vents into joints at the same time sealants are being installed. Locate weeps and vents spaced recommended by sealant manufacturer and the window and curtain wall fabricator and erector. Do not install weeps and vents at outside building corners. Do not install vents at horizontal joints immediately below shelf angles, sills, and through wall flashings.
- F. Sealants: Install sealants by proven techniques resulting in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at same time sealant backings are installed.
 - 1. Apply sealants in depth in accordance with manufacturer's recommendations and recommended general proportions and limitations.
 - 2. Apply elastomeric sealants, in joints not subject to traffic or abrasion, to a depth equal to 50% of the joint width, but not less than 1/4 inch (6 mm) and not more than 1/2 inch (13 mm).
 - 3. Apply nonelastomeric sealants to a depth approximately equal to the joint width.
- G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform, beads to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces. Tool exposed surfaces of sealants to the profile shown, or if none is shown, tool slightly concave.
 - 1. Use masking tape to protect adjacent surfaces of recessed tooled joints.
 - 2. Provide a slight wash on horizontal joints where horizontal and vertical surfaces meet.
 - 3. Against rough surfaces or in joints of uneven widths avoid the appearance of excess sealant or compound by locating the compound or sealant well back into joint wherever possible.
- H. Installation of Preformed Silicone Sealant System:
 - 1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
 - 2. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone sealant system manufacturer's written instructions and covering a bonding area of not less than 3/8 inch (10 mm). Hold edge of sealant bead 1/4 inch (6 mm) inside masking tape.

3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
 4. Complete installation of sealant system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.
- I. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping. Do not pull or stretch material. Produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures, apply heat to sealant in compliance with sealant manufacturer's written instructions.
- J. Acoustical Sealant Installation: At sound rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer written recommendations.

3.4 FIELD QUALITY CONTROL

- A. Field Adhesion Testing: Field test exterior wall joint sealant adhesion to joint substrates:
1. Extent of Testing: Test completed and cured sealant joints:
 - a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
 - b. Perform 1 test for each 1000 feet (300 m) of joint length thereafter or 1 test per each floor per elevation.
 2. Test Method: Test joint sealants according to Method A, Field Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer field adhesion hand pull test criteria.
 4. Record test results in a field adhesion test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
 5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure original sealant surfaces are clean and new sealant contacts original sealant.
- B. Evaluation of Field Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 SITE ENVIRONMENTAL PROCEDURES

- A. Indoor Air Quality: Provide temporary ventilation during work. Coordinate interior application of sealants with interior finishes schedule.

3.6 CLEANING AND PROTECTION

- A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.
- B. Protect joint sealants during and after curing from contact with contaminating substances and from damage so sealants are without deterioration or damage at time of Substantial Completion. If, despite protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

END OF SECTION 07 92 00

SECTION 07 95 00 - EXPANSION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Expansion joint cover assemblies.
 - 2. Accessories necessary for a complete installation.

1.3 PERFORMANCE REQUIREMENTS

- A. Expansion Joint Design Criteria:
 - 1. Type of Movement: Thermal and wind sway.
 - a. Nominal Joint Width: Indicated on Drawings.
 - b. Minimum Joint Width: Indicated on Drawings.
 - c. Maximum Joint Width: Indicated on Drawings.

1.4 SUBMITTALS

- A. Product Data: Technical data for each type of product including construction details, material descriptions, dimensions of individual components and profiles, and finishes for expansion joint cover assemblies.
- B. Shop Drawings: Submit for each expansion joint cover assembly.
 - 1. Include plans, elevations, sections, details, splices, block out requirement, attachments to other work, and line diagrams showing entire route of each expansion joint.
 - 2. Where expansion joint cover assemblies change planes, provide isometric or clearly detailed drawing depicting how components interconnect.
- C. Expansion Joint Cover Assembly Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:
 - 1. Manufacturer and model number for each expansion joint cover assembly.
 - 2. Expansion joint cover assembly location cross-referenced to Drawings.
 - 3. Nominal, minimum, and maximum joint width.
 - 4. Movement direction.
 - 5. Materials, colors, and finishes.
 - 6. Product options.
 - 7. Fire resistance ratings.
- D. Product Test Reports: For each fire resistance rated expansion joint cover assembly, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Fire Resistance Ratings: Provide expansion joint cover assemblies with fire barriers identical to those of systems tested for fire resistance according to UL 2079 or ASTM E 1966 by a qualified testing agency.

- a. Hose Stream Test: Wall-to-wall and wall-to-ceiling assemblies shall be subjected to hose stream testing.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063-T5 for extrusions; ASTM B 209 (ASTM B 209M), Alloy 6061-T6 for sheet and plate. Apply protective coating on aluminum surfaces in contact with cementitious materials.
- B. Elastomeric Seals: Preformed elastomeric membranes or extrusions to be installed in metal frames.
- C. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to comply with performance criteria for required fire-resistance rating.
- D. Moisture Barrier: Flexible elastomeric material. Continuous, waterproof membrane within joint and attached to substrate on sides of joint. Provide where indicated on Drawings.
- E. Nonmetallic, Shrinkage Resistant Grout: ASTM C 1107/C 1107M, factory packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30 minute working time.
- F. Fasteners: Recommended attachment devices. Include anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

2.2 FLOOR EXPANSION JOINT COVERS

- A. Metal Plate Floor Joint Cover: Metal cover plate fixed on one side of joint gap and free to slide on other.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Architectural Art Manufacturing Inc.; a division of Pittcon Architectural Metals, LLC.
 - b. Construction Specialties, Inc.
 - c. InPro Corporation (IPC).
 - d. MM Systems Corporation.
 - e. Nystrom, Inc.
 - f. Balco.
 2. Application: Floor to wall.
 3. Installation: Surface mounted.
 4. Load Capacity:
 - a. Uniform Load: 50 lb/sq. ft. (244 kg/sq. m).
 - b. Concentrated Load: 300 lb (136 kg).
 - c. Maximum Deflection: 0.0625 inch (1.6 mm).
 5. Fire Resistance Rating: Not less than indicated on Drawings and adjacent construction.
 6. Cover Plate Design: Plain.
 7. Exposed Metal: Aluminum, clear anodic, Class I.
- B. Elastomeric Seal Floor Joint Cover: Assembly consisting of elastomeric seal anchored to frames fixed to sides of joint gap.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Architectural Art Manufacturing Inc.
 - b. Construction Specialties, Inc.
 - c. EMSEAL Joint Systems, Ltd.
 - d. InPro Corporation (IPC).
 - e. MM Systems Corporation.
 - f. Nystrom, Inc.
 - g. Masters Builders Solutions.
 - h. Balco, a CSW Industrials Company.
2. Application: Floor to floor.
3. Installation: Indicated on Drawings.
4. Load Capacity:
 - a. Uniform Load: 50 lb/sq. ft. (244 kg/sq. m).
 - b. Concentrated Load: 300 lb (136 kg).
 - c. Maximum Deflection: 0.0625 inch (1.6 mm).
5. Fire Resistance Rating: Not less than that indicated on Drawings and adjacent construction.
6. Exposed Metal: Aluminum, clear anodic, Class I.
7. Seal: Preformed elastomeric membrane or extrusion.

2.3 WALL EXPANSION JOINT COVERS

- A. Metal Plate Wall Joint Cover: Metal cover plate fixed on one side of joint gap and free to slide on other.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Architectural Art Manufacturing Inc.; a division of Pittcon Architectural Metals, LLC.
 - b. Construction Specialties, Inc.
 - c. InPro Corporation (IPC).
 - d. MM Systems Corporation.
 - e. Nystrom, Inc.
 - f. Masters Builders Solutions.
 - g. Balco, a CSW Industrials Company.
 2. Application: Wall to wall.
 3. Fire Resistance Rating: Not less than indicated on Drawings and adjacent construction.
 4. Exposed Metal: Aluminum, clear anodic, Class I.

2.4 CEILING EXPANSION JOINT COVERS

- A. Metal Plate Ceiling Joint Cover: Metal cover plate fixed on one side of joint gap and free to slide on other.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Architectural Art Manufacturing Inc.
 - b. Construction Specialties, Inc.
 - c. InPro Corporation (IPC).
 - d. MM Systems Corporation.
 - e. Nystrom, Inc.
 - f. Balco, a CSW Industrials Company.
 2. Application: Wall to ceiling.
 3. Fire Resistance Rating: Not less than indicated on Drawings and adjacent construction.

4. Exposed Metal: Aluminum, Clear anodic, Class I.

2.5 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces where expansion joint cover assemblies will be installed for installation tolerances and other conditions affecting performance of the work.
- B. Notify Architect where discrepancies occur that will affect proper expansion joint cover assembly installation and performance.
- C. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

- A. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.
- B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion joint cover assemblies. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion joint cover assemblies.
- C. Furnish units in longest practicable lengths to minimize field splicing.
- D. Include factory fabricated closure materials and transition pieces, T joints, corners, curbs, cross connections, and other accessories as required to provide continuous expansion joint cover assemblies.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.
- B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion joint cover assemblies.
 1. Repair or grout block out as required for continuous frame support using nonmetallic, shrinkage resistant grout.
 2. Install frames in continuous contact with adjacent surfaces.
 - a. Shimming is not permitted.
 3. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
 4. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation.
 5. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
 6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches (75 mm) from each end and not more than 24 inches (600 mm) o.c.

- C. Seals: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.
 - 1. Provide in continuous lengths for straight sections.
 - 2. Seal transitions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
 - 3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure sensitive tape as recommended by manufacturer.
- D. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.
- E. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.
- F. Fire Resistance Rated Assemblies: Coordinate installation of expansion joint cover assembly materials and associated work so complete assemblies comply with performance requirements.
 - 1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.
- G. Moisture Barrier Drainage: If indicated, provide drainage fittings and connect to drains.

3.4 PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.
- B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over expansion joint cover assemblies. Reinstall cover plates or seals prior to Substantial Completion.

END OF SECTION 07 95 00

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Provide items shown on the drawings and specified, including, but not limited to the following:
 - 1. Standard and fire rated hollow metal doors
 - 2. Hollow metal frames for doors, sidelites, transoms, and windows.
 - 3. Louvers and vision lites in steel doors, if shown or required.

1.3 RELATED WORK

- A. Section 04 20 00 - Unit Masonry.
- B. Section 05 40 00 – Cold-Formed Metal Framing.
- C. Section 05 50 00 – Metal Fabrications.
- D. Section 08 14 23 – Plastic-Laminate-Faced Wood Doors.
- E. Section 08 80 00 - Glazing: Glazing in doors, sidelites, transoms, and windows.
- F. Section 09 90 00 - Paintings and Coatings.

1.4 REFERENCES

- A. American National Standards Institute (ANSI)
 - 1. A115.IG, Installation Guide for Doors and Hardware.
 - 2. A224.1, Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors & Frames.
 - 3. A250.8, Recommended Specifications for Standard Steel Doors and Frames.
 - 4. A250.11, Recommended Erection Instructions for Steel Frames.
- B. ASTM International (ASTM)
 - 1. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. A924, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 - 3. A1008, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
 - 4. A1011, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
 - 5. C1363 - Standard Test Method for the Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus.

6. E283 – Standard Test Method for Determining the rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
 7. E413 - Standard Classification for Rating Sound Insulation
- C. Federal Specification (Fed Spec)
1. Fed Spec C578 Bead Fusion Test.
- D. Hollow Metal Manufacturers Association (HMMA)
1. HMMA 802 - Manufacturing of Hollow Metal Doors and Frames.
 2. HMMA 810 - Hollow Metal Doors.
 3. HMMA 830 - Hardware Preparation and Locations for Hollow Metal Doors and Frames.
 4. HMMA 840 - Installation and Storage of Hollow Metal Doors and Frames.
 5. HMMA 850 - Fire Rated Hollow Metal Doors & Frames.
 6. HMMA 890 - Technical Summary of Hollow Metal by HMMA.
- E. National Fire Protection Association (NFPA)
1. 80, Fire Doors and Fire Windows.
 2. 252, Fire Tests of Door Assemblies.
- F. Steel Door Institute – Current Standards
1. Technical Data Series.
- G. Underwriters Laboratories Inc. (UL)
1. Building Materials Directory.
 2. Listing and Labeling.
 3. 10B and 10C, Fire Tests of Door Assemblies.
 4. 1784, Air Leakage Tests of Door Assemblies.
- H. Intertek Testing, Services (Warnock Hersey, Inc. (WHI))
1. Listing and Labeling.

1.5 SUBMITTALS

- A. Product Data:
1. Manufacturer's standard details and catalog data demonstrating compliance with specifications and referenced standards.
 2. Manufacturer's installation instructions.
- B. Shop Drawings:
1. Indicate complete schedule in detail for each steel door and frame using the same reference number for details and openings as those on the Contract Drawings. If any door is not by the steel door manufacturer only the door opening number should be shown along with the type of door (wood, plastic laminate faced, etc.).
 2. Show details of construction, installation, connections, anchors, hardware reinforcement, hardware preparation, louvers, and floor and threshold clearances.
- C. Samples are required from non-Steel Door Institute members:
1. 12 inch x 12 inch sample of a fire-rated and non-rated door, cut from corner of door, showing door construction.
 2. 12 inch x 12 inch sample of each type of door louver specified or required, showing louver construction.
 3. 6 inch long sample of a fire-rated, non-rated frame, and each type of glass stop specified or required, showing corner and construction.

- D. Certificates:
 - 1. Manufacturer's certification that oversized openings are in compliance with specifications.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: If other than a manufacturer listed under Paragraph 2.1 is proposed for use on the Project, it shall be a company specializing in the manufacturer of steel doors and frames of the type specified for this Project with a minimum of five (5) years experience.
- B. All steel doors and frames shall be by a single manufacturer, shop drawings to be submitted with manufacturer's insignia which is being supplied.
- C. Furnish steel doors and frames to meet current ANSI/Steel Door Standards.
- D. ANSI/SDI-A250.13 (2003) Testing and Rating of Sever Windstorm Resistant Components for Swing Door Assemblies.
- E. ASTM E 330-97, Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
- F. Comply with ASTM E 283 – Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

1.7 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies:
 - 1. Fire-Rated Door, Panel, Frame, and Fire Window Construction: Shall conform to ASTM E2074, NFPA 252, or UL 10B, as applicable, and acceptable to the code authorities having jurisdiction.
 - 2. Fire-Rated Door Construction:
 - a. Notwithstanding any other requirements of this Specification, provide gauge of metal, method of construction, hardware preparation, reinforcement, and placement, glass opening size, and other specifics required to obtain the specified or required label. The label shall contain the fire resistance rating (20 minute, 45 minute, 1 hour, 1-1/2 hour, 3 hour, etc.) and the designation (A, B, C, D, or E). Doors with "B" Label shall be 1-1/2 hour.
 - b. Fire-rated doors used in a stairway enclosure, shall be so constructed so that the maximum transmitted temperature shall not exceed 450 degrees F above ambient temperature at the end of 30 minutes of the Standard Fire Exposure Test and shall be so noted on the label.
 - 3. Fire-Rated Openings: Conform to NFPA 80 for fire-rated class shown or required by code authorities having jurisdiction.
 - a. Units shall be identical to assemblies whose fire resistance characteristics have been determined in accordance with requirements specified under Paragraph C, 01, above, and shall be labeled and listed by UL, WHI, or other inspection and testing agency acceptable to the code authorities having jurisdiction.
 - b. Fire-rated steel doors, panels, frames, and fire windows shall bear permanent labels attesting to fire resistance. At stairway enclosures, provide units listed for 450 degree F maximum temperature rise rating for 30 minutes of exposure.
 - c. Oversized openings shall be constructed in accordance with all applicable requirements for labeled door construction.

- d. Fire rated door assemblies with gaps in excess of 1/8 inch between door and frame will not comply with NFPA 80.
 - e. Locate label on hinge side of doors and frames so that when door is closed, label is not visible.
 - f. Caution shall be taken to ensure that labels are not removed, damaged or painted over.
 - g. Glass panes shall not exceed sizes allowed whether indicated or not on the drawings.
- B. Wind Loads: Provide hollow metal and door hardware assemblies approved by the Texas Department of Insurance, including anchorage, capable of withstanding windload design pressures which are calculated for this project by a registered Architect or Engineer and is part of the construction documents per the Texas Department of Insurance, authorities having jurisdiction and the International Building Code Design Loads per section 1609.
- C. Hurricane-Resistance Test Performance: Provide hollow metal and door hardware approved assemblies that pass large missile-impact tests, as required by Texas Department of Insurance systems location above grade, and cyclic-pressure tests according to testing requirements of authorities having jurisdiction.
- 1. Impact Resistance: Hollow metal with approved door hardware assemblies must satisfy the Texas Department of Insurance's criteria for protection from windborne debris in both the Inland 1 zone and the Seaward zone. The assemblies must have passed the large missile impact test (which equates to Missile Level D specified in ASTM E 1996-02). The assemblies may be installed at any height on the structure as long as the design pressure rating for the assemblies is not exceeded. These assemblies will and do not need to be protected with an impact protective system when installed in areas where windborne debris protection is required.

1.8 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 00 – Project Management and Coordination.

1.9 COORDINATION

- A. Coordinate the Work of this Section with Work in which hollow metal Work is installed.
- B. Coordinate hardware installation with opening construction. Door hardware is specified in Section 08 71 00.
- C. Coordinate doors, frames, and windows with glazing specified in Section 08 80 00.
- D. Coordinate doors and frames with painting specified in Section 09 91 00.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Deliver and store products in accordance with manufacturer's instructions, and as follows:
 - 1. In manufacturer's original, clearly labeled, undamaged containers or wrappers.
 - 2. Containers or wrappers shall list the name of the manufacturer and product.
- B. Deliver materials to allow for minimum storage time at the project site. Coordinate delivery with the scheduled time of installation.
- C. Protect products from moisture, construction traffic, and damage.
 - 1. Store under cover in a clean, dry place, protected from weather and abuse.

2. Store in a manner that will prevent rust or damage.
3. Store doors in a vertical position, spaced with blocking to permit air circulation.
4. Do not use non-vented plastic or canvas shelters.
5. Should containers or wrappers become wet, remove immediately.

1.11 WARRANTY

- A. Warrant the Work specified herein for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials and workmanship.
- B. Defects shall include, but not be limited to:
 1. Use of incorrect materials in opening
 2. Incorrect labeled components installed within opening.
 3. Noisy, rough or difficult operation
 4. Failure to meet specified quality assurance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed below whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must comply with Paragraph 1.5, A, Manufacturer Qualifications, must manufacture equivalent products to those specified and comply with requirements of Division 1 regarding substitutions to be considered.
 1. CECO Door Products, an Assa Abloy company. (888-264-7474).
 2. Curries Company, an Assa Abloy company. (641-423-1334).
 3. Deansteel Mfg. Co.; (210) 226-8271.
 4. Door Pro Systems, Inc., (713) 462-0860.
 5. Mesker Door Inc.; (256) 851-6670.
 6. Pearland Industries; (713) 434-9898.
 7. Pioneer Industries, Inc.; (309) 856-6000.
 8. Republic Builders Products Company; (800) 733-3667.
 9. Steelcraft Mfg. Co., an Assa Abloy company; (513) 745-6400.

2.2 MATERIALS, GENERAL

- A. Steel requirements, all frames to be manufactured of commercial quality, stretcher leveled flatness, cold rolled steel per ASTM-A1008 general requirements. Internal reinforcing may be manufactured of hot rolled pickled and oiled steel per ASTM-A1011. Exterior frames and interior frames where shown on drawings or required in damp, moist, humid, and wet areas, i.e., toilets, locker rooms, showers, etc., to be manufactured of commercial quality, stretcher leveled flatness, cold rolled steel and galvanized to 'A-60' minimum coating weight standard per ASTM-A653 and A924, with coating weight of not less than 0.60 ounce per square foot (0.30 ounce per square foot per side).

2.3 FRAME FABRICATION

- A. Minimum Gauges:
 1. Interior Openings:
 - a. Less than 4 feet-0 inches in Width: 16 gauge.
 - b. 4 feet-0 inches in Width and greater: 14 gauge.
 2. Exterior Openings: 14 gauge

B. Design and Construction:

1. Frames shall be custom made, welded units with integral trim of sizes and shapes shown on approved shop drawings. Hinge jambs that butt adjacent 90 degree walls shall have at least four (4) inch wide frame face to assure the door trim will not strike the wall prior to the door opening at least 90 degrees. Frame profile shall match wall thickness where practical, i.e., 4-3/4 inch at 4 inch CMU, 6-3/4 inch at 6 inch CMU, and 8-3/4 inch at 8 inch CMU. At masonry wall openings, fabricate frames to suite masonry opening with 2 inch head member.
2. Frames shall be strong and rigid, neat in appearance, square, true and free of defects, warp and buckle. Molded members shall be clean cut, straight and of uniform profile throughout their length.
3. Jamb depths, trim, profile and backbends shall be as shown on approved shop drawings.
4. Corner joints, including face and inside corners, shall have contact edges closed tight, with trim faces mitered and continuously welded, and stops butted. The use of gussets shall not be permitted. Face of frame shall be ground smooth. Knockdown (KD) frames are not permitted.
5. Minimum depth of stops shall be 5/8 inch, except at fire windows where minimum depth of stops shall be 3/4 inch.
6. Frames for multiple openings shall have mullion and rail members which are closed tubular shapes having no visible seams or joints. Joints between faces of abutting members shall be securely welded and finished smooth. Mullions shall be key locked removable type. Keys shall be master keyed to Owner's Best system.
7. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inch and wider with mortise/butt type hinges only at top hinge location to deter against hinge reinforcement sag.
8. Continuous Hinge Reinforcement: Provide welded continuous 12 gage strap for continuous hinges specified in hardware sets in Division 8 Door Hardware.
9. Provide countersunk flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops; provide security head screws at exterior locations.
10. Provide A60 Galvannealed coating at frames in restrooms and locker rooms with showers/Jacuzzi, clean areas such as kitchen rooms.
11. Electrical Knock Out Boxes: Factory weld 18 gage electrical knock out boxes to frame for electrical hardware preps; included but not limited to electric thru wire hinges, electrical raceways, door position switches, electric strikes, jamb mount card readers, and magnetic licks as noted in door hardware sets in Division 8, Door Hardware.
 - a. Electrical knock out boxes are required at door position switches, electric strikes, card readers, and middle hinge locations for all exterior locations regardless of electrical hardware specified in Division 8, Door Hardware.
 - b. Provide electrical knock out boxes with 3/4-inch knockouts.
 - c. Conduit to be coordinated and installed in field from middle hinge box and strike box to door position box.
 - d. Electrical knock out boxes to comply with NFPA requirements and fit electrical door hardware as specified in hardware sets in Division 8, Door Hardware.
 - e. Electrical knock out boxes for continuous hinges should be located in the center of the vertical dimension on the hinge jamb.
 - f. Provide field installed conduit per Division 28 section for standardized plug connectors to accommodate up to twelve (12) wires as required for electrified door hardware specified in hardware sets in Division 8, Door Hardware. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Wire nut connections are not acceptable.

12. Hardware Reinforcements:
 - a. Frames shall be mortised, reinforced, drilled and tapped at factory for fully template mortised hardware in accordance with approved hardware schedule and templates provided by Section 08 71 00. Where surface-mounted hardware is to be applied, frames shall have reinforcing plates only.
 - b. Minimum thickness of hardware reinforcing plates shall be as follows:
 - 1) Hinge and pivot reinforcements (1-1/4 inch x 10 inch minimum size): 7 gauge.
 - 2) Strike reinforcements: 12 gauge.
 - 3) Flush bolt reinforcements: 12 gauge.
 - 4) Closer reinforcements: 12 gauge.
 - 5) Reinforcements for surface-mounted hardware, hold-open arms, surface panic devices: 12 gauge.
 13. Floor Anchors: Minimum 14 gauge, securely welded inside each jamb, with holes for floor anchorage.
 14. Jamb Anchors:
 - a. Frames for installation in masonry walls shall be provided with adjustable jamb anchors of the T-Strap type. Anchors shall be not less than 16 gauge steel. The number of anchors provided at each jamb shall be as follows:
 - 1) Frames up to 7 feet-6 inch height - Three (3) anchors
 - 2) Frames 7 feet-6 inch to 8 feet-0 inch height - Four (4) anchors
 - 3) Frames over 8 feet-0 inch height - One (1) anchor for each 2 feet or fraction thereof in height.
 - b. Frames for installation in wood or metal stud partitions shall be provided with steel anchors of suitable approved design, not less than 16 gauge thickness, securely welded inside each jamb as follows:
 - 1) Frames up to 7 feet-6 inch height - Four (4) anchors
 - 2) Frames 7 feet-6 inch to 8 feet-0 inch height - Five (5) anchors
 - 3) Frames over 8 feet-0 inch height - Four (4) anchors plus one (1) additional for each 2 feet or fraction thereof over 8 feet-0 inches.
 - c. Frames to be anchored to previously placed concrete, masonry or structural steel shall be provided with anchors of suitable design as shown on approved shop drawings.
 15. Dust Cover Boxes: Shall be of not less than 26 gauge steel and shall be provided at all mortised hardware items. Eight (8) inch CMU walls with face brick shall have dual offset jamb anchors.
 16. Steel Spreader: Shall be provided on all frames, temporarily attached to bottoms of both jambs for bracing during shipping and handling.
 17. Loose Glazing Stops: Shall be of cold rolled steel, not less than 20 gauge, butted at corner joints and secured to the frame with countersunk cadmium or zinc-plated screws. Loose stops at exterior frames shall be placed on the interior side of the frames.
 18. At sound rated door openings and at masonry openings, coat inside of frame profile with corrosion resistant coating to minimum thickness of 1/16 inch.
- C. Frame Color: Field painted under Section 09 90 00 to match face of door.

2.4 DOOR FABRICATION

- A. Minimum Gauges:
 1. Interior Doors: SDI Grade III, 0.047-inch or ~~18~~-16 gauge (16 gauge for high frequency

- doors).
2. Exterior Doors: SDI Grade III, or 14 gauge (14 gauge for windstorm rated doors).
 3. Hollow Metal Glazing Frames: 14 gauge.
- B. Design and Construction:
1. Types: Doors shall be custom fabricated, of types and sizes shown on approved shop drawings, and shall be seamless face construction with no visible seams or joints on vertical edges with fully welded seams free from blemishes and defects. Thickness: Shall be 1-3/4 inch, unless specifically noted or shown otherwise.
 2. Exterior Doors: Provide doors with 22 gage steel z-channels placed at 6 inches apart with foamed in place polyurethane core, with a thermal insulation calculated R factor of 11.01 per ASTM C518 Standards.
 3. Fabrication:
 - a. Doors shall be strong, rigid and neat in appearance, free from warpage and buckle.
 - b. Corner bends shall be true and straight and of minimum radius for gage of metal used.
 - c. Provide 22 gauge steel stiffeners spaced maximum six (6) inches on center and extending full height of door.
 - d. Fill interior with noncombustible fiberglass insulation. Use mineral board filler as required for labeled doors.
 - e. Faces shall be joined at vertical edges of door by a continuous weld extending full height of door. Welds shall be ground, filled and dressed smooth to provide a smooth flush surface.
 - f. Top and bottom edges of doors shall be closed with a continuous recessed steel channel not less than 16 gauge, extending full width of door and spot weld to both faces. Exterior doors shall have an additional flush closing channel at top and bottom edges. Openings shall be provided in the bottom closure channel at top and bottom edges. Openings shall be provided in the bottom closure of exterior doors to permit the escape of entrapped moisture.
 - g. Continuous Hinge Reinforcement: Provide welded continuous 12 gage strap for continuous hinges specified in hardware sets in Division 8, Door Hardware.
 - h. Electrical Raceways: Provide raceways for standardized plug connectors to accommodate up to twelve (12) wires as required for electrified door hardware specified in hardware sets in Division 8, Door Hardware. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Wire nut connections are not acceptable.
 - i. Doors within in wet or humid areas shall have a top cap and solid foam interior core to prevent internal moisture accumulation and galvannealed.
 - j. Edge profile shall be provided on both vertical edges of door as follows:
 - 1) Single-Acting Swing Doors: Beveled 1/8 inch in 2 inches.
 - k. Hardware Reinforcements:
 - 1) Doors shall be mortised, reinforced, drilled and tapped at factory for fully template hardware, in accordance with the approved hardware schedule and templates provided by Section 08 71 00. Where surface-mounted hardware is to be applied, doors shall have reinforcing plates only.
 - 2) Minimum gauges for hardware reinforcing plates shall be as follows:
 - a) Hinge & pivot reinforcements: 7 gauge
 - b) Reinforcements for lock face, flush bolts, concealed holders, concealed or surface-mounted closers: 12 gauge.
 4. Glass Moldings and Stops: Loose stops shall be not less than 20 gauge steel, with butt corner joints, secured to frame opening by countersunk screws. Snap-on attachments will not be acceptable.

5. Louvers: Shall be inverted "V" blade, sightproof type, unless noted otherwise. 24 gauge. A galvanized wire mesh insect screen shall be provided at the inside face of exterior door louvers.
 6. Edge Clearances:
 - a. Between Door and Frame at Head and Jambs: 1/8 inch.
 - b. At DoorSills with No Threshold: 5/8 inch to 3/4 inch above finished floor.
 - c. At DoorSills with Threshold: As required to suit threshold.
 - d. Between Meeting Edges of Double Doors: 1/8 inch.
 7. Double Doors: Center mullions for latching and key removable.
- C. Finish:
1. Shop paint steel (whether galvanized or ungalvanized) stops and accessories as follows:
 - a. Clean surfaces free of mill scale, rust, oil, grease, dirt and other foreign matter.
 - b. Chemically treat surfaces and apply one (1) coat of an approved baked-on rust-inhibitive primer paint to provide a minimum 0.5 mil dry film thickness.
 2. Field painted under Section 09 90 00.

2.5 LABELED DOORS AND FRAMES

- A. Labeled doors and frames shall be provided for openings requiring fire protection ratings as scheduled and to comply with NFPA 80. Such doors and frames shall be constructed as tested and approved by UL, WHI, or other nationally recognized testing agency having a factory inspection service and approved by code authorities having jurisdiction and shall bear the appropriate permanent label.
- B. If any door or frame scheduled to be fire-rated cannot qualify for appropriate labeling because of its size, design, hardware or other reason; the Architect shall be so advised before fabrication work on that item is started.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Separate dissimilar metals. Protect against galvanic action.
- B. Frames:
 1. Anchorage and Connections: Secure to adjacent construction. Where practical, interior door frames shall be flush with the pull side wall to minimize or eliminate the reveal and allow full 180 degree door swing.
 2. Install frames in accordance with manufacturer's instructions and install labeled frames in accordance with NFPA 80.
 3. Frame Spreader Bars: Leave intact until frames are set perfectly square and plumb and anchors are securely attached.
 4. Remove hardware, with the exception of prime-coated items, tag box, and reinstall after finish paint Work is completed. Do not remove or paint over labels on labeled frames.
- C. Doors:
 1. Install hardware in accordance with hardware manufacturer's templates and instructions.
 2. Install doors in accordance with manufacturer's instructions and install labeled doors in accordance with NFPA 80.
 3. Adjust operable parts for correct function.
 4. Remove hardware, with the exception of prime-coated items, tag, box, and reinstall after

finish paint Work is completed. Do not remove or paint over labels on labeled doors.

3.2 ADJUST AND CLEAN

- A. Adjust doors for proper operation, free from binding or other defects.
- B. Clean and restore soiled surfaces.
- C. Remove scraps and debris, and leave site in clean condition.

END OF SECTION 08 11 13

SECTION 08 14 23 – PLASTIC-LAMINATE-FACED WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 RELATED SECTIONS

- A. Section 06 20 00 – Finish Carpentry & Millwork.
- B. Section 08 11 13 – Hollow Metal Doors and Frames.
- C. Section 08 71 00 – Door Hardware.
- D. Section 08 80 00 – Glazing.
- E. Section 09 90 00 – Paintings and Coatings.

1.3 REFERENCES

- A. Architectural Woodwork Institute (AWI) – Veneer Standards.
- B. National Fire Protection Association (NFPA)
 - 1. 80, Fire Doors and Fire Windows
 - 2. 252, Fire Tests of Door Assemblies
- C. Underwriters Laboratories (UL)
 - 1. Building Materials Directory
 - 2. Listing and Labeling
 - 3. 10 (c), Fire Tests of Door Assemblies - Positive Pressure
- D. Wood Door and Window Manufacturers Association (WDMA) I.S. 1A – Flush Wood Door Performance Standards
- E. Intertek Testing, Services (Warnock Hersey, Inc. (WHI))
 - 1. Certification Listings for Fire Doors

1.4 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Shop Drawings:
 - 1. Show or schedule location, size, thickness, elevation, details of construction, location and extent of hardware blocking, fire rating, and other pertinent data for each door required.
 - 2. Include schedule of hardware preparation required for each door.
 - 3. Indicate requirements for veneer matching.
- C. Samples: Plastic laminate in colors and patterns for Architect's selection.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with AWI Quality Standards, Custom Grade A.
- B. Comply with WDMA I.S. 1A, 2004 Edition "Industry Standard for Architectural Wood Flush Doors" and exceed Extra heavy Duty performance standards.
- C. Fire Rated Door Construction:
 - 1. Conform to ASTM E2074, NFPA 252, or UL 10 (c) as applicable and as required by code authorities having jurisdiction.
 - 2. Fire doors shall bear labels, permanently attached to the hinge stile or to top rail that:
 - a. Allows label to be visible when door is open.
 - b. Are approved by and shows testing laboratory approval for classification specified, scheduled or required. The testing laboratory shall be UL or WHI.
- D. Fire Rated Door Installation:
 - 1. Conform to NFPA 80 and as required by code authorities having jurisdiction.

1.6 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 00 – Project Management and Coordination.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver to site, store, protect, and handle doors in accordance with AWI Quality Standards and manufacturer's instructions. Accept doors on site in manufacturer's standard packaging. HVAC systems shall be operating and balanced prior to arrival of doors. Acceptable humidity shall be no less than 25 percent nor greater than 55 percent.
- B. Storage:
 - 1. Store doors in a clean and dry location protected from weather and abuse.
 - 2. Stabilize moisture content prior to installation.
- C. Mark each door on the top or in the top hinge with opening numbers corresponding to approved shop drawings.

1.8 WARRANTY

- A. Provide for lifetime replacing, including cost of rehangng and refinishing, at no cost to Owner, wood doors exhibiting defects in materials or workmanship including, but not limited to the following:
 - 1. Warp in excess of 1/4 inch as defined by AWI.
 - 2. Warp or twist to a degree that door will not operate properly.
 - 3. Delamination of face.
 - 4. Telegraphing or show through of stiles, rails, or core greater than 0.01 inch in any 3 inch area.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

- A. Manufacturers listed or named in the specifications who produce equivalent products to those specified are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with requirements of Division 1 regarding substitutions to be considered.
 - 1. Doors:
 - a. Door Pro Systems; (713-462-0860).
 - b. VT Industries; (712-368-4381).
 - c. Eggers Industries; (920-722-6444).

- d. Marshfield Doors Systems, Inc.; (715-384-2141).
 - e. Oshkosh Architectural Door Company; (920-233-6161).
2. Plastic Laminate:
 - a. Wilsonart International; (800-433-3222).
 - b. Formica Corp.; (1-800-367-6422).
 - c. Panolam Industries International; (1-877-726-6526)
 - d. Pionite Decorative Surfaces.

2.2 MATERIALS

- A. Flush Interior Non-Rated Wood Doors – Plastic Laminate:
 1. General: 3-ply AWI PC-HPDL-3 High Pressure Decorative Laminate (HPDL), Bonded Particle Core, stile and rails abrasively planed as an assembly prior to laminating, factory machine and fit.
 2. Thickness: 1-3/4 inch.
 3. Core: 32 lbs per cubic foot particleboard, 1LD2 in accordance with ANSI A208.1
 - a. Furnish Structural Lumber Core:
 - 1) At doors with more than 40 percent of door core removed due to light or vent cutouts.
 - 2) At doors with exit devices.
 4. Stile: LSL, 1-3/8 inch, bonded to core
 5. Rail: LSL bonded to core, 1-1/8 inch minimum, 5 inch head rail for closer reinforcement.
- B. Accessories:
 1. Glazing: Factory glaze with glass as indicated. Verify compatibility of glazing system with positive pressure requirements where applicable.
 2. Glass Stops: Glass stops, if any, shall be metal type painted to match door frame under Section 09 90 00. Stops prepared for countersink style tamper proof screws. Size for 6 inch by 36 inch vision glass, unless noted otherwise. Color will be approved by Architect.
 3. Adhesive: Type 1, hot pressed
 4. Plastic Laminate: 0.050 inch thick, as selected by Architect.
Seal top, bottom and cut surface of openings at factory with two (2) coats of varnish.
 5. All door edges shall be factory painted to match door face. Factory shall supply matching paint and edges shall be touched-up in field.
- C. Fabrication:
 1. Factory machine doors for hardware that is not surface applied. Comply with final hardware schedules, door frame shop drawings, DHI A115-W series standards, and hardware templates.
 2. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 3. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
 4. Doors with mortised hinges to be furnished pre-drill pilot holes for hinge screws.
 5. Electrical Wiring: Provide flush wood doors receiving electrified hardware with concealed wiring harness and standardized Molex plug connectors on both ends to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the through wire transfer hardware or wiring harness specified in hardware sets in Division 8 "Finish Hardware".

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Doors and hardware installed under Section 06 20 00, Finish Carpentry and Millwork. Follow manufacturer's printed instructions. Coordinate work with door opening construction, and door and frame hardware installation.
- B. Clearances:
 - 1. Head and Jambs, meeting edges: 1/8 inch maximum.
 - 2. Sill: 1/2 inch typically, except provide 1/4 inch clearance from top surface of carpeting.
- C. Verify that frames comply with indicated requirements for type, size, location and swing characteristics and that the frames are installed plumb, level and parallel. Reject doors with defects that are not repairable.
- D. Coordinate hardware installation for proper door operation. Adjust locks and latches to engage snugly without forcing. Align hardware to function without squeaking, binding, or racking. Mortise as required for automatic door bottoms.
- E. Protect doors from damage and replace doors that are damaged. Verify that tops and bottoms of doors have been sealed prior to installation, as required for warranty.

3.2 CLEANING AND REPAIRING

- A. Clean doors in accordance with manufacturer's instructions.
- B. Repair or replace damaged doors at no expense to Owner.
- C. Do not remove or paint over labels on labeled doors.

END OF SECTION 08 14 23

SECTION 08 31 13 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Access doors in gypsum board, masonry partitions, and plaster/stucco soffits, where shown or required.

1.3 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's literature, including schedules, charts, and illustrations to indicate the performance, fabrication, procedures, product variations, and accessories.
 - 2. Manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing access doors meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions in order to be considered.
 - 1. The Bilco Company.
 - 2. Acudor Products, Inc.
 - 3. Babcock-Davis (Cierra Products).
 - 4. Bar-co, Alfab, Inc., Enterprise, AL.
 - 5. J. L. Industries, Incorporated.
 - 6. Karp Associates, Inc.
 - 7. Larsen's Manufacturing Company.
 - 8. Nystrom Building Products Co. Inc.
 - 9. The Williams Brothers Corporation of America.
- B. Specifications are based on DW-5058 as manufactured by Acudor Products, Inc.

2.2 PRODUCTS

- A. General: The following access panel types are for selection as required whether or not indicated on drawings. The contractor shall evaluate the specific requirements and provide the appropriate system based on the condition, as all types may not be required on the project. The inclusion of any of the listed access panel types does not necessarily imply that the condition exists in the scope of work.
- B. Standard type flush steel door for wallboard construction:
 - 1. Size: 2 feet-0 inches x 2 feet-0 inches unless otherwise noted in drawings or specifications.

2. Material: Aluminum extrusion with 5/8 inch drywall in door panel.
3. Hinges: Concealed, spring loaded hinge pin allow panel to open to 90 degrees.
4. Finish: Mill finish.
5. Frames: 0.080 inch Aluminum extrusion recessed to provide similar edge to drywall bead to allow for finishing of wall or ceiling surface.
6. Doors: 0.080 inch Aluminum.
7. Lock: Concealed touch latches.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Locate and provide panels to the trade that is constructing the material being penetrated.

3.2 LOCATIONS

- A. Provide where required by code and where needed to service and maintain equipment.
- B. If not shown on the drawings, consult the Architect before locating in finished spaces.

END OF SECTION 08 31 13

SECTION: 08 35 16 FOLDING GRILLES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Side-folding aluminum grilles.
2. Operating hardware and supports.

B. Related Sections:

1. Division 01: Administrative, procedural, and temporary work requirements.
2. Section 087100 - Door Hardware.

1.02 PERFORMANCE REQUIREMENTS

- A. All locking posts shall allow for horizontal sway without pressure to side walls of track from trollies while opening and closing the curtain.
- B. All post's standard locking hardware and handles shall be flush within post with exceptions for exit hardware.

1.03 REFERENCES

- A. ASTM International (ASTM) B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

1.04 SUBMITTALS

A. Submittals for Review:

1. Shop Drawings: Indicate track layout and dimensions including pocket, required curves, types and locations of posts, required locking and hardware, options, finish and installation details.
2. Product Data: Provide information on grille construction, components, materials, and finishes.

B. Sustainable Design Submittals:

1. Recycled Content.
2. Regional Materials – not applicable.

C. Closeout Submittals:

1. Operation and Maintenance Data

1.05 WARRANTIES

- A. Provide manufacturer's 2-year warranty against defects in materials and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of design: Products as manufactured by Dynamic Closures Corporation.
(www.dynamicclosures.com)
- B. Subject to compliance with requirements, the following are approved for use on this Project:
 - 1. CHI Overhead Doors. (www.chiohd.com)
 - 2. Overhead Door Corp. (www.overheaddoor.com)
 - 3. Wayne-Dalton Corp. (www.wayne-dalton.com)
- C. Substitutions: Under provisions of Division 01.

2.02 MATERIALS

- A. Aluminum Extrusions: ASTM B221, 6063-T5 or T6 alloy and temper.

2.03 COMPONENTS

- A. SL 124 Straight curtain:
 - 1. 4 inches [102mm] wide with 4 inches [102mm] high bottom and 4 inches [102mm] high top plates, truss-like aluminum.
 - 2. Panels connected with one-piece vertical aluminum hinges and 4 inches [102mm] wide by 1 inch [25mm] high aluminum links vertically spaced 12 inches [305mm] apart on 5/16 inch [8mm] aluminum center rod covered with 1/2 inch [13mm] aluminum tubes.
 - 3. Pattern: Straight
 - 4. Stacking depth: 11% of curtain length. Add 3 inches [76mm] per Hook Bolt post, Intermediate post, Top and Bottom post, Travelling post. Add 4 inches [102mm] per Bi-Part post.
 - 5. Clearance width required: 5 inches [127mm] continuous on center of track.
- B. Operation: Manual push/pull. Provide pull straps on openings over 9 feet [2743mm] in height and countertop applications.
- C. Curtain Carriers: Dual bearing trolleys with 1.125 inches [29mm] diameter tires.
- D. Overhead Track: Extruded aluminum, 1.375 inches [35mm] wide x 1.675 inches [43mm] high, continuous profile seamed with alignment bars and track pins at splices.
- E. Curves: Detailed type and location on drawing if required.
- F. Locking Post: Extruded aluminum, all post's standard locking hardware and handles shall be flush within post with exceptions for exit hardware. Locks may be on the public side, secure side or both. All stainless-steel lock rods engage stainless steel floor or counter sockets. All locking posts shall allow for horizontal sway without pressure to side walls of track from trolleys while opening and closing the curtain. Refer to detailed drawing for location and type of posts.
 - 1. Wall Channel: A floor to track extruded aluminum channel that the hook bolt fits and locks into. This channel is secured permanently to the wall.
 - 2. Hook Bolt Lead: This post has a hook bolt that secures it to the Wall Channel. Additional top locking or double hook bolt locking available.

3. Bi-Part: A pair of posts that lock together with a hook bolt with an added lock rod to keep the curtain in place. It is used to separate larger doors into manageable sections, or to split the door to stack in two different directions. The concealed stainless-steel lock rod engages into a floor or counter socket. Doors should have at least one Bi-Part for every 30 feet [9144mm] of width. Top stainless-steel rod locking available.
 4. Top & Bottom: Lead or Trailing End option. This post contains spring-loaded stainless-steel lock rods that engage a floor or counter socket with the bottom rod and the top rod engages into the track and header. They are unlocked with a keyed cylinder, thumb turn or paddle, both disengaging in one motion. A rubber bumper is the standard leading edge but may also have 4 inches [102mm] or 7 inches [178mm] flange.
 5. Intermediate: A middle post in a door located between door sections, containing a spring-loaded stainless-steel lock rod that engages a floor or counter socket to keep the door in place and unlocked by a keyed cylinder or a thumb turn. Recommended straight line spacing of all posts is 10 feet [3048mm]. Curves and countertop applications will require closer spacing.
 6. Traveling End: The Traveling End post terminates a door inside of a pocket (storage area). It is free to travel back and forth inside of the pocket. The post self-locks into permanent header and floor stops that prevent the door from fully leaving the pocket. A rear flange attached to the back of the post prevents reaching around.
 7. Fixed End: Simply attaches the end of a door permanently to a wall.
- G. Emergency Egress Door - Detailed latch type and location on drawing if required. Swing out emergency egress door within the curtain providing a clear opening of 79.5 inches [2019mm] high x 34 inches [864mm] wide.
- H. Steel Pocket Door: Made to order from 14-gauge formed steel up to 144 inches [3658mm] height (from finished floor to track support). Covers a standard 8 inch [203mm] pocket opening and has three durable commercial grade 4 inch [102mm] butt hinges placed up one side for maximum support. Specify left-handed or right-handed opening. Finished in silver-grey paint (PPG 301189). Custom colors are available or painted in the field. The Pocket Door comes equipped with a thumb turn lock or optional keyed cylinder lock matched to the security door.

2.04 2.4 FINISHES

- A. Aluminum: Clear anodized standard. If required, custom anodized detailed on drawing.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install assembly in accordance with manufacturer's instructions.
- B. Anchor to adjacent construction without distortion or stress, level and plumb, to provide smooth operation.

3.02 ADJUSTING

- A. Adjust grilles for smooth operation throughout full operating range.

END OF SECTION

SECTION 08 41 13 – ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Exterior and interior storefront framing.
 - 2. Exterior and interior manual swing entrance doors.
 - 3. Accessories necessary for a complete installation.

1.3 DEFINITIONS

- A. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

1.4 PERFORMANCE REQUIREMENTS

- A. Performance: Aluminum framed systems shall withstand the effects of specified performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
 - 1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
 - 2. Dimensional tolerances of building frame and other adjacent construction.
 - 3. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferring to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
 - d. Noise or vibration created by wind and by thermal and structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Sealant failure.
 - g. Failure of operating units.
- B. Structural Loads:
 - 1. Wind Loads: Indicated on Drawings.
- C. Deflection of Framing Members:
 - 1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed L/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch19 mm, whichever is less.
 - 2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch3.2 mm, whichever is smaller.
- D. Structural Test Performance: Provide aluminum framed systems tested according to ASTM E 330 as follows:

1. When tested at positive and negative wind load design pressures, systems do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.
- E. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. 0.03 L/s per sq. m of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).
- F. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
- G. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 degrees F (67 degrees C, ambient; 180 degrees F 100 degrees C, material surfaces).
 2. Interior Ambient-Air Temperature: 75 degrees F (24 degrees C).
- H. Condensation Resistance: Provide aluminum framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 45 when tested according to AAMA 1503.
- I. Thermal Conductance: Provide aluminum framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.57 Btu/sq. ft. x h x degrees F 3.23 W/sq. m x K when tested according to AAMA 1503.

1.5 SUBMITTALS

- A. Product Data: Technical data for each type of product indicated including construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum framed systems.
- B. Shop Drawings: Submit aluminum storefront framing and entrances shop drawings including plans, elevations, sections, full size details, and attachments to other Work.
1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
 2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
- C. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related Work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
- D. Engineer's calculations of performance requirements.
- E. Maintenance Data: For aluminum framed systems to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Accessibility Requirements: Comply with applicable requirements.
 - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
 - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
 - c. Texas Accessibility Standards (TAS) 2012.
- B. Installer Qualifications: Installer having minimum 10 years documented experience who is an authorized representative of the manufacturer and is trained and approved for installation of units required.
- C. Engineering Responsibility: Prepare data for aluminum framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated.
- D. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in service performance.
 - 1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.
- E. Source Limitations: Obtain aluminum framed entrances from single source from single manufacturer.
- F. Preinstallation Conference: Conduct conference at site.
- G. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Perform testing on mockups according to specified requirements.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 WARRANTY

- A. Warranty: Written warranty signed by Manufacturer, Contractor, and Installer in which manufacturer agrees to repair or replace components of aluminum framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration caused by thermal movements.

- c. Water leakage through fixed glazing and framing areas.
 - d. Failure of operating components.
2. Warranty Period: Two years from date of Substantial Completion.
- B. Finish Warranty: Written warranty signed by manufacturer in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.
1. Warranty Period: 10 years from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

- A. Entrance Door Hardware:
1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
 2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Basis of Design: Kawneer Trifab 601/601T impact resistant system, maximum design pressure +/- 45 psf. Subject to compliance with requirements, provide comparable storefront system by one of the following:
1. EFCO Corporation.
 2. Old Castle Building Envelope
 3. Tubelite, Inc.
 4. US Aluminum Corporation.
 5. Vistawall.
 6. YKK America AP, Inc.
- B. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Sheet and Plate: ASTM B 209/ASTM B 209M.
 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221/ASTM B 221M.
 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 4. Structural Profiles: ASTM B 308/B 308M.
- C. Framing Members: Extruded aluminum framing members of thickness required and reinforced necessary to support imposed loads.
1. Construction: Nonthermal/Thermal.
 2. Glazing System: Retained mechanically with gaskets on four sides.
 3. Glazing Plane: Center.
- D. Accessories:
1. Brackets and Reinforcements: High strength aluminum with nonstaining, nonferrous shims for aligning system components.
 2. Fasteners and Accessories: Corrosion resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

- a. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - b. Reinforce members as required to receive fastener threads.
3. Concrete and Masonry Inserts: Hot dip galvanized cast iron, malleable iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.
 4. Concealed Flashing: Corrosion resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
 5. Framing System Gaskets and Sealants: Recommended by manufacturer for joint type.
- E. Glazing: Refer to Section 08 80 00 for impact resistant laminated insulating glass with low-e coating on Number 2 surface.
1. Glazing Gaskets: Compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
 2. Spacers and Setting Blocks: Elastomeric type.
- F. Entrance Doors: Glazed entrance doors for manual swing operation.
1. Door Construction: 1-3/4 inch (44.5 mm) overall thickness, with minimum 0.125 inch (3.2 mm) thick, extruded aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 2. Door Design: Nominal width of 6 inch (152.4 mm) vertical stiles and 6-1/2 inch (165.1 mm) bottom rail.
 3. Glazing Stops and Gaskets: Square, snap on, extruded aluminum stops and preformed gaskets.
- G. Entrance Door Hardware: Refer to Section 08 71 00 for aluminum entrance hardware sets.
1. Basis of Design: Series 500 Wide Stile, swing door standard as manufactured by Kawneer Co., Inc. or equivalent product from list of approved manufacturers.
 2. Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door to comply with requirements in this Section.
 - a. Opening-Force Requirements:
 - 1) Egress Doors: Maximum than 15 lbf 67 N to release the latch and not more than 30 lbf 133 N to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.
 - 2) Accessible Interior Doors: Maximum 5 lbf to fully open door.
 - b. Weather Stripping: Standard replaceable components to match existing.
 - c. Weather Sweeps: Standard exterior door bottom sweep with exposed fasteners on mounting strip to match existing.
- H. Accessories:
1. Joint Sealants: For installation at perimeter of aluminum framed systems, refer to Section 07 92 00.
 2. Bituminous Paint: Cold applied, asphalt mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30 mil 0.762 mm thickness per coat.

2.3 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Framing Members: Fabricate components that, when assembled, have specified characteristics:
 1. Profiles that are sharp, straight, and free of defects or deformations.

2. Accurately fitted joints with ends coped or mitered.
 3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
 4. Physical and thermal isolation of glazing from framing members.
 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 6. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
 8. Provide sill receptors with end dams at all sill conditions.
- C. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- D. Storefront Framing: Fabricate components for assembly using screw spline system.
- E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
1. At exterior doors, provide weather stripping at fixed stops.
 2. At interior doors, provide weather stripping at stops to prevent metal to metal contact.
- F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
1. At pairs of exterior doors, provide compression type weather stripping retained in adjustable strip and mortised into door edge.
 2. At exterior doors, provide weather sweeps applied to door bottoms.
- G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.5 ALUMINUM FINISHES

- A. Finish:
1. Architect to select finish from clear anodized, color anodized, baked enamel, and powder coat. Architect to select color from manufacturer's full range of colors.
 2. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
 3. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 4. Baked Enamel or Powder Coat Finish: AAMA 2605. Comply with coating manufacturer's written instructions for cleaning, conversion coating, application, and baking.

2.6 SUN CONTROL

- A. Sunshades: Assemblies consisting of manufacturer's standard outrigger brackets, louvers, and fascia, designed for attachment to storefront with mechanical fasteners. Refer to Section 10 71 13.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and conditions affecting performance of the Work. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

- A. Comply with aluminum framed storefront manufacturer recommended installation instructions. Coordinate installation with curtain wall work.
 - 1. Do not install damaged components.
 - 2. Fit joints to produce hairline joints free of burrs and distortion.
 - 3. Rigidly secure nonmovement joints.
 - 4. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
 - 5. Seal joints watertight unless otherwise indicated.
- B. Metal Protection:
 - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
 - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- D. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 to produce weathertight installation.
- E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.
- F. Install glazing specified in Section 08 80 00.
- G. Entrance Doors and Hardware: Install doors to produce smooth operation and tight fit at contact points.
 - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 - 2. Field Installed Entrance Door Hardware: Install surface mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
- H. Install perimeter joint sealants as specified in Section 07 92 00 to produce weathertight installation.

3.3 ERECTION TOLERANCES

- A. Install aluminum framed systems to comply with the following maximum erection tolerances:
 - 1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
 - 2. Alignment:
 - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch 1.5 mm.
 - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch 0.8 mm.
- B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch 3 mm.

3.4 ADJUSTING

- A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.

1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches 75 mm from the latch, measured to the leading door edge.

END OF SECTION 08 41 13

SECTION 08 44 13 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 1. Glazed aluminum curtain walls.
 2. Accessories necessary for a complete installation.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, licensed in the State of Texas with experience in the design of curtainwalls and aluminum storefronts to design glazed aluminum curtain walls using performance requirements and design criteria indicated.
- B. Provide curtain wall assembly, storefront system, and windows by a single source and tested as a combined single assembly.
- C. System Description: Curtainwall assembly fabricated from aluminum stick framed system with exposed interior and exterior metal framing. Design system to allow for installation tolerances, expansion and contraction of adjacent materials and joint design.
 1. Drawings are diagrammatic and do not identify or solve thermal or structural movement, glazing, anchorage, or moisture disposal. Details establish basic dimension of unit, sight lines, and profiles of members.
 2. Glass, sealants, and interior finishes do not contribute to framing member strength, stiffness, or lateral stability.
 3. Design and fabricate glazing systems for interior glazing.
 4. Design perimeter conditions to allow for installation tolerances, expansion and contraction of adjacent materials, and sealant manufacturer's recommended joint design.
 5. Design attachments to address site conditions, expansion, and contraction movements to eliminate possibility of loosening, weakening, or fracturing connection between units and building structure or between units themselves.
 6. Allow for expansion and contraction due to structural movement without detriment to appearance or performance.
 7. Design system to drain to exterior face of wall, water entering joints and condensation occurring within system by drain holes and gutters of adequate size to evacuate water without infiltration to interior or the top of lower lites of glass.
 8. Design metal faces to be visually flat under lighting conditions.
 9. Design interior dense EPDM wedge gasket with sealed corners, with maximum 30% compression when glazed, to create a water and air seal.
 10. Design rigid isolators to maintain flatness of face caps and provide thermal break between exterior and interior members.
 11. For stresses placed on structural silicone sealants, maintain sealant manufacturer's recommended maximum.
 12. Not Permitted: Vibration harmonics, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system.

- D. Performance Criteria: Coordinate with Section 084100 for performance criteria, fabrication, and erection standards. Provide curtain wall assemblies to meet or exceed performance requirements:
1. Design and fabricate curtain wall to withstand the operating loads without measurable permanent deflection. Limit deflections to provide the normal degree of rigidity required to avoid glass breakage, air infiltration, and objectionable results of excessive flexibility.
 2. Glazed aluminum curtain walls shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 3. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- E. Structural Loads:
1. Wind Loads: Design, fabricate, and install framing system to withstand the maximum inward and outward wind pressures required by IBC.
 - a. Basic Wind Speed: Refer to Structural Drawings.
 - b. Exposure Category: Refer to Structural Drawings.
 - c. Risk Category: Refer to Structural Drawings.
 2. Deflection of Framing Members: At design wind pressure:
 - a. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
 - b. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.
 - 1.) Operable Units: Provide a minimum 1/16 inch (1.6 mm) clearance between framing members and operable units.
 - c. Cantilever Deflection: Where framing members overhang an anchor point:
 - 1.) Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 11 feet 8-1/4 inches (3.6 m) or 1/175 times span, for spans less than 11 feet 8-1/4 inches (3.6 m).
 - d. Do not permit permanent deformation (set) in metal framing work. Permanent deformation, fastener, weld, or gasket failure, component breakage or disengagement shall not occur under wind loading equal to 1.5 times the wind loads (positive or negative). Permanent deformation shall be taken as deflection without recovery exceeding 1/1000 times span.
- F. Structural: Test according to ASTM E 330:
1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

- G. Air Infiltration: Test according to ASTM E 283 for infiltration:
 - 1. Fixed Framing and Glass Area:
 - a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa) and 6.24 lbf/sq. ft. (300 Pa).
- H. Water Penetration under Static Pressure: Test according to ASTM E 331:
 - 1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 15 lbf/sq. ft. (720 Pa).
- I. Water Penetration under Dynamic Pressure: Test according to AAMA 501.1:
 - 1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 15 lbf/sq. ft. (720 Pa).
 - 2. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.
- J. Interstory Drift: Accommodate design displacement of adjacent stories indicated.
 - 1. Design Displacement: Indicated on Drawings.
 - 2. Test Performance: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.4 at design displacement
- K. Energy Performance: Certify and label energy performance according to NFRC:
 - 1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.57 Btu/sq. ft. x h x deg F (3.23 W/sq. m x K) as determined according to NFRC 100.
 - 2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than **0.40** as determined according to NFRC 200.
 - 3. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC certified condensation resistance rating of no less than as determined according to NFRC 500. Excessive condensation is defined as the accumulation of uncontrolled condensate flowing from the curtain wall at any location, or visible ice, frost, or water on more than 5% of the area of any module of the exterior wall.
- L. Noise Reduction: Test according to ASTM E 90, with ratings determined by ASTM E 1332:
 - 1. Outdoor-Indoor Transmission (OITC) Class: Minimum **30**
- M. Sound Transmission: Provide window wall and storefront systems with fixed glazing and framing areas having sound transmission characteristics of:
 - 1. Sound Transmission Class (STC): Minimum 31 standard and 37 laminated STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.
- N. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
 - 1. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.
 - 2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
 - a. High Exterior Ambient Air Temperature: That which produces an exterior metal surface temperature of 180 degrees F (82 degrees C).
 - b. Low Exterior Ambient Air Temperature: 0 degrees F (minus 18 degrees C).

- O. Structural Sealant Joints:
 - 1. Designed to carry gravity loads of glazing.
 - 2. Designed to produce tensile or shear stress of less than 20 psi (138 kPa).

- P. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by structural sealant glazed curtain walls without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.
 - 1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
 - 2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.

- Q. Design Modifications: Submit design modifications necessary to meet performance requirements and field coordination.
 - 1. Variations in details or materials shall not adversely affect the appearance, durability, or strength of components, nor shall variations cause excessive stress, or deflections, to building structural frame.
 - 2. Maintain general design concept without altering size of members, profiles, and alignment.

1.4 SUBMITTALS

- A. Combined Submittals: Combine submittals for exterior curtainwall and storefronts into a single submission. Submit combined shop drawing which has been reviewed, annotated, and coordinated by each of the principal exterior cladding subcontractors.
 - 1. As an indication of review, and as a condition of acceptance by the Architect, provide combined submittal with a cover sheet clearly indicating the signatures of the Contractor and each exterior cladding subcontractor.
 - 2. Coordinate curtainwall, storefronts and entrances, windows, ACM, and window wall submittals.

- B. Product Data: Manufacturer technical data for each type of product, including construction details, material descriptions, dimensions of individual components and profiles, and finishes.

- C. Shop Drawings: Submit plans, elevations, sections, full size details, and attachments to other work.
 - 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
 - 2. Include full size isometric details of each vertical to horizontal intersection of glazed aluminum curtain walls, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.
 - f. Thermal breaks.
 - g. Interface with building construction.
 - 3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
 - 4. Indicate glazing details, methods, locations of various types and thickness of glass, emergency breakout locations, and internal sealant requirements.
 - 5. Indicate locations of exposed fasteners and joints for Architect's acceptance.

- D. Fabrication Sample (Mock Up Drawings): Submit drawings for field mockup of each vertical to horizontal intersection of assemblies, made from 12 inch (300 mm) lengths of full size components and showing details of the following:
 - 1. Joinery, including concealed welds.
 - 2. Anchorage.
 - 3. Expansion provisions.
 - 4. Glazing.
 - 5. Flashing and drainage.
- E. Delegated Design Submittal: For glazed aluminum curtain walls indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for the preparation.
- F. Structural Calculations: Submit sealed copies of structural calculations indicating complete compliance with the specified performance requirements. Submit calculations prepared, signed, and sealed by a Professional Engineer licensed in the State of Texas.
- G. Preconstruction Laboratory Mockup Testing Submittals: Submit the following:
 - 1. Testing Program: Developed specifically for Project.
 - 2. Test Reports: Prepared by a qualified preconstruction testing agency for each mockup test.
 - 3. Record Drawings: Record drawings prepared from as built drawings of preconstruction laboratory mockups showing changes made during preconstruction laboratory mockup testing.
- H. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components from manufacturer.
 - 1. Basis for Certification: NFRC certified energy performance values for each glazed aluminum curtain wall.
- I. Reports: Submit the following:
 - 1. Product Test Reports: Submit report for tests performed by a qualified testing agency.
 - 2. Quality Control Program: Program developed specifically for Project, including fabrication and installation, according to recommendations in ASTM C 1401. Include periodic quality control reports.
 - 3. Source quality control reports.
 - 4. Field quality control reports.
- J. Maintenance Data: Submit maintenance data to include in maintenance manuals.
- K. Maintenance Data for Structural Sealant: For structural sealant glazed curtain walls to include in maintenance manuals. Include ASTM C 1401 recommendations for post-installation-phase quality control program.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Building Code: Comply with applicable requirements of IBC with Austin amendments for building cladding.
 - 2. Energy Code: Comply with applicable provisions of the IECC.
 - 3. Surface Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame Spread Index: 25 or less.
 - b. Smoke Developed Index: 450 or less.

4. Accessibility Requirements: Comply with applicable requirements.
 - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
 - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
 - c. Texas Accessibility Standards (TAS) 2012.
 5. Welding Standards: Welding shall be performed by skilled and qualified mechanics. Welding shall be performed in accordance with the applicable provisions of AWS D1.1 *Structural Welding Code - Steel* and AWS D1.2 *Structural Welding Code - Aluminum*.
 6. Federal Standard 16 CFR 1201, Consumer Product Safety Commission (CPSC): *Safety Standard for Architectural Glazing Materials*, published in Code of Federal Regulations (CFR).
 - a. Comply with applicable requirements of authorities having jurisdiction, wherever requirements conflict the more stringent shall be required. Obtain approvals from authorities.
 - b. As a minimum provide safety glazing complying with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for Category II materials.
 7. Structural Sealant Glazing: Comply with ASTM C 1401 for design and installation of structural sealant glazed curtain walls.
 8. Energy Performance Standards: NFRC for minimum standards of energy performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.
- B. Manufacturer/Fabricator Qualifications: Fabricator specializing in the fabrication of aluminum framed window wall and window systems and components, having minimum 10 years documented experience, and with sufficient production capacity, organized quality control and testing procedures, and published written and illustrated installation manuals, to produce and install the entrance assemblies required.
- C. Installer Qualifications: Firm that specializes in the erection of aluminum framed window wall, storefront, and window systems, having minimum 10 years documented experience, and approved or certified by manufacturer/fabricator.
1. Engineering Responsibility: Prepare data for curtainwall, storefront, and window systems, including Shop Drawings, based on testing and engineering analysis of manufactured units in systems similar to those indicated.
 - a. Professional Engineer Qualifications: A professional engineer who is legally licensed to practice in the State of Texas, experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of heavy glass storefront and entrance system similar to those indicated in material, design, and extent.
- D. Laboratory Mockup Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025.
- E. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025.
- F. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

- G. Structural Sealant Glazing: Comply with ASTM C 1401 for design and installation of curtain wall assemblies.
- H. Source Limitations: Obtain components of curtain wall system, including framing entrances and accessories, from single manufacturer.
- I. Preinstallation Conference: Conduct conference at site.
- J. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Perform testing on mockups according to specified requirements.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- K. Preconstruction Laboratory Mockups:
 - 1. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform testing on preconstruction laboratory mockups.
 - 2. Build preconstruction laboratory mockups at testing agency facility; use personnel, products, and methods of construction that will be used at Project site.
 - a. Size and Configuration: As indicated on Drawings.
 - b. Notify Architect seven days in advance of the dates and times when preconstruction laboratory mockups will be constructed and tested.
 - 3. Preconstruction Laboratory Mockup Testing Program: Test preconstruction laboratory mockups according to requirements. Perform the following tests in the following order:
 - a. Structural: ASTM E 330 at 50 percent of positive test load.
 - b. Air Infiltration: ASTM E 283.
 - c. Water Penetration under Static Pressure: ASTM E 331.
 - d. Water Penetration under Dynamic Pressure: AAMA 501.1.
 - e. Structural: ASTM E 330 at 100 percent of positive and negative test loads. Repeat the following:
 - 1) Air Infiltration: ASTM E 283.
 - 2) Water Penetration under Static Pressure: ASTM E 331.
 - f. Interstory Drift: AAMA 501.4 at 100 percent of design displacement. Repeat the following:
 - 1) Air Infiltration: ASTM E 283.
 - 2) Water Penetration under Static Pressure: ASTM E 331.
 - g. Vertical Interstory Movement: AAMA 501.7. Repeat the following:
 - 1) Air Infiltration: ASTM E 283.
 - 2) Water Penetration under Static Pressure: ASTM E 331.
 - h. Thermal Cycling: According to AAMA 501.5. Repeat the following:
 - 1) Air Infiltration: ASTM E 283.
 - 2) Water Penetration under Static Pressure: ASTM E 331.
 - i. Structural: ASTM E 330 at 100 and 150 percent of positive and negative test loads. Repeat the following:
 - 1) Air Infiltration: ASTM E 283.
 - 2) Water Penetration under Static Pressure: ASTM E 331.

- L. Laboratory Mockup Testing: Curtain wall mock up testing shall include components of fixed window units, glazed framing including captured mullions and SSG mullions, and storefront units in mock up.
1. Laboratory Mockup Testing: Provide mockups as specified for testing. Verify required mockup submittals are reviewed and have received final approval from the Architect prior to construction of the mockups.
 - a. Laboratory testing mockups are used as a standard for judging visual and performance acceptability of the Work for the project. Replace unsatisfactory work as directed. Provide personnel to construct exterior wall mockups who will be the same personnel who will be performing and supervising the actual Work. Simulate actual construction conditions as accurately as possible in every way. Provide extra materials necessary to replace any which fail during tests. Cut glass used in mockups to the minimum tolerances expected in the final exterior wall installation.
 - b. Size: As shown but not less than the requirements of AAMA Standard 501 and ASTM E 331 Section 9. Provide larger mockup(s) if the proposed exterior wall details create a condition requiring a larger mockup(s) for proper evaluation and testing. Provide mockups at wall testing facility complete with glass, aluminum framing, metal panels, anchors, connections, flashings, sealants, and joint fillers as accepted on the mockup shop drawings. Do not take special precautions or use techniques that do not represent those to be used on the work.
 - c. Laboratory Testing: Notify the Architect of the readiness of the mockups for preliminary and final testing. Do not begin the testing program without the presence of the Owner's representative and the Architect.
 - 1) Preliminary Test: Conduct single static pressure test at 50 percent of the maximum Wind Pressure followed by a single test for water penetration at 50 percent of the pressure specified.
 - a) The preliminary test is purposely limited to a single event. No interim or repeat preliminary testing for Contractor benefit or correction of systems shall be permitted.
 - 2) Perform tests of the mockup(s) in accordance with the standards except as modified, in the order listed, and in accordance with the specified performance criteria. Tests 1 and 5 shall be conducted at 1.57 lbf/sq. ft. (75 Pa) and 6.24 lbf/sq. ft. (300 Pa), respectively. Tests 2, 3, and 6 shall be conducted at 12 lbf/sq. ft. (600 Pa) for 1 cycle, maintaining the test pressure for 15 minutes.
 - a) Test 1 (For Air Infiltration): ASTM E 283. Extraneous air leakage (tare) shall be limited to 10 percent or less of the net air leakage through the exterior wall assembly as provided under ASTM E 283. Provide pressure taps as required within the test chamber to ensure uniform stratification of design test pressure across the exterior wall assembly.
 - b) Test 2 (For Water Penetration - Uniform Static Pressure): ASTM E 331.
 - c) Test 3 (For Water Penetration - Dynamic Pressure): AAMA 501.1.
 - d) Test 4 (For Structural Performance): ASTM E 330, Method B, test to .5, and 1.0 times the wind pressure, during test. Deflection readings shall be taken at end connections and midspans of main framing members, at intersections of framing members and at midspans of glass holding members, glass, and panels. Take readings for both positive and negative loading. If failure occurs through glass breakage prior to achieving 1.5 times the maximum wind pressure, replace glass and repeat test. Two successive failures of the same light or panel not otherwise attributable to inherent glass defects will be considered unacceptable. Further tests shall be suspended until

- deficiencies are corrected, which may include increasing the stiffness of glass holding members and/or adjustment of the glazing details.
- e) Test 5 (Retest for Air Infiltration): ASTM E 283. Extraneous air leakage (tare) shall be limited to 10 percent or less of the net air leakage through the exterior wall assembly as provided under ASTM E 283. Provide pressure taps as required within the test chamber to ensure uniform stratification of design test pressure across the exterior wall assembly.
 - f) Test 6 (Retest for Water Penetration, Uniform Static Pressure): ASTM E331.
 - g) Test 7 (For Structural Performance): ASTM E 330, Method B, except conduct test to 1.5 times the maximum wind pressure. Record pressures and deflections at 1.5 times the wind pressure, during test.
 - h) Test 8 (For Live Load Deflection Performance): AAMA 501.4 Modified. Test for live load deflection by applying vertical load to the frame supporting the mockup specimen, so as to induce a deflection in the mockup equivalent to the live load deflection identified on the drawings at the location the mockup is simulating. The load shall be applied and released through ten (10) cycles. Visually inspect mockup specimen after each displacement.
 - i) Test 9 (Exterior Window Maintenance Equipment Test): Perform concentrated load testing on the exterior wall maintenance tie back equipment attached to the exterior wall framing. Apply outward, inward, and side-loading of a magnitude and for a duration as required to comply with the authorities having jurisdiction for window washing equipment. There shall be no failure or gross permanent distortion of the tie back equipment or any part of the exterior wall framing.
 - j) Test 10 (For Thermal Transmittance and Condensation Resistance): At the completion of Test 9, carefully disassemble the glass, glazing, and metal framing components and reassemble them as a mockup, and test the mockup, in accordance with AAMA 1503.1.
- d. Corrective Measures: Correct deficiencies in mockups observed during testing and repeat tests as required to show compliance with performance standards. Deficiencies requiring repair or modification to mockup(s) require complete retesting of mockup(s) beginning with the specified Preliminary Test unless otherwise directed by the Architect.
- 1) The Owner will pay the cost of the first mock up test. The cost of subsequent tests and retesting is the responsibility of the contractor. The Contractor shall bear costs for additional retesting until compliance with performance standards is accomplished.
 - 2) Incorporate corrective measures indicated by the test report into the final exterior wall assemblies after review by the Architect.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Identify components of curtainwall work after fabrication by marks clearly indicating location in the building. Package components to protect components from damage during shipping and handling.
- B. Storage on Site: Store units, components, and materials in clean, dry location, away from uncured concrete, masonry work, sprayed on fireproofing work, and construction activities. Cover with nonstaining waterproof paper, tarpaulin, or polyethylene sheeting to permit circulation of air inside the covering.

- C. Keep handling on site to a minimum. Exercise care to avoid damage to finishes of metals or breakage of glass.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions of supporting structure by field measurements before fabrication so curtainwall work is accurately designed, fabricated, and fitted to the structure. Indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work. Use Contractor's lines and benchmarks as a basis for measurements.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the work, establish dimensions and proceed with fabricating curtainwalls without field measurements. Coordinate supporting structure construction to ensure actual dimensions correspond to established dimensions.

1.8 WARRANTY

- A. Assembly Warranty: Written warranty signed by manufacturer, Contractor, and Installer in which the manufacturer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to meet performance requirements.
 - b. Structural failures including, but not limited to, excessive deflection.
 - c. Glass breakage due to defective design.
 - d. Noise or vibration created by wind and thermal and structural movements.
 - e. Deterioration of metals metal finishes and materials beyond normal weathering.
 - f. Water penetration through fixed glazing and framing areas.
 - g. Deterioration of materials and finishes beyond normal weathering.
 - h. Failure of insulating glass.
 - i. Noise or vibration created by wind and thermal and structural movements.
 - j. Failure of operating components.
 - 2. Warranty Period: Ten (10) years from date of Substantial Completion.
- B. Finish Warranty: Written warranty signed by manufacturer in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory applied finishes within specified warranty period.
 - 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Warranty Period: Twenty (20) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FRAMING

- A. Basis of Design Manufacturer/Product: Kawneer North America, 1600 Series or equivalent product from list of approved manufacturers. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.
 - 1. Arcadia, Inc.
 - 2. Bruce Wall Systems Corporation.
 - 3. CMI Architectural.

4. EFCO Corporation.
 5. EXTECH/Exterior Technologies, Inc.
 6. Oldcastle Building Enclosure.
 7. Pittco Architectural Metals, Inc.
 8. SAFTI FIRST Fire Rated Glazing Solutions.
 9. Trulite Glass & Aluminum Solutions, LLC.
 10. Tubelite Inc.
 11. U.S. Aluminum; a brand of C.R. Laurence.
 12. Unitized Systems LLC.
 13. Vistawall International.
 14. Vitro America.
 15. Waltek & Company Limited.
 16. Wausau Window and Wall Systems; Apogee Wausau Group.
 17. YKK AP America, Inc.
- B. Framing Members: Extruded or formed aluminum framing members of thickness required and reinforced necessary to support imposed loads.
1. Construction: Thermally broken.
 2. Glazing System: Retained mechanically with gaskets on two sides and structural sealant on two sides.
 3. Glazing Plane: Front.
 4. Finish: Baked Enamel.
 5. Fabrication Method: Factory fabricated unit and mullion system.
- C. Aluminum Curtain Wall System:
1. Structural Properties:
 - a. Limit the dead load deflection of horizontal members supporting glass to 1/175 of the clear span with a 1/8 inch maximum deflection.
 - b. Limit the deflection of any member in a direction parallel to the plane of the wall and of any corner mullion in both parallel and perpendicular directions to a maximum of 25 percent of the glass bite dimension and maintain a minimum of 1/8 inch clearance between the member and the edge of the glass, panel, or other component.
 - c. Limit the wind load deflection of any member to 1/240 plus 1/4 inch of the clear span, based on "pinned" ends.
 - d. Limit the wind load deflection of corner mullions to the span as specified above, with the specified pressure acting on one face of the building with no pressure acting on the adjacent face, or 1/2 the specified pressure acting on one face of the building with 1/2 the specified suction acting on the adjacent face, whichever is the greatest.
 - e. No wall element shall sustain permanent deflection of glass breakage under maximum design load.
 - f. The panels and their connections shall accommodate movements of the structure resulting from lateral forces. Provide connections with sufficient ductility to preclude brittle failure, at or near, welds.
- D. Framing Sizes: 2-1/2 inches x 6-3/4 inches where indicated on the drawings. Miter ends of horizontals to form segmented curve at commons
- E. Pressure Caps: Aluminum components that mechanically retain glazing with snap on aluminum trim that conceals fasteners.
- F. Brackets and Reinforcements: High strength aluminum with nonstaining, nonferrous shims for aligning system components.
- G. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - a. Sheet and Plate: ASTM B 209 (ASTM B 209M).
 - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
 - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
 - d. Structural Profiles: ASTM B 308/B 308M.
2. Steel Reinforcement: Zinc rich, corrosion resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.
 - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 - b. Cold Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 - c. Hot Rolled Sheet and Strip: ASTM A 1011/A 1011M.
3. Carbon Steel: ASTM A36.

2.2 ENTRANCES

- A. Entrances: Comply with Section 08 41 00.

2.3 GLAZING

- A. Glazing: Comply with Section 08 80 00.
- B. Glazing Gaskets: Comply with Section 08 80 00.
- C. Glazing Sealants: Recommended by manufacturer.
- D. Structural Glazing Sealants: ASTM C 1184, chemically curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in curtainwall assembly indicated.
 1. Color: Architect to select from manufacturer's full range of colors.
- E. Weatherseal Sealants: ASTM C 920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural sealant, weatherseal sealant, and structural sealant glazed curtainwall manufacturers for this use.
 1. Color: Match structural sealant.

2.4 ACCESSORIES

- A. Fasteners and Accessories: Corrosion resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 2. Reinforce members as required to receive fastener threads.
 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- B. Anchors: Three way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot dip galvanized cast iron, malleable iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- C. Concealed Flashing: Corrosion resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- D. Bituminous Paint: Cold applied asphalt mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

2.5 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
 1. Profiles that are sharp, straight, and free of defects or deformations.
 2. Accurately fitted joints with ends coped or mitered.
 3. Physical and thermal isolation of glazing from framing members.
 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 5. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
 6. Provisions for safety railings mounted on interior face of mullions.
 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
 8. Components curved to indicated radii.
- D. Fabricate components to resist water penetration:
 1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
 2. Pressure equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.
- E. Curtainwall Framing: Fabricate components for assembly using shear block system.
- F. Factory Assembled Frame Units:
 1. Rigidly secure nonmovement joints.
 2. Prepare surfaces that are in contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion.
 3. Preparation includes, but is not limited to, cleaning and priming surfaces.
 4. Seal joints watertight unless otherwise indicated.
 5. Install glazing to comply with requirements in Section 08 80 00.
- G. After fabrication, clearly mark components to identify locations according to Shop Drawings.

2.6 ALUMINUM FINISHES

- A. Finish:
 - 1. Clear Anodic Finish to match existing: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.7 SOURCE QUALITY CONTROL

- A. Structural Sealant: Perform quality control procedures complying with ASTM C 1401 recommendations including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

2.8 SUN CONTROL

- A. Sunshades: Assemblies consisting of manufacturer's standard outrigger brackets, louvers, and fascia, designed for attachment to storefront with mechanical fasteners. Refer to Section 10 71 13.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, adjoining construction, structural support, anchorage, and conditions for compliance with requirements for installation tolerances and conditions affecting performance of the work.
 - 1. Verify rough opening dimensions, levelness of sill plate, and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and built in components to ensure weathertight window wall installation.
 - 2. Notify Architect in writing, of dimensions, or conditions, found which prevent proper execution of the window wall work, including specified tolerances.
- B. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

- A. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.3 INSTALLATION

- A. Coordinate installation with building enclosure work.
- B. Comply with manufacturer's written instructions for installing curtain wall, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.
 - 1. Do not install damaged components.
 - 2. Fit frame joints to produce hairline joints free of burrs and distortion.
 - 3. Rigidly secure nonmovement joints.
 - 4. Remove loose particles present or resulting from fabrication or field cutting and drilling by blowing out joints with oil free compressed air, or by vacuuming joints.
 - 5. Remove protective coatings, oils from cutting and drilling operations, and residue on metallic surfaces with solvents that leave no residue.
 - 6. Do not allow solvent to air dry without wiping. Use lint free towels for wiping of surfaces. Wipe metal surfaces with IPA (isopropyl alcohol) or xylene unless otherwise required by

- compatibility and adhesion testing results. Seal joints watertight. Clean excess joint sealants from finished surfaces.
7. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 8. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
 9. Seal joints watertight unless otherwise indicated.
 10. Set components within erection tolerances with uniform joints. Place components on shims and fasten to supporting substrates using bolts and similar fasteners.
 11. Do not erect components that are warped, deformed, bowed, dented, defaced, or damaged and impair strength or appearance. Remove and replace members damaged in process of erection.
 12. Coat concealed surfaces of dissimilar materials, and ferrous metal components, with heavy coating of bituminous paint, zinc rich primer or separation in accordance with manufacturer's recommendations. Where aluminum components will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
 13. Do not burn, cut into or field drill holes or slots in building framing member without written acceptance of the structural engineer.
- C. Metal Protection:
1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
 2. Where aluminum is in contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- D. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
- E. Install components plumb and true in alignment with established lines and grades.
- F. Permanently fasten to building structure with manufacturer recommended attachments and shims to permanently fasten system to building structure. Securely anchor components and units in place, allowing for required movement, including expansion and contraction. Set sill members in bed of sealant. Set other members with internal sealants and baffles to provide weathertight construction.
- G. Water Drainage: Compartmentalize each light of glass using joint plugs and silicone sealant to divert water to the horizontal weep locations. Locate weep holes in the horizontal pressure plates and covers to divert water to the exterior of the building.
- H. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather stripping contact and hardware movement to produce proper operation.
- I. Glazing: Install glazing gaskets and sealants in accordance with manufacturer's instructions without exception; including surface preparations. Refer to Section 088000.
1. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
- J. Insulation and Fire Stopping: Refer to Section 07 21 00 and Section 07 84 00, respectively.
- K. Weatherseal: Install weatherseal sealant according to Section 07 92 00 and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

3.4 ERECTION TOLERANCES

- A. Erection Tolerances: Install glazed aluminum curtain walls to comply with the following maximum tolerances:
1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
 2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
 3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
 - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
 - c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).
 4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.
 5. Tolerances are not accumulative.

3.5 FIELD QUALITY CONTROL

- A. The Owner reserves the rights to engage an independent testing and inspection agency to verify the adequacy of the Contractor's quality control. Obtain inspections from representative of the Owner's independent testing and inspection agency. Testing and inspecting agency will interpret tests and state in each report whether tested Work complies with or deviates from requirements.
- B. Test Area: Perform tests on representative areas of glazed aluminum curtain walls.
- C. Field Quality Control Testing: Perform the following test on representative areas of glazed aluminum curtain walls.
1. Water Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
 - a. Perform a minimum of two tests in areas as directed by Architect.
 - b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.
 2. Air Infiltration: ASTM E 783 at 1.5 times the rate specified for laboratory testing but not more than 0.09 cfm/sq. ft. (0.45 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
 - a. Perform a minimum of three tests in areas as directed by Architect.
 - b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.
 3. Water Penetration: ASTM E 1105 at a minimum static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing, but not less than 6.24 lbf/sq. ft. (300 Pa), and shall not evidence water penetration.
- D. Structural Sealant Adhesion: Test structural sealant according to recommendations in ASTM C 1401, Destructive Test Method A, *Hand Pull Tab (Destructive)*, Appendix X2.
1. Test a minimum of four areas on each building facade.
 2. Repair installation areas damaged by testing.
- E. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.

- F. Prepare test and inspection reports.
- G. Remove and replace noncomplying windows and retest as specified.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 CLEANING

- A. Clean metal surfaces promptly after installation, exercising care to avoid damage to factory finished exposed surfaces.
- B. Wash glass on both faces not more than 4 days prior to date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer. Remove excess glazing and sealant compounds, dirt, and other substances.
- C. Immediately remove deleterious material from surfaces of aluminum.

3.7 PROTECTION

- A. Institute protective measures required throughout the remainder of the construction period to ensure that window wall Work will be without damage or deterioration, other than normal weathering, at time of acceptance.

END OF SECTION 08 44 13

SECTION 08 71 00 – DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes commercial door hardware for the following:
 - 1. Swinging doors.
 - 2. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
 - 2. Electromechanical door hardware.
 - 3. Automatic operators.
 - 4. Cylinders specified for doors in other sections.
- C. Related Sections:
 - 1. Division 08 Section "Hollow Metal Doors and Frames".
 - 2. Division 08 Section "Flush Wood Doors".
 - 3. Division 08 Section "Aluminum-Framed Entrances and Storefronts".
 - 4. Division 08 Section "Automatic Door Operators".
 - 5. Division 28 Section "Access Control Hardware Devices".
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - 2. ICC/IBC - International Building Code.
 - 3. NFPA 70 - National Electrical Code.
 - 4. NFPA 80 - Fire Doors and Windows.
 - 5. NFPA 101 - Life Safety Code.
 - 6. NFPA 105 - Installation of Smoke Door Assemblies.
 - 7. UL/ULC and CSA C22.2 – Standards for Automatic Door Operators Used on Fire and Smoke Barrier Doors and Systems of Doors.
 - 8. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards:
 - 1. ANSI/BHMA Certified Product Standards - A156 Series
 - 2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 - 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
 - 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Warranty information for each product.
 - 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Shop Drawings: Details of electrified access control hardware indicating the following:
 - 1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
 - a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
 - b. Complete (risers, point-to-point) access control system block wiring diagrams.
 - c. Wiring instructions for each electronic component scheduled herein.
 - 2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

- D. Proof of Certification: Provide copy of manufacturer(s) official certification or accreditation document indicating proof of status as a qualified and authorized provider of the primary Integrated Wiegand Access Control Products.
- E. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- F. Informational Submittals:
 - 1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.
- G. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

1.4 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- D. Integrated Wiegand, Wireless, and IP-Enabled Access Control Products Supplier Qualifications: Integrated access control products and accessories are required to be supplied and installed through current members of the ASSA ABLOY "Authorized Channel Partner" (ACP) and "Certified Integrator" (CI) programs. Suppliers are to be factory trained, certified prior to project bid, and a direct purchaser of the specified product. Installers are to be factory trained, certified prior to project bid, and are responsible for commissioning, servicing, and warranting the installed equipment specified for the project.
- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
 - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
1. Function of building, purpose of each area and degree of security required.
 2. Plans for existing and future key system expansion.
 3. Requirements for key control storage and software.
 4. Installation of permanent keys, cylinder cores and software.
 5. Address and requirements for delivery of keys.
- H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 3. Review sequence of operation narratives for each unique access controlled opening.
 4. Review and finalize construction schedule and verify availability of materials.
 5. Review the required inspecting, testing, commissioning, and demonstration procedures
- I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.
- C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
 - 1. Structural failures including excessive deflection, cracking, or breakage.
 - 2. Faulty operation of the hardware.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 4. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
 - 1. Ten years for mortise locks and latches.
 - 2. Five years for exit hardware.
 - 3. Twenty five years for manual overhead door closer bodies.
 - 4. Five years for motorized electric latch retraction exit devices.
 - 5. Two years for electromechanical door hardware.

1.8 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
 - 1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

- A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
 - 1. Quantity: Provide the following hinge quantity:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
 - e. Four hinges at 4'0" wide doors
 - f. Four hinges at aluminum doors.
 - 2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
 - 3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
 - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
 - 4. Hinge Options: Comply with the following:
 - a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

5. Manufacturers:

- a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - TA Series.

2.3 POWER TRANSFER DEVICES

- A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

- a. Securitron (SU) - EL-CEPT Series.

- B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:

- a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - Electrical Connecting Kit: QC-R001.
b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - Connector Hand Tool: QC-R003.

2. Manufacturers:

- a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) – QC-C Series.

2.4 DOOR OPERATING TRIM

- A. Door Push Plates and Pulls: ANSI/BHMA A156.6 certified door pushes and pulls of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.

5. Manufacturers:

- a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).

2.5 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

1. Manufacturers:

- a. Sargent Manufacturing (SA).
- b. No Substitution.

B. Cylinders: Original manufacturer cylinders complying with the following:

1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.
2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
5. Keyway: Match Facility Standard.
6. At integrated access control locks and exits, permanent cores to be provided by 087100.

C. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:

1. Interchangeable Cores: Core insert, removable by use of a special key; usable with other manufacturers' cylinders.

D. Keying System: Each type of lock and cylinders to be factory keyed.

1. Conduct specified "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
3. Existing System: Field verify and key locks to match Owner's existing system.

E. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Three (3).
2. Master Keys (per Master Key Level/Group): Five (5).
3. Construction Keys (where required): Ten (10).
4. Construction Control Keys (where required): Two (2).
5. Permanent Control Keys (where required): Two (2).

F. Construction Keying: Provide temporary keyed construction cores. Contractor is responsible for removing construction cores and installing permanent cores. Credit to be provided to the owner once the construction cores are removed.

G. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
 2. Provide transcript list in writing or electronic file as directed by the Owner.
- H. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.
1. Manufacturers:
 - a. Lund Equipment (LU).
 - b. MMF Industries (MM).
 - c. Telkee (TK).
 - I. Key Control Software: Provide one network version of "Key Wizard" branded key management software package that includes one year of technical support and upgrades to software at no charge. Provide factory key system formatted for importing into "Key Wizard" software.

2.6 MECHANICAL LOCKS AND LATCHING DEVICES

- A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 certified. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.
1. Manufacturers:
 - a. Sargent Manufacturing (SA) – 8200 Series.
 - b. No Substitution.

2.7 INTEGRATED WIRED OUTPUT LOCKING DEVICES – MULTI-CLASS READER

- A. Integrated Wired Output Multi-Class Mortise Locks: Wiegand or Open Supervised Device Protocol (OSDP) output ANSI A156.13, Grade 1, mortise lockset with integrated card reader with or without keypad option, request-to-exit signaling, door position status switch, and latchbolt monitoring in one complete unit. Hard wired, solenoid driven locking/unlocking control of the lever handle trim, 3/4" deadlocking anti-friction latch, and 1" case-hardened steel deadbolt. Lock is U.L listed and labeled for use on up to 3 hour fire rated openings. Available with or without keyed high security cylinder override.
1. Open architecture, hard wired platform supports centralized control of locking units with new or existing Wiegand or OSDP compatible access control systems. Latchbolt monitoring and door position switch act in conjunction to report door-in-frame (DPS) and door latched (door closed and latched) conditions.
 2. Integrated reader supports the following credentials:
 - a. 125kHz proximity credentials: HID, AWID, Indala, and EM4102.
 - b. 13.56 MHz proximity credentials: HID Secure Identity Object™ (SIO) on iCLASS Seos, HID iCLASS, HID iCLASS SE/SR, MIFARE Classic, DESFire EV1 and EV2.
 - c. 2.4 GHz credentials: Secure Identity Object™ (SIO) on Mobile IDs (Bluetooth Smart)
 - d. ISO14443A/B (PIV-compatible Transparent FASC-N read) available with pivCLASS variant
 - e. NFC-enabled mobile phones
 - f. PIN code only or PIN + credential with keypad option.

3. 12VDC external power supply required for reader and lock, with optional 24VDC lock solenoid. Fail safe or fail secure options.
4. Energy Efficient Design: Provide lock bodies which have a holding current draw of 500mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.
5. Support end-of-line resistors contained within the lock case.
6. Installation requires only one cable run from the lock to the access control panel without requirements for additional proprietary lock panel interface boards or modules.
7. Installation to include manufacturer's access control panel interface board or module where required for Wiegand or OSDP output protocol.
8. Manufacturers:
 - a. Sargent Manufacturing (SA) – SN200 8200 Series.
 - b. No Substitution.

2.8 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
 3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
 4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.
- B. Standards: Comply with the following:
 1. Strikes for Mortise Locks and Latches: BHMA A156.13.
 2. Strikes for Bored Locks and Latches: BHMA A156.2.
 3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
 4. Dustproof Strikes: BHMA A156.16.

2.9 CONVENTIONAL EXIT DEVICES

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
 1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
 2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.

3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
 4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
 5. Energy Efficient Design: Provide lock bodies which have a holding current draw of 15mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.
 6. Motorized Electric Latch Retraction: Devices with an electric latch retraction feature must use motors which have a maximum current draw of 600mA. Solenoid driven latch retraction is not acceptable.
 7. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
 - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
 - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
 8. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
 9. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
 10. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
 11. Rail Sizing: Provide exit device rails factory sized for proper door width application.
 12. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.
1. Manufacturers:
 - a. Sargent Manufacturing (SA) - 80 Series.
 - b. No Substitution.
- C. Tube Steel Removable Mullions: ANSI/BHMA A156.3 removable steel mullions with malleable-iron top and bottom retainers and a primed paint finish.
1. Provide keyed removable feature where specified in the Hardware Sets.
 2. Provide stabilizers and mounting brackets as required.
 3. Provide electrical quick connection wiring options as specified in the hardware sets.

4. Manufacturers:
 - a. Sargent Manufacturing (SA) - 980S Series.

2.10 INTEGRATED WIRED OUTPUT EXIT DEVICES - MULTI-CLASS READER

- A. Integrated Wired Output Multi-Class Exit Hardware: Wiegand output ANSI 156.3 Grade 1 rim, mortise, and vertical rod exit device hardware with integrated card reader with or without keypad option, latchbolt and touchbar monitoring, and request-to-exit signaling, in one complete unit. Hard wired, solenoid driven locking/unlocking control of the lever handle exit trim with 3/4" throw latch bolt. U.L listed and labeled for either panic or "fire exit hardware" for use on up to 3 hour fire rated openings. Available with or without keyed high security cylinder override.
 1. Open architecture, hard wired platform supports centralized control of locking units with new or existing Wiegand or OSDP compatible access control systems. Inside push bar (request-to-exit) signaling and door position (open/closed status) monitoring (via separately connected DPS).
 2. Integrated reader supports the following credentials:
 - a. 125kHz proximity credentials: HID, AWID, Indala, and EM4102.
 - b. 13.56 MHz proximity credentials: HID Secure Identity Object™ (SIO) on iCLASS Seos, HID iCLASS, HID iCLASS SE/SR, MIFARE Classic, DESFire EV1 and EV2.
 - c. 2.4 GHz credentials: Secure Identity Object™ (SIO) on Mobile IDs (Bluetooth Smart)
 - d. ISO14443A/B (PIV-compatible Transparent FASC-N read) available with pivCLASS variant
 - e. NFC-enabled mobile phones
 - f. PIN code only or PIN + credential with keypad option
 3. 12VDC external power supply required for reader. 24VDC required for solenoid operated exit trim. Fail safe or fail secure options.
 4. Installation requires only one cable run from the exit hardware to the access control panel without requirements for additional proprietary lock panel interface boards or modules.
 5. Competitor Alternates Allowed Option: Installation to include manufacturer's access control panel interface board or module where required for Wiegand or OSDP output protocol.
 6. Manufacturers:
 - a. Sargent Manufacturing (SA) – SN200 80 Series.
 - b. No Substitution.

2.11 DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
 1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.
 2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.

3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.
 4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.
 5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
 6. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
 7. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
- B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
1. Manufacturers:
 - a. Sargent Manufacturing (SA) - 351 Series.
 - b. No Substitution.

2.12 ELECTROHYDRAULIC DOOR OPERATORS

- A. General: Provide low energy operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for compliance with UL 325. Coordinate operator mechanisms with door operation, hinges, and activation devices.
1. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.
- B. Standard: Certified ANSI/BHMA A156.19.
- C. Performance Requirements:
1. Opening Force if Power Fails: Not more than 15 lbf required to release a latch if provided, not more than 30 lbf required to manually set door in motion, and not more than 15 lbf required to fully open door.
 2. Entrapment Protection: Not more than 15 lbf required to prevent stopped door from closing or opening.
- D. Configuration: Surface mounted or in-ground as required. Door operators to control single swinging and pair of swinging doors.

- E. Operation: Power opening and spring closing operation capable of meeting ANSI A117.1 accessibility guideline. Provide time delay for door to remain open before initiating closing cycle as required by ANSI/BHMA A156.19. When not in automatic mode, door operator to function as manual door closer with fully adjustable opening and closing forces, with or without electrical power.
- F. Features: Operator units to have full feature adjustments for door opening and closing force and speed, backcheck, motor assist acceleration from 0 to 30 seconds, time delay, vestibule interface delay, obstruction recycle, and hold open time from 0 up to 30 seconds.
- G. Provide outputs and relays on board the operator to allow for coordination of exit device latch retraction, electric strikes, magnetic locks, card readers, safety and motion sensors and specified auxiliary contacts.
- H. Brackets and Reinforcements: Manufacturer's standard, fabricated from aluminum with nonferrous shims for aligning system components.
- I. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Norton Door Controls (NO) - 6000 Series.

2.13 ARCHITECTURAL TRIM

- A. Door Protective Trim
 - 1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
 - 2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
 - 3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
 - 4. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:
 - a. Stainless Steel: 300 grade, 050-inch thick.
 - 5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
 - 6. Manufacturers:
 - a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).

2.14 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
 - 1. Manufacturers:
 - a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).

2.15 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
 - 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
 - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Manufacturers:
 - 1. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).

2.16 ELECTRONIC ACCESSORIES

- A. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.

1. Manufacturers:

- a. Securitron (SU) - DPS Series.

B. Power Supplies

1. By security contractor

2.17 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.18 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.
- C. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
 - 2. All quick connection below the ceiling to be made by hardware installer at the time of installation.
- D. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
 - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- E. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- F. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- G. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.3 FIELD QUALITY CONTROL

- A. Field Inspection (Punch-Out Report): Reference Division 01 Section "Closeout Procedures". Final inspect installed door hardware and state in report whether work complies with or deviates from specification requirements, including whether door hardware is properly installed, operating and adjusted.

3.4 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.5 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.6 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.7 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
 - 1. Quantities listed are for each pair of doors, or for each single door.
 - 2. The supplier is responsible for handling and sizing all products.
 - 3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate selection for the material and application.
 - 4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.
- B. Manufacturer's Abbreviations:
 - 1. MK - McKinney
 - 2. SA - SARGENT
 - 3. RO - Rockwood
 - 4. NO - Norton
 - 5. PE - Pemko
 - 6. OT - Other
 - 7. SU - Securitron

Hardware Sets based on plans dated 03/06/2024 – Issue for proposal

Set: 1.0

Doors: 4132A, 4132B

Description: Exterior Alum Pair - NL x DT

8 Hinge (heavy weight)	T4A3386 4 1/2" x 4 1/2" (NRP)	US32D	MK
1 Removable Mullion	L980S	US28	SA
1 Rim Exit Device, Storeroom	16 TB 43 72 8804 862	US32D	SA
1 Rim Exit Device, Dummy	16 TB 43 72 8810 862	US32D	SA
1 Mullion Cylinder	72 980C1	US26D	SA
4 Small Format Inter Core	7P-7300B	US15	SA
2 Surface Closer	TB 351 CPS brkt/spacer as req	EN	SA
2 Drop Plate	351D as required	EN	SA
2 Kit	581-2	EN	SA
1 Rain Guard	346C		PE
2 Sweep	3452AV		PE
1 Lip Threshold	2005AT		PE
1 Perimeter Seal	By door mfgr		OT
2 Position Switch	DPS-M-BK		SU

Notes: Confirm hardware compatibility with aluminum door manufacturer. Wide stile required.

Set: 2.0

Doors: 1127, 4149A, 4149B, 9100, A1026A

Description: Exterior Alum Pair - Access Control

7 Hinge (heavy weight)	T4A3386 4 1/2" x 4 1/2" (NRP)	US32D	MK
1 Hinge, Full Mortise, Hvy Wt	T4A3386 QC* 4-1/2" x 4-1/2"	US32D	MK
1 Electric Power Transfer	EL-CEPT	630	SU
1 Removable Mullion	L980S	US28	SA
1 Rim Exit Device	TB 43 72 56-SN200-8804 862	US32D	SA
1 Rim Exit Device, Dummy	16 TB 43 55 8810 862	US32D	SA
1 Mullion Cylinder	72 980C1	US26D	SA
4 Small Format Inter Core	7P-7300B	US15	SA
2 Surface Closer	TB 351 CPS brkt/spacer as req	EN	SA
2 Drop Plate	351D as required	EN	SA
2 Kit	581-2	EN	SA
1 Rain Guard	346C		PE
2 Sweep	3452AV		PE
1 Lip Threshold	2005AT		PE
1 Perimeter Seal	By door mfgr		OT
3 Elec Cables - Exit to Hinge	QC-CxxxP		MK
2 Elec Cables - Hinge to Above	QC-C1500P		MK
1 Power	By Security		OT

Notes: Timer is by security contractor where required.

Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times. EL-CEPT on active leaf.

Confirm hardware compatibility with aluminum door manufacturer. Wide stile required.

Set: 3.0

Doors: 1126B, 4133B, 4133C

Description: Exterior HM Pair - Exit

6 Hinge (heavy weight)	T4A3386 4 1/2" x 4 1/2" (NRP)	US32D	MK
1 Removable Mullion	L980S	PC	SA
1 Rim Exit Device, Storeroom	16 TB 43 72 8804 862	US32D	SA
1 Rim Exit Device, Dummy	16 TB 43 72 8810 862	US32D	SA
1 Mullion Cylinder	72 980C1	US26D	SA
4 Small Format Inter Core	7P-7300B	US15	SA
2 Surface Closer	TB 351 CPS brkt/spacer as req	EN	SA
1 Astragal Set (2)	18041CNB		PE
1 Rain Guard	346C		PE
1 Perimeter Seal	2891APK		PE
2 Sweep	3452AV		PE
1 Lip Threshold	2005AT		PE

Notes: Confirm hardware compatibility with door manufacturer. Wide stile required.

Set: 4.0

Doors: 9110, 9121, 9122A, 9131

Description: Exterior Sgl Alum Exit - Access Control

4 Hinge (heavy weight)	T4A3386 4 1/2" x 4 1/2" (NRP)	US32D	MK
1 Electric Power Transfer	EL-CEPT	630	SU
1 Rim Exit Device	TB 43 72 56-SN200-8804 862	US32D	SA
1 Small Format Inter Core	7P-7300B	US15	SA
1 Surface Closer	TB 351 CPS brkt/spacer as req	EN	SA
1 Kit	581-2	EN	SA
1 Rain Guard	346C		PE
1 Sweep	3452AV		PE
1 Lip Threshold	2005AT		PE
1 Perimeter Seal	By door mfgr		OT
1 Elec Cables - Exit to Hinge	QC-CxxxP		MK
1 Elec Cables - Hinge to Above	QC-C1500P		MK
1 Position Switch	DPS-M-BK		SU
1 Power	By Security		OT

Notes: Timer is by security contractor where required.

Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times.

Confirm hardware compatibility with aluminum door manufacturer. Wide stile required.

Set: 5.0

Doors: 4146A

Description: Exterior HM Exit

3 Hinge (heavy weight)	T4A3386 4 1/2" x 4 1/2" (NRP)	US32D	MK
1 Rim Exit Device, Storeroom	16 TB 43 72 8804 FSW	US32D	SA
2 Small Format Inter Core	7P-7300B	US15	SA
1 Surface Closer	TB 351 CPS brkt/spacer as req	EN	SA
1 Rain Guard	346C		PE
1 Perimeter Seal	2891APK		PE
1 Sweep	3452AV		PE
1 Lip Threshold	2005AT		PE
1 Position Switch	DPS-M-BK		SU

Set: 6.0

Doors: 4147, A129B

Description: Exterior HM - Lock - DPS

3 Hinge (heavy weight)	T4A3386 4 1/2" x 4 1/2" (NRP)	US32D	MK
1 Storeroom/Closet Lock	72 8204 LNJ	US26D	SA
1 Small Format Inter Core	7P-7300B	US15	SA
1 Surface Closer	TB 351 CPS brkt/spacer as req	EN	SA
1 Rain Guard	346C		PE
1 Perimeter Seal	2891APK		PE
1 Sweep	3452AV		PE
1 Lip Threshold	2005AT		PE
1 Position Switch	DPS-M-BK		SU

Set: 7.0

Doors: 9101

Description: Vest Alum Sgl - Exit

4 Hinge (heavy weight)	T4A3786 4 1/2" x 4 1/2"	US26D	MK
1 Rim Exit Device, Storeroom	16 TB 43 72 8804 862	US32D	SA
2 Small Format Inter Core	7P-7300B	US15	SA
1 Surface Closer	TB 351 CPS brkt/spacer as req	EN	SA
1 Kit	581-2	EN	SA
1 Perimeter Seal	By door mfr		OT

Notes: Buzzer if required is by security contractor.

Set: 8.0

Doors: A4100A

Description: Pair Alum - Corr / Gym / Cafeteria - MHO

8 Hinge (heavy weight)	T4A3786 4 1/2" x 4 1/2"	US26D	MK
1 Removable Mullion	L980S	US28	SA
2 Rim Exit Device, Classroom	16 TB 43 72 8813 ETJ	US32D	SA
1 Mullion Cylinder	72 980C1	US26D	SA
5 Small Format Inter Core	7P-7300B	US15	SA
2 Door Closer	TB 351 O / PS as req	EN	SA
2 Kit	581-2	EN	SA
2 Electromagnetic Holder	990 Series	689	RF
1 Perimeter Seal	By door mfg		OT

Notes: Doors are held open. Upon loss of power or signal from fire control, doors will close and latch.
Wiring is by others.

Set: 10.0

Doors: 4139A

Description: Pair Storage Closer

6 Hinge, Full Mortise	TA2714 4 1/2" x 4 1/2"	US26D	MK
1 Dust Proof Strike	570	US26D	RO
2 Flush Bolt	555 - 12"/72" A.F.F.	US26D	RO
1 Storeroom/Closet Lock	72 8204 LNJ	US26D	SA
1 Small Format Inter Core	7P-7300B	US15	SA
2 Door Closer	TB 351 O / PS as req	EN	SA
2 Silencer	608		RO

Set: 12.0

Doors: 4133A, 4133D, 4146B, 2150A, 2156, 2120B A3140,

Description: *Pair - Corr/Gym/Classroom

6 Hinge (heavy weight)	T4A3786 4 1/2" x 4 1/2"	US26D	MK
1 Removable Mullion	L980S	PC	SA
2 Rim Exit Device, Classroom	16 TB 43 72 8813 ETJ	US32D	SA
1 Mullion Cylinder	72 980C1	US26D	SA
5 Small Format Inter Core	7P-7300B	US15	SA
2 Surface Closer	TB 351 CPS brkt/spacer as req	EN	SA
1 Astragal Set (2)	18041CNB		PE
1 Perimeter Seal	S88BL		PE

Notes: At existing doors and frames, verify all existing conditions and modify hardware as required prior to purchase.

Set: 13.0

Doors: 2810

Description: *Sgl - Corr/Gym - 4'

4 Hinge (heavy weight)	T4A3786 4 1/2" x 4 1/2"	US26D	MK
1 Rim Exit Device, Classroom	16 TB 43 72 8813 ETJ	US32D	SA
2 Small Format Inter Core	7P-7300B	US15	SA
1 Surface Closer	TB 351 CPS brkt/spacer as req	EN	SA
1 Perimeter Seal	S88BL		PE

Set: 14.0

Doors: A1015, A1021

Description: Pair - Corr/Gym/Classroom - MHO

6 Hinge (heavy weight)	T4A3786 4 1/2" x 4 1/2"	US26D	MK
1 Removable Mullion	L980S	PC	SA
2 Rim Exit Device, Classroom	16 TB 43 72 8813 ETJ	US32D	SA
1 Mullion Cylinder	72 980C1	US26D	SA
5 Small Format Inter Core	7P-7300B	US15	SA
2 Surface Closer	TB 351 CPS brkt/spacer as req	EN	SA
2 Electromagnetic Holder	990 Series	689	RF
1 Astragal Set (2)	18041CNB		PE
1 Perimeter Seal	S88BL		PE

Notes: Doors are held open. Upon loss of power or signal from fire control, doors will close and latch.
Wiring is by others.

Set: 15.0

Doors: 1126A, 3132

Description: Pair Stair

6 Hinge (heavy weight)	T4A3786 4 1/2" x 4 1/2"	US26D	MK
1 Removable Mullion	12-L980	PC	SA
2 Rim Exit Device, Passage	12 TB 43 8815 ETJ	US32D	SA
1 Mullion Cylinder	72 980C1	US26D	SA
1 Small Format Inter Core	7P-7300B	US15	SA
2 Surface Closer	TB 351 CPS brkt/spacer as req	EN	SA
2 Perimeter Seal	S88BL		PE

Set: 17.0

Doors: 1116C, 1125B, , 1161A, 1165B, 1165C, 1167B, 1172A, 1213E, 1218A, 2116A, 2116B, 2122, 2126A, 2126B, 2161B,3115C, 7101C, 7105A, 9114, 9117, 9128, 9138,

Description: Storage

3 Hinge, Full Mortise	TA2714 4 1/2" x 4 1/2"	US26D	MK
1 Storeroom/Closet Lock	72 8204 LNJ	US26D	SA
1 Small Format Inter Core	7P-7300B	US15	SA
1 Door Stop	481	US26D	RO
3 Silencer	608		RO

Set: 19.0

Doors: 1120, 1163, 1213A, 3119, 3128, 4135, 4136, 4137, 4138, 9130

Description: Storage - Closer

3 Hinge, Full Mortise	TA2714 4 1/2" x 4 1/2"	US26D	MK
1 Storeroom/Closet Lock	72 8204 LNJ	US26D	SA
1 Small Format Inter Core	7P-7300B	US15	SA
1 Door Closer	TB 351 O / PS as req	EN	SA
1 Door Stop	481	US26D	RO
3 Silencer	608		RO

Set: 20.0

Doors: 4139B

Description: Storage - Closer - 4'

4 Hinge (heavy weight)	T4A3786 4 1/2" x 4 1/2"	US26D	MK
1 Storeroom/Closet Lock	72 8204 LNJ	US26D	SA
1 Small Format Inter Core	7P-7300B	US15	SA
1 Door Closer	TB 351 O	EN	SA
1 Door Stop	481	US26D	RO
3 Silencer	608		RO

Add to Set: 21.1

Doors: 2157

Description: Storage - Closer - Gasket -4'

4 Hinge (heavy weight)	T4A3786 4 1/2" x 4 1/2"	US26D	MK
1 Storeroom/Closet Lock	72 8204 LNJ	US26D	SA
1 Small Format Inter Core	7P-7300B	US15	SA
1 Door Closer	TB 351 O / PS as req	EN	SA
1 Door Stop	481	US26D	RO
1 Perimeter Seal	S88BL		PE

Set: 22.0

Doors: 1043, 1100C, 1113C, 3112C, 3127, 3130, 4134, 9118, 9119, 9120, 9124

Description: Storage - Closer - Gasket

3 Hinge, Full Mortise	TA2714 4 1/2" x 4 1/2"	US26D	MK
1 Storeroom/Closet Lock	72 8204 LNJ	US26D	SA
1 Small Format Inter Core	7P-7300B	US15	SA
1 Door Closer	TB 351 O / PS as req	EN	SA
1 Door Stop	481	US26D	RO
1 Perimeter Seal	S88BL		PE

Set: 23.0

Doors: 2103C, 7111A

Description: Storage - Closer/stop - Gasket

3 Hinge, Full Mortise	TA2714 4 1/2" x 4 1/2"	US26D	MK
1 Storeroom/Closet Lock	72 8204 LNJ	US26D	SA
1 Small Format Inter Core	7P-7300B	US15	SA
1 Surface Closer	351 PS	EN	SA
1 Perimeter Seal	S88BL		PE

Set: 24.0

Doors: 9116

Description: Storage -Dutch- OH Stop

4 Hinge, Full Mortise	TA2714 4 1/2" x 4 1/2"	US26D	MK
1 Dutch Door Bolt	630-4	US26D	RO
1 Storeroom/Closet Lock	72 8204 LNJ	US26D	SA
1 Small Format Inter Core	7P-7300B	US15	SA
1 Concealed Overhead Stop	690S	US26D	SA
1 Door Stop	481	US26D	RO
3 Silencer	608		RO

Set: 25.0

Doors: 1125A, 1125C, 1125D, 1125E, 1125F, 1205A, 1213A, 1213B, 1213C, 1213D, 2115A, 2121A, 2121B, 2159A, 4143, 4144, 7102,9105, 9108, 9109, 9112, 9113, 9133, 9135, 9136,

Description: Office

3 Hinge, Full Mortise	TA2714 4 1/2" x 4 1/2"	US26D	MK
1 Office/Entry Lock	72 8205 LNJ	US26D	SA
1 Small Format Inter Core	7P-7300B	US15	SA
1 Door Stop	481	US26D	RO
3 Silencer	608		RO

Notes: At existing doors and frames, verify all existing conditions and modify hardware as required prior to purchase.

Set: 26.0

Doors: 1115A, 1115B, 1117A, 1117B, 3114A, 3114B, 3116A, 3116B, 3160A, 7103, 7104, 7105, 9115, 9101B,

Description: *Large Classroom / Media Typical- Exit

3 Hinge (heavy weight)	T4A3786 4 1/2" x 4 1/2"	US26D	MK
1 Rim Exit Device, Classroom	16 TB 43 72 8813 ETJ	US32D	SA
1 Small Format Inter Core	7P-7300B	US15	SA
1 Surface Closer	TB 351 CPS brkt/spacer as req	EN	SA
3 Silencer	608		RO

Set: 27.0

Doors: 1167A, 9126, 9137

Description: Classroom

3 Hinge, Full Mortise	TA2714 4 1/2" x 4 1/2"	US26D	MK
1 Classroom Lock	72 8237 LNJ	US26D	SA
1 Small Format Inter Core	7P-7300B	US15	SA
1 Door Stop	481	US26D	RO
3 Silencer	608		RO

Set: 29.0

Doors: 1114A, 1114B, 1121, 1122, 1123, 1124, 1125, 1128, 1164, 1213, 1214, 1216, 1217, 1214A, 1214B, 2126, 2158, 2159, 3113A, 3113B, 3120, 3121, 3122, 3123, 3124, 3126, 3213A, 3213B, 3234, 3236, 9102, 9103,

Description: *Typical Classroom/ Corridor - Closer

3 Hinge, Full Mortise	TA2714 4 1/2" x 4 1/2"	US26D	MK
1 Classroom Lock	72 8237 LNJ	US26D	SA
1 Small Format Inter Core	7P-7300B	US15	SA
1 Door Closer	TB 351 O / PS as req	EN	SA
1 Door Stop	481	US26D	RO
3 Silencer	608		RO

Notes: At existing doors and frames, verify all existing conditions and modify hardware as required prior to purchase.

Set: 32.0

Doors: [1213](#), [9111](#), [9122B](#)

Description: Classroom - Closer

3 Hinge, Full Mortise	TA2714 4 1/2" x 4 1/2"	US26D	MK
1 Classroom Lock	72 8237 LNJ	US26D	SA
1 Small Format Inter Core	7P-7300B	US15	SA
1 Door Closer	TB 351 O	EN	SA
3 Silencer	608		RO

Add to Set: 32.1

Doors: [2400H](#)

Description: Replace Lockset - Locker

1 Classroom Lock	72 8237 LNJ	US26D	SA
1 Small Format Inter Core	7P-7300B	US15	SA

Notes: Existing lock must be field verified prior to purchase. This set is for design intent only.

Set: 33.0

Doors: 9132

Description: Alum Office- Closer

4 Hinge, Full Mortise	TA2714 4 1/2" x 4 1/2"	US26D	MK
1 Classroom Lock	72 8237 LNJ	US26D	SA
1 Small Format Inter Core	7P-7300B	US15	SA
1 Door Closer	TB 351 O	EN	SA
1 Door Stop	481	US26D	RO
1 Perimeter Seal	By door mfg		OT

Notes: Confirm hardware compatibility with aluminum door manufacturer. Wide stile required.

Set: 36.0

Doors: [1113A](#), [1113B](#), [1116A](#), [1116B](#), [3112A](#), [3112B](#), [3115A](#), [3115B](#)

Description: Prep

3 Hinge, Full Mortise	TA2714 4 1/2" x 4 1/2"	US26D	MK
1 Classroom Lock	72 8237 LNJ	US26D	SA
1 Small Format Inter Core	7P-7300B	US15	SA
1 Door Stop	481	US26D	RO
3 Silencer	608		RO

Set: 38.0

Doors: 1118, 1119, 2123, 2124, 2815, 2841, 3117, 3118, 4141, 4142A2, 4142B2, 4143A, 4144A, 4145B, 4145C, 4148

Description: Shared Restroom/Locker / Dressing P/P

3 Hinge, Full Mortise	TA2714 4 1/2" x 4 1/2"	US26D	MK
1 Push Plate	70E	US32D	RO
1 Pull Plate	111x70C	US32D	RO
1 Door Closer	TB 351 O / PS as req	EN	SA
1 Door Stop	481	US26D	RO
1 Perimeter Seal	S88BL		PE

Notes: At existing doors and frames, verify all existing conditions and modify hardware as required prior to purchase.

Set: 39.0

Doors: 4142A1, 4142B1, 4145A, 4145D

Description: Locker - Closer - DB

3 Hinge, Full Mortise	TA2714 4 1/2" x 4 1/2"	US26D	MK
1 Public Toilet Deadlock	72 4878	US26D	SA
1 Small Format Inter Core	7P-7300B	US15	SA
1 Push Plate	70E	US32D	RO
1 Pull Plate	111x70C	US32D	RO
1 Door Closer	TB 351 O / PS as req	EN	SA
1 Perimeter Seal	S88BL		PE

Set: 41.0

Doors: 9107, 9125, 9129

Description: Int Restroom / Admin area

3 Hinge, Full Mortise	TA2714 4 1/2" x 4 1/2"	US26D	MK
1 Privacy Set w/ Indicator	49 8265 LNJ	US26D	SA
1 Door Closer	TB 351 O / PS as req	EN	SA
1 Door Stop	481	US26D	RO
1 Perimeter Seal	S88BL		PE

Set: 42.0

Doors: 9106, 1165A

Description: Class Restroom

3 Hinge, Full Mortise	TA2714 4 1/2" x 4 1/2"	US26D	MK
1 Privacy Set w/ Indicator	49 8265 LNJ	US26D	SA
1 Door Stop	481	US26D	RO
1 Perimeter Seal	S88BL		PE

Set: 43.0

Doors: 9127, 9134

Description: Isolation / Exam

3 Hinge, Full Mortise	TA2714 4 1/2" x 4 1/2"	US26D	MK
1 Passage Set	8215 LNJ	US26D	SA
1 Door Stop	481	US26D	RO
3 Silencer	608		RO

Add to Set: 44.0

Doors: 1219B, 1219C, 1220B, 1220C

Description: Practice- Sound Seals

3 Hinge, Full Mortise	TA2714 4 1/2" x 4 1/2"	US26D	MK
1 Passage Set	8215 LNJ	US26D	SA
1 Door Stop	481	US26D	RO
2 Seal @ Jambs	350CSR		PE
1 Seal @ Head	2891APK		PE
1 Mortised Auto Door Bottom	420APKL		PE

Notes: At existing doors and frames, verify all existing conditions and modify hardware as required prior to purchase.

END OF SECTION 08 71 00

SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 1. Tempered glass.
 2. Laminated glass.
 3. Insulated glass.
 4. Spandrel glass.
 5. Glazing sealants.
 6. Accessories necessary for a complete installation.

1.3 DEFINITIONS

- A. Glass Thickness: Indicated by thickness designations in millimeters according to ASTM C 1036.
- B. Interspace: Space between lites of an insulating glass unit.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design glass panels including comprehensive engineering analysis by a qualified professional engineer lawfully licensed in the State of Texas, using performance requirements and design criteria indicated.
- B. Installed Glazing: Design glazing systems to withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.
 1. Design Wind Pressures: Indicated on Drawings.
 2. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
 - a. Wind Design Data: As indicated on the Drawings.
 - b. Basic Wind Speed: As indicated on the Drawings.
 - c. Importance Factor: 1.0.
 3. Exposure Category: C.
 4. Design Snow Loads: Indicated on Drawings.
 5. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
 6. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.
 7. Maximum Lateral Deflection: For glass supported on all four edges, limit center of glass deflection at design wind pressure to not more than 1/50 times the short side length or 1 inch (25 mm), whichever is less.

- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
3. For insulating glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 4. U-Factors: Center of glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
 5. Solar Heat Gain Coefficient and Visible Transmittance: Center of glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

1.5 SUBMITTALS

- A. Product Data: Technical data for each type of product including recommended installation and cleaning procedures.
- B. Glass Samples: For each type of glass required. Prepare samples from same material to be used for Work.
- C. Glazing Schedule: List glass types and thickness for each size opening and location. Use same designations indicated on Drawings.
- D. Delegated Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Product Certificates: Submit glass product certificates required by Code.
1. Glass Manufacturer Certificate: The glass manufacturer shall submit a letter certifying it has reviewed the glazing details proposed for the project, including the use of gaskets and sealants, and that each product furnished is recommended for the application shown and compliance with the Code.
- F. Thermal Stress and Wind Load Analyses: Submit the following from the glass manufacturer:
1. Thermal stress analysis for each exterior glass unit type, each building elevation. The analysis shall clearly indicate the expected service temperature ranges and the effects of partial and full shading on the glass.
 - a. Attach to the thermal stress analysis a statement from the glass manufacturer that based upon this analysis that the resulting thermal stresses will not reduce the specified statistical probability of breakage.
 2. Wind load analysis for each glass unit type, each building elevation. The analysis shall indicate the statistical probability of breakage at the design wind pressure does not exceed the specified statistical probability of breakage.
- G. Product Test Reports: Submit test reports for insulating glass and glazing sealants, for tests performed by a qualified testing agency.
1. Glazing Sealants: Provide test reports based on testing current sealant formulations within previous 36 month period.
 2. Glazing Sealants: Preconstruction adhesion and compatibility test report.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
1. Building Code: Comply with applicable requirements of the IBC for glazing.

2. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
 - a. As a minimum provide Category II materials complying with testing requirements in 16 CFR 1201 (Consumer Product Safety Commission *Safety Standard for Architectural Glazing Materials*, published in the Code of Federal Regulations) and ANSI Z97.1.
 - b. Permanently mark safety glass with certification label of Safety Glazing Certification Council.
3. Insulating Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
4. Glazing Publications: Comply with published recommendations of glass product organizations.
 - a. GANA: Glazing Manual.
 - b. IGMA: SIGMA TM-3000 Vertical Glazing Guidelines.
 - c. GANA: Laminated Glazing Reference Manual.
 - d. AAMA: AAMA GDSG-1 Glass Design for Sloped Glazing.
 - e. AAMA: TIR A7 Sloped Glazing Guidelines.
 - f. IGMA for Sloped Glazing: IGMA TB-3001 Guidelines for Sloped Glazing.
 - g. IGMA for Insulating Glass: SIGMA TM-3000 North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use.
5. Fire Rated Door Assemblies: Assemblies complying with NFPA 80 listed and labeled by UL for fire ratings indicated, based on testing according to NFPA 252.
6. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
 - a. Minimum Glass Thickness for Exterior Lites: 1/4 inch (6 mm).
 - b. Thickness of Tinted Glass: Provide same thickness for each tint color indicated.
7. Strength: Where annealed float glass is indicated, provide annealed float glass, heat strengthened float glass, or fully tempered float glass necessary to comply with performance requirements.
 - a. Where heat strengthened float glass is indicated, provide heat strengthened float glass or fully tempered float glass necessary to comply with performance requirements.
 - b. Where fully tempered float glass is indicated, provide fully tempered float glass.
- B. Manufacturer Qualifications for Insulating Glass Units with Sputter Coated, Low E Coatings: Insulating glass manufacturer who is approved and certified by coated glass manufacturer.
- C. Installer Qualifications, Glazer: Experience entity having minimum 5 years documented experience and who employs glass installers certified under the National Glass Association's Certified Glass Installer Program.
- D. Installer Qualifications, Decorative Film: Experience entity having minimum 5 years documented experience in the installation of glass films.
- E. Source Limitations for Glass and Glass Accessories: Obtain each type of glass and glass accessories from a single source.
- F. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- G. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

- H. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
- I. Install glazing in mockups specified in Section 08 41 13 to match glazing systems required for Project, including glazing methods.
 - 1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- J. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass framing member for adhesion to and compatibility with elastomeric glazing sealants.
 - 1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
 - 2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
 - 3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
 - 4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
 - 5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.
- K. Preinstallation Conference: Conduct conference at site.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by manufacturer.
- D. Exercise exceptional care to prevent edge damage to glass, and damage/deterioration to coating on glass.
- E. Comply with insulating glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 degrees F (4.4 degrees C).
- B. Field Measurements: Verify actual dimensions of openings and construction contiguous with decorative glass by field measurements before fabrication.

1.9 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.10 WARRANTY

- A. Written warranty, executed by glass manufacturer agreeing to repair or replace glass units that fail in materials and workmanship or deteriorate within warranty period. Warranty covers only deterioration due to normal conditions of use and not to handling, installing, and cleaning practices contrary to decorative glass manufacturer's published instructions.
 - 1. Warranty Period: Five (5) years from date of Substantial Completion.
- B. Laminated Glass: Written warranty signed by manufacturer in which manufacturer agrees to replace laminated glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
 - 1. Warranty Period: Ten (10) years from date of Substantial Completion.
- C. Insulating Glass: Written warranty signed by manufacturer in which manufacturer agrees to replace insulating glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: Ten (10) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Glass:
 - a. AGC Glass Company North America, Inc.
 - b. Cardinal Glass Industries.
 - c. Guardian Industries Corp.; SunGuard.
 - d. Oldcastle BuildingEnvelope.
 - e. Pilkington North America.
 - f. Viracon.
- B. Tinted Annealed Float Glass: ASTM C 1036, Type I, Class 2 (tinted), Quality-Q3.
- C. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller hearth) process with roll wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
 - 2. At Butt Glazing Assembly: 1/2-inch thickness clear, fully tempered glass with silicon joints.
- D. Adhered Backing: Adhered scrim backing to ceramic coated surface; provide backed units identical to materials which, while possibly developing cracks and fissures, show no shear nor develop any openings large enough for the unobstructed penetration of 3 inch diameter sphere when tested by approved independent testing laboratory:

1. Mount test specimens consisting of 3 glass assemblies, 34" x 76" (plus zero or minus 3/16 inch), for testing as specified in ANSI Z-97.1.
 2. Expose specimens to 100 cycles of the following conditions:
 - a. 1 hour at 0 degrees F, ambient humidity.
 - b. 3 hours increase from 0 degrees F to 140 degrees F, 95 to 100 percent relative humidity.
 - c. 1 hour at 140 degrees F, 95 to 100 percent relative humidity.
 - d. 3 hours decrease from 140 degrees F to 0 degrees F, ambient humidity.
 3. Break glass by springloaded prick punch at midpoint of either vertical edge.
 4. After breaking glass, subject it to pressure of 4 lbf per sq. ft. for 5 minutes to simulate wind load.
- L. Silicone Coated Spandrel Glass: ASTM C 1048, Type I, Condition C, Quality-Q3.
- M. Reflective Coated Spandrel Glass: ASTM C 1376, Kind CS.

2.2 INSULATING GLASS

- A. Insulating Glass Units: Factory assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
- B. Performance Properties:
1. Basis of Design Product: SNX 62/27 on Gray as manufactured by Guardian Sunguard.
 2. Outboard-Inboard Substrate: Sputter-coated Tinted glass -Clear Annealed Float glass.
 3. Overall Unit Thickness: 1/4 inch (6 mm).
 4. Outdoor Lite: Sputter-coated Gray Float Glass.
 5. Interspace Content: 10% Air and 90% Argon.
 6. Indoor Lite: Clear float glass.
 7. Winter U-Value Nighttime: 0.24 Btu/hr·ft²·F.
 8. Summer U-Value Daytime: 0.21 Btu/hr·ft²·F.
 8. Solar Heat Gain Coefficient: 0.17.
 9. Light to Solar Gain (LSG): 1.8.
- C. Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary sealants.
1. Spacer: Aluminum with black, color anodic finish. Thermally broken aluminum.
 2. Manufacturers: Subject to compliance with requirements, provide products by Technoform Glass Insulation NA, Inc.
 3. Desiccant: Molecular sieve or silica gel, or a blend of both.
- D. Fire Protection Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire protection ratings indicated, based on positive pressure testing according to NFPA 257 or UL 9, including the hose stream test, and complying with NFPA 80. For ratings 60 minutes or greater, glazing shall meet the test requirements of ASTM E119 or UL 263.
- E. Fire Protection Rated Glazing Labeling: Permanently mark fire protection rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction indicating manufacturer's name; test standard; whether glazing is permitted to be used in doors or openings; if permitted in openings, whether or not glazing has passed the hose-stream test; whether or not glazing meets 450 degrees F (250 degrees C) temperature rise limitation; and the fire resistance rating in minutes.

2.3 LAMINATED GLASS

- A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
 - 1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
 - 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
 - 3. Interlayer Thickness: 0.090 inch (2.29 mm).
 - 4. Interlayer Color: Clear unless otherwise indicated.
- B. Windborne Debris Impact Resistant Laminated Glass: Comply with requirements for laminated glass except laminate glass with ionomeric polymer interlayer to comply with interlayer manufacturer's written instructions:

2.4 GLAZING ACCESSORIES

- A. Compatibility: Provide glazing sealants compatible with one another and with other materials in contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of service and application, demonstrated by sealant manufacturer based on testing and field experience.
- B. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
- C. Colors of Exposed Glazing Sealants: Selected by Architect.
- D. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Corning Corporation.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.
 - c. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - d. Pecora Corporation.
 - e. Sika Corporation.
- E. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems.
 - b. Dow Corning Corporation.
 - c. GE Construction Sealants; Momentive Performance Materials Inc.
 - d. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - e. Pecora Corporation.
 - f. Polymeric Systems, Inc.
 - g. Sika Corporation.
- F. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bostik, Inc.
 - b. Dow Corning Corporation.

- c. GE Construction Sealants; Momentive Performance Materials Inc.
 - d. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - e. Polymeric Systems, Inc.
 - f. Schnee-Morehead, Inc., an ITW company.
 - g. Sika Corporation.
- G. Glazing Sealant: Acid curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems.
 - b. Bostik, Inc.
 - c. Dow Corning Corporation.
 - d. GE Construction Sealants; Momentive Performance Materials Inc.
 - e. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - f. Pecora Corporation.
 - g. Polymeric Systems, Inc.
 - h. Schnee-Morehead, Inc., an ITW company.
 - i. Sika Corporation.
- H. Glazing Sealants for Fire rated Glazing Products: Neutral curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Corning Corporation.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.
 2. Colors of Exposed Glazing Sealants: Selected by Architect.
- I. Back Bedding Mastic Glazing Tapes: Preformed, butyl based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- J. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.
- K. Miscellaneous Glazing Accessories: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with proven record of compatibility with surfaces contacted in installation.
1. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
 2. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
 3. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

4. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
5. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
6. Perimeter Insulation for Fire Resistant Glazing: Product approved by testing agency listed and labeled fire resistant glazing product with which it is used for application and fire protection rating indicated.

2.5 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - a. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.
 2. Edge and Surface Conditions: Comply with the recommendations of AAMA *Structural Properties of Glass* for clean cut edges, except comply with manufacturer's recommendations.
 3. Exposed Glass Edges and Surface Condition: Finish edges flat with an arris edge profile (small bevel of uniform width not exceeding 1.5 mm at an angle of approximately 45 degrees to the surface of the glass) with polished (surface is reflective in appearance similar to the major surface of the glass) surface.
- B. Cutting: Wheel cut or sawed edges and seamed at manufacturer's option. For site cut glass, provide glass 2 inches (50.8 mm) larger than required in both dimensions to facilitate cutting of clean cut edges without the necessity of seaming or nipping. Do not cut, seam, nip or abrade heat treated glass.
- C. Butt Glazing: Clean cut or flat grind vertical edges of butt glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
 1. Edges: Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 1. Manufacturing and installation tolerances, including size, squareness, and offsets at corners.
 2. Presence and functioning of weep systems.
 3. Minimum required face and edge clearances.
 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

- A. Clean glazing channels and framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

1. Comply with manufacturer instructions for wiping of surfaces immediately before application of primers.
 2. Wipe metal surfaces with IPA (isopropyl alcohol) unless otherwise required by compatibility and adhesion testing results.
- B. Inspect each piece of glass immediately before installation. Do not install pieces improperly sized or with damaged edges, scratches, abrasion, or evidence damage. Remove labels from glass immediately after installation.
- C. Examine glazing units to locate exterior and interior surfaces. Label or mark units so exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.
- D. Seal vent (breather or capillary) tubes in insulating glass units in accordance with insulating glass manufacturer written recommendations.

3.3 GLAZING

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 2. Provide 1/8 inch (3 mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

- J. Where wedge shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
1. Square cut wedge shaped gaskets at corners and install gaskets as recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.
- K. Tape Glazing: Position tapes on fixed stops so that, when compressed by glass, the exposed edges are flush with or protrude slightly above sightline of stops.
1. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make tapes fit opening.
 2. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
 3. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
 4. Do not remove release paper from tape until right before each glazing unit is installed.
 5. Apply heel bead of elastomeric sealant.
 6. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
 7. Apply cap bead of elastomeric sealant over exposed edge of tape.
- L. Gasket Glazing (Dry): Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
1. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
 2. Installation with Drive in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
 3. Installation with Pressure Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
 4. Install gaskets to protrude past face of glazing stops.
- M. Sealant Glazing (Wet): Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
1. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
 2. Tool exposed surfaces of sealants to provide a substantial wash away from glass.
- N. Structurally Glazed Units: Set full height continuous structural gaskets/spacers to vertical mullions. Set glass units with void between edge of units and head/sill channel, but with units fully within head/sill rebate so as to provide a proper bite.
1. Align glass unit edges over vertical mullion continuous structural gasket/spacers and secure with manufacturers recommended temporary cleats.
 2. Structurally seal glass unit to vertical mullions with specified one part structural silicone sealant. Tool structural silicone flush in alignment to mullion face and perpendicular to face of interior glass light; remove excess structural silicone from glass and metal substrates.

3. After full cure of structural silicone sealant remove temporary cleats. Immediately seal holes left in the vertical mullions caused by temporary cleats.
4. Insert and shape weatherseal joint backer rods, or gaskets, into vertical void between glass units and at a proper depth to receive silicone weatherseal sealant.
5. Place silicone weatherseal sealant into void and tool flush with adjacent exterior glass light faces; remove excess sealant from glass and metal substrates.

O. Erection Tolerances:

1. Maximum Deviation from Vertical: 1/8 inch in any story and 1/4 inch in any 45 foot run.
2. Maximum Deviation from Horizontal: 1/8 inch in any 30 foot run.
3. Maximum Deviation from True Alignment: 1/32 inch for any two (2) abutting units. Allow no edge projections.
4. Maximum Joint Gap: 1/32 inch.

3.4 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 1. If contaminating substances come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

PART 4 – SCHEDULE

4.1 GLAZING SCHEDULE

- A. G-1 Insulated Glass: 1 inch sealed insulated unit consisting of an exterior lite of 1/4 inch sputter-coated tinted float glass to match existing, 1/2 inch air space, and 1/4 inch annealed clear float glass interior lite.
- B. G-3 Clear, Tempered Float Glass: 1/4 inch thick glazing quality, clear tempered float glass.
- C. G-6 Insulated Spandrel Glass: 1 inch sealed insulated unit consisting of an exterior lite of 1/4 inch sputter-coated tinted float glass to match existing, 1/2 inch air space, and 1/4 inch spandrel glass with a ceramic frit on interior face (#4 surface on interior lite). Add opaci coat paint at the 4th surface, plenum locations only.
- D. G-7 Float Spandrel Glass: 1/4 inch thick spandrel glass, with a colored lead-free ceramic frit, fire-fused to its interior surface to match tinted tempered float glass specified as Type G-1 above.

END OF SECTION 08 80 00

SECTION 08 83 00 - MIRRORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Glass mirrors with Safety Film Backing.
 - 2. Accessories necessary for a complete installation.
- B. Related Work:
 - 1. Section 08 80 00 - Glazing.

1.3 DEFINITIONS

- A. Deterioration of Mirrors: Defects developed from normal use attributable to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning mirrors contrary to mirror manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide mirrors that will not fail under normal usage. Failure includes glass breakage and deterioration attributable to defective manufacture, fabrication, and installation.

1.5 SUBMITTALS

- A. Product Data: Technical data for mirror units including description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality control provisions.
- B. Shop Drawings: Submit mirror elevations, edge details, mirror hardware, and attachments to other Work.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Accessibility Requirements: Comply with applicable requirements.
 - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
 - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
 - c. Texas Accessibility Standards (TAS) 2012.
 - 2. Glazing Publications: Comply with published recommendations:
 - a. *GANA Glazing Manual* unless more stringent requirements are indicated.
 - b. *GANA Mirror Division Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors.*

3. Safety Glazing Products: For tempered mirrors, provide products complying with testing requirements in 16 CFR 1201 for Category II materials.
- B. Installer Qualifications: Experienced installer having minimum 5 years documented experience and has completed mirror glazing similar in material, design, and extent to that indicated.
- C. Source Limitations for Mirrors: Obtain mirrors from one source for each type of mirror indicated.
- D. Source Limitations for Mirror Glazing Accessories: Obtain mirror glazing accessories from one source for each type of accessory indicated.
- E. Preconstruction Mirror Mastic Compatibility Test: Submit mirror mastic products to mirror manufacturer for testing to determine compatibility of mastic with mirror backing and substrates on which mirrors are installed.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect mirrors according to mirror manufacturer's written instructions and necessary to prevent damage to mirrors from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors, protected from moisture including condensation.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

1.9 WARRANTY

- A. Warranty: Warranty made out to Owner and signed by mirror manufacturer agreeing to replace mirrors that deteriorate, f.o.b. the nearest shipping point to site, within specified warranty period:
 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Manufacturers: Subject to compliance with requirements, provide mirrors by one of the following:
 1. Guardian Industries Corp.
 2. Trulite Glass & Aluminum Solutions; (713) 747-5430.
 3. Virginia Mirror Company, Inc.;
 4. VVP America, Inc.; Binswanger Mirror Products.
 5. Walker Glass Co., Ltd.
- B. Clear Glass Mirrors: Annealed monolithic glass, ASTM C 1503, Mirror Select Quality, clear float glass with a minimum 91 percent visible light transmission.
 1. Nominal Thickness: 6.0 mm.
- C. Setting Blocks: Elastomeric material with Type A Shore durometer hardness of 85, plus or minus 5.

- D. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.
- E. Mirror Mastic: Adhesive setting compound, produced specifically for setting mirrors and certified by both mirror manufacturer and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed. Provide product recommended by mirror manufacturer.
- F. Safety Backing: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.
 - 1. Provide at Fine Arts
- G. Top and Bottom Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover bottom and top edges of each mirror in a single piece.
 - 1. Bottom Trim: J-channels formed with front leg and back leg not less than 3/8 inch and 7/8 inch (9.5 mm and 22 mm) in height, respectively, and a thickness of not less than 0.04 inch (1.0 mm).
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Laurence, C. R. Co., Inc.; CRL Standard "J" Channel.
 - 2) Sommer & Maca Industries, Inc.; Aluminum Shallow Nose "J" Moulding Lower Bar.
 - 2. Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch (16 and 25 mm) in height, respectively, and a thickness of not less than 0.04 inch (1.0 mm).
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Laurence, C. R. Co., Inc.; CRL Deep "J" Channel.
 - 2) Sommer & Maca Industries, Inc.; Aluminum Deep Nose "J" Moulding Upper Bar.
 - 3. Finish: Clear.
- H. Top and Bottom Clips: As indicated.
- I. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.
- J. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead shield expansion bolt devices for drilled in place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

2.2 FABRICATION

- A. Mirror Sizes: To suit conditions, cut mirrors to final sizes and shapes.
- B. Cutouts: Fabricate cutouts for notches and holes in mirrored glass without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrored glass.
- C. Mirror Edge Treatment:
 - 1. Cutting and Polishing: Flat edges where the clean cut square edge of the glass is flat and surface edges are slightly arched. After grinding the arched edges, polish edges to a high gloss surface where the surface reflectivity is similar in appearance to the major surface of the glass.
 - 2. Edge Sealing: Immediately after cutting to final sizes, and applying edge treatment, factory seal edges of mirrors with edge sealer to prevent chemical or atmospheric penetration of glass coating.

- D. Film Backed Safety Mirrors: Apply film backing with adhesive coating over mirror backing paint as recommended in writing by film backing manufacturer to produce a surface free of bubbles, blisters, and other imperfections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, over which mirrors are to be mounted for compliance with installation tolerances, substrate preparation, and conditions affecting performance. Verify compatibility with and suitability of substrates, including compatibility of mirror mastic with existing finishes or primers. Proceed with mirror installation after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

- A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating surfaces with mastic manufacturer's special bond coating where applicable.

3.3 INSTALLATION

- A. Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images. Provide minimum air space of 1/8 inch (3 mm) between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.
- B. Wall Mounted Mirrors: Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.
 - 1. For metal or plastic clips, place a felt or plastic pad between mirror and each clip to prevent spalling of mirror edges.
 - 2. Top and Bottom Aluminum J-Channels: Provide setting blocks 1/8 inch (3 mm) thick by 4 inches (100 mm) long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch (6.4 mm) wide by 3/8 inch (9.5 mm) long at bottom channel.
 - 3. Mirror Clips: Place a felt or plastic pad between mirror and each clip to prevent spalling of mirror edges. Locate clips to be symmetrically placed and evenly spaced.
 - a. Fabricate bottom trim in single lengths to fit and cover bottom edges of mirrors. Locate top clips so they are symmetrically placed and evenly spaced.
 - 4. Mastic: Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
 - a. Apply mastic in vertical beads or mounds to the wall, not to the mirror back to avoid potential damage caused by mastic applicator tools, in compliance with mastic manufacturer's written instructions to allow air circulation between back of mirrors and face of mounting surface.
 - b. Make each vertical bead approximately 1/2 inch in width with minimum of one bead for every square foot of mirror.
 - c. Make each mound approximately 1-1/2 inch in diameter with a minimum of one mound for every square foot of mirror.
 - d. Do not apply mastic within 6 inches of the mirror edges to prevent squeeze out. Place beads or mounds leaving a space between mirror and wall. After mastic is applied, align mirrors and press into place. Spread each vertical bead to approximately 2 inches in width and spread each mound to a pat approximately 3-1/2 inch in diameter after pressing mirror into place.

- e. After mastic is applied, align mirrors and press into place while maintaining a minimum air space of 1/8 inch (3 mm) between back of mirrors and mounting surface.

3.4 CLEANING AND PROTECTION

- A. Protect mirrors from breakage and contaminating substances resulting from construction operations. Do not permit edges of mirrors to be exposed to standing water. Maintain environmental conditions that will prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.
- B. Wash exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash mirrors as recommended in writing by mirror manufacturer.

END OF SECTION 08 83 00

SECTION 08 87 23 - SAFETY AND SECURITY FILM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Safety and security film for application to existing glazing where indicated.
- B. Related Sections
 - 1. Section 08 80 00 - Glazing; general glazing applications to receive architectural window film.

1.3 REFERENCES

- A. ASHRAE - American Society for Heating, Refrigeration, and Air Conditioning Engineers; Handbook of Fundamentals.
- B. ASTM International (ASTM):
 - 1. ASTM D 882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
 - 2. ASTM D 1004 - Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting.
 - 3. ASTM D 1044 - Standard Method of Test for Resistance of Transparent Plastics to Surface Abrasion (Taber Abrader Test).
 - 4. ASTM D 2582 - Standard Test Method for Puncture-Propagation Tear Resistance of Plastic Film and Thin Sheeting.
 - 5. ASTM D 4830 - Standard Test Methods for Characterizing Thermoplastic Fabrics Used in Roofing and Waterproofing.
 - 6. ASTM E 84 - Standard Method of Test for Surface Burning Characteristics of Building Materials.
 - 7. ASTM E 308 - Standard Recommended Practice for Spectrophotometry and Description of Color in CIE 1931 System.
 - 8. ASTM E 903 - Standard Methods of Test for Solar Absorbance, Reflectance and Transmittance of Materials Using Integrating Spheres.
 - 9. ASTM E 1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
 - 10. ASTM E 1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.
- C. Window 5.2 - A Computer Tool for Analyzing Window Thermal Performance; Lawrence Berkeley Laboratory.
- D. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.
- E. Consumer Products Safety Commission 16 CFR, Part 1201 - Safety Standard for Architectural Glazing Materials.

- F. GSA Standard Test for Glazing and Glazing Systems Subject to Airblast Loadings.
- G. ISO 16933, International Standard for Glass in Building: Explosion-resistant security glazing - Test and classification for arena air-blast testing.
- H. Underwriters Laboratories Inc. (UL): UL 972 - Burglary Resisting Glazing Material.

1.4 PERFORMANCE REQUIREMENTS

- A. Safety Glazing Impact Performance:
 - 1. 400 ft-lbs impact resistance, meeting ANSI Z97.1 (Class A, Unlimited) and 16 CFR 1201 (Category 2) impact requirements with film is applied on 1/4 inch annealed glass.
- B. Fire Performance: Surface burning characteristics when tested in accordance ASTM E 84:
 - 1. Flame Spread: 25, maximum.
 - 2. Smoke Developed: 450, maximum.
- C. Abrasion Resistance: Film must have a surface coating that is resistant to abrasion such that, less than 5 percent increase of transmitted light haze will result in accordance with ASTM D 1044 using 50 cycles, 500 grams weight, and the CS10F Calbrase Wheel.
- D. UV Light Rejection:
 - 1. Minimum of 99% UV light rejection (300 - 380 nm), per ASTM E903, as determined with film applied on 1/4 inch clear glass.

1.5 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- B. Selection Samples: For each film specified, submit film samples representing manufacturer's film type for the project.
- C. Verification Samples: For each film specified, two samples representing film color and pattern.
- D. Performance Submittals: Provide laboratory data of emissivity and calculated window U-Factors for various outdoor temperatures based upon established calculation procedure defined by the ASHRAE Handbook of Fundamentals, Chapter 29, or Lawrence Berkeley Laboratory Window 5.2 Computer Program.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten years experience.
- B. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five years demonstrated experience in installing products of the same type and scope as specified.
 - 1. Provide documentation that the installer is authorized by the Manufacturer to perform Work specified in this section.
 - 2. Provide a commercial building reference list of 5 properties where the installer has applied window film. This list will include the following information:
 - a. Name of building.

- b. The name and telephone number of a management contact.
 - c. Type of glass.
 - d. Type of film.
 - e. Amount of film installed.
 - f. Date of completion.
3. Provide a Glass Stress Analysis of the existing glass and proposed glass/film combination as recommended by the film manufacturer.
 4. Provide an application analysis to determine available energy cost reduction and savings.
- C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
1. Finish areas designated by Architect.
 2. Do not proceed with remaining Work until workmanship, color, and sheen are approved by Architect.
 3. Refinish mock-up area as required to produce acceptable Work.
 4. Upon acceptance, mock-up may become part of the Work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local authorities having jurisdiction.

1.8 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 WARRANTY

- A. At project closeout, provide to Owner or Owners Representative an executed current copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Products: Products specified herein are those of 3M Window Film, St. Paul, MN. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
 1. Madico Window Films, St Petersburg, FL.
 2. Johnson Window Films, Carson CA.
 3. Solar Gard, Saint-Gobain, Houston, TX

2.2 CLEAR SAFETY AND SECURITY WINDOW FILM

- A. Clear Safety and Security Window Film: 3M Safety S140 (SH14CLARL) Safety and Security Window Film as supplied by Armor Glass International, Inc.; Sugar Land, Tx.; (713) 213-5080. Optically clear polyester film with a durable acrylic abrasion resistant coating over one surface and a pressure sensitive adhesive over the other.
 1. Physical / Mechanical Performance Properties:

- a. Film Color: Clear.
 - b. Thickness at Vestibule:
 - 1) 15.0 mil. Applying 8mil on the daylight side of all the glazing and 7mil on the opposing side of all the glazing.
 - c. Thickness at Exterior Glazing:
 - 1) 14 mil.
 - d. Thickness at Interior Glazing:
 - 1) 14 mil.
 - e. Tensile Strength (ASTM D 882): 25,000 psi.
 - f. Break Strength (ASTM D 882) (Per Inch Width): 350 lbs.
2. Uniformity: No noticeable pin holes, streaks, thin spots, scratches, banding or other optical defects.
 3. Variation in Total Transmission across the Width: Less than 2 percent over the average at any portion along the length.
 4. Identification: Labeled as to Manufacturer as listed in this Section.
 5. Solar Performance Properties: Film applied to 1/4 Inch (6.4 mm) thick clear glass.
 - a. Visible Light Transmission (ASTM E 903): 85 percent.
 - b. Visible Reflection (ASTM E 903): Not more than 10 percent.
 - c. Ultraviolet Transmission (ASTM E 903): Less than 1 percent.
 - d. Solar Heat Gain Coefficient (ASTM E 903): 0.78.
 6. Windstorm Protection
 - a. Film shall pass impact of Medium Large Missile "C" and withstand subsequent pressure cycling (per ASTMs E 1996 and E 1886) at 50 psf Design Pressure with use of 3M Impact Protection Adhesive attachment system.
 7. Bomb Blast Mitigation: Independent testing with results from high explosive arena blast testing.
 - a. GSA Rating with minimum blast pressure and impulse of 7 psi and 36 psi.msec, respectively: "3B" (Low Hazard / High Protection).
 - b. GSA Rating with minimum blast pressure and impulse of 11 psi and 55 psi.msec, respectively: "3B" (Low Hazard / High Protection).
 8. Forced Entry Protection: Independent lab testing according to UL 972 protocol (Multiple Impact Test).
 - a. Annealed Glass (1/4 inch) - Pass
 - b. Tempered Glass (1/4 inch) - Pass

2.3 ATTACHMENT SYSTEMS

- A. General: Subject to compliance with testing and performance requirements, provide one of the following perimeter attachment systems.
 1. Wet-glaze: The security film is applied to the glass in a fashion whereby the window glazing gaskets are trimmed and the film's edges are inserted behind the window frame. A bead of Dow Corning 995® structural silicone is then applied flush against the frame to overlap the security film and take the place of the original gaskets
 2. Mechanical Batten: The security film overlaps the window frame on one, two, or four sides and is then clamped to the frame at a 90° angle using a proprietary mechanical batten system secured to the window frame.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. If preparation of glass surfaces is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.
 - 1. Glass surfaces receiving new film should first be examined to verify that they are free from defects and imperfections, which will affect the final appearance:
- B. Do not proceed with installation until glass surfaces have been properly prepared and deviations from manufacturer's recommended tolerances are corrected. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result under the project conditions.
- C. Commencement of installation constitutes acceptance of conditions.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Apply film to each side of the glazing identified in the drawings. Install in accordance with manufacturer's instructions.
- B. All exterior glass up to six (6) feet or the next mullion requires 14 mil security film on the interior and exterior side of the glass at new additions.
- C. All interior glass at new additions is required to have security film on the inside face of the room.
- D. Cut film edges neatly and square at a uniform distance of 1/8 inch (3 mm) to 1/16 inch (1.5 mm) of window sealant. Use new blade tips after 3 to 4 cuts.
- E. Spray the slip solution, composed of one capful of baby shampoo or dishwashing liquid to 1 gallon of water, on window glass and adhesive to facilitate proper positioning of film.
- F. Apply film to glass and lightly spray film with slip solution.
- G. Squeegee from top to bottom of window. Spray slip solution to film and squeegee a second time.
- H. Bump film edge with lint-free towel wrapped around edge of a 5-way tool.
- I. Upon completion of film application, allow 30 days for moisture from film installation to dry thoroughly, and to allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.

3.4 CLEANING AND PROTECTION

- A. Remove left over material and debris from Work area. Use necessary means to protect film before, during, and after installation.

- B. Touch-up, repair or replace damaged products before Substantial Completion.
- C. After application of film, wash film using common window cleaning solutions, including ammonia solutions, 30 days after application. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching film. Use synthetic sponges or soft cloths.

END OF SECTION 08 87 23

SECTION 08 91 00 - FIXED LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 1. Fixed, extruded aluminum and formed metal louvers.
 2. Accessories necessary for a complete installation.

1.3 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades (i.e., the axes of the blades are horizontal).
- C. Vertical Louver: Louver with vertical blades (i.e., the axes of the blades are vertical).
- D. Drainable Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.
- E. Wind Driven Rain Resistant Louver: Louver that provides specified wind driven rain performance determined by testing according to AMCA 500-L.

1.4 SUBMITTALS

- A. Product Data: Technical data for each type of product indicated. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other Work. Show frame profiles and blade profiles, angles, and spacing.
 1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
 2. Show mullion profiles and locations.
 3. Windstorm: Design loads as indicated on drawings.
- C. Samples: Submit for units with factory applied color finishes.

1.5 QUALITY ASSURANCE

- A. Delegated Design Submittal: For louvers indicated to comply with structural [**and seismic**] performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

- C. Windborne debris impact resistance test reports.
- D. Regulatory Requirements:
 - 1. SMACNA Standard: Comply with recommendations in SMACNA *Architectural Sheet Metal Manual* for fabrication, construction details, and installation procedures.
 - 2. Welding: Qualify procedures and personnel according to the following:
 - a. AWS D1.2/D1.2M Structural Welding Code - Aluminum.
- E. Source Limitations: Obtain louvers and vents from single source from a single manufacturer where indicated to be of same type, design, or factory applied color finish.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 WARRANTY

- A. Warrant the work specified herein for 20 years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to:
 - 1. Fading, corrosion, or other finish deterioration.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 (Z275) zinc coating, mill phosphatized.
- D. Stainless Steel Sheet: ASTM A 240/A 240M, Type 304, No. 4 finish, with grain running parallel to length of blades and frame members..
- E. Fasteners: Use types and sizes to suit unit installation conditions.
 - 1. Use tamper resistant screws for exposed fasteners unless otherwise indicated.
 - 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
 - 3. For fastening galvanized steel, use hot dip galvanized steel or 300 series stainless steel fasteners.
 - 4. For fastening stainless steel, use 300 series stainless-steel fasteners.
 - 5. For color finished louvers, use fasteners with heads that match color of louvers.
- F. Postinstalled Fasteners for Concrete and Masonry: Torque controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FIXED, EXTRUDED ALUMINUM LOUVERS

- A. Horizontal Continuous Line, Drainable Blade Louver:
1. Basis of Design: Model LE-54 as manufactured by American Warming and Ventilating (AWV). Other manufacturers are subject to compliance with requirements, provide products of one of the following:
 - a. Airolite Company, LLC (The).
 - b. Arrow United Industries.
 - c. Construction Specialties, Inc.
 - d. Greenheck Fan Corporation.
 - e. Ruskin Company; Tomkins PLC.
 2. Louver Blade: 0.060 inch thick, extruded aluminum, ASTM B 209, Alloy 6063-T5.
 3. Frame: 5 inch deep channel, 0.078 inch thick extruded aluminum, ASTM B209, Alloy 6063-T5.
 4. Screen: 1/2 inch removable expanded aluminum bird screen, located on interior.
 5. Panel Size: Refer to the Drawings.
 6. Blade Spacing: 2 inch.
 7. Blade Orientation: Horizontal.
 8. Pressure Drop: 0.31 in w.g. at 1250 fpm and 8850 scfm.
 9. Water Penetration: 1250 fpm.
 10. Finish: Mill.

2.3 FABRICATION

- A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field bolted assembly with close fitting joints in jambs and mullions, reinforced with splice plates.
1. Continuous Vertical Assemblies: Fabricate units without interrupting blade spacing pattern unless horizontal mullions are indicated.
 2. Horizontal Mullions: Provide horizontal mullions at joints unless continuous vertical assemblies are indicated.
- C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill to produce uniform appearance.
- D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- E. Include supports, anchorages, and accessories required for complete assembly.
- F. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches (1830 mm) o.c., whichever is less.
1. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close fitting blade splices designed to permit expansion and contraction.
 2. Semirecessed Mullions: Where indicated, provide mullions partly recessed behind louver blades so louver blades appear continuous. Where length of louver exceeds fabrication and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.
 3. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling

limitations, provide interlocking split mullions designed to permit expansion and contraction.

4. Exterior Corners: Prefabricated corner units with mitered blades with concealed close fitting splices and with fully recessed mullions at corners.

- G. Provide subsills made of same material as louvers or extended sills for recessed louvers.
- H. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.4 FINSHES

- A. Comply with NAAMM *Metal Finishes Manual for Architectural and Metal Products* for recommendations for applying and designating finishes.
- B. Aluminum Finishes:
 1. Finish louvers after assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent Work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective Work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- F. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 07 92 00 for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers damaged during installation and construction so no evidence remains of corrective Work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
 - 1. Touch up minor abrasions in finishes with air dried coating that matches color and gloss of, and is compatible with, factory applied finish coating.

END OF SECTION 08 91 00

SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 1. Gypsum Board.
 2. Partition Framing Systems.
 3. Reinforced Gypsum Board Sheathing (Tile Backer Board).
 4. Ceiling Suspension Systems.
 5. Acoustically Enhanced Gypsum Board:
 6. Impact Resistant Gypsum Board.
 7. Accessories necessary for a complete installation.

1.3 PERFORMANCE REQUIREMENTS

- A. Performance Requirements: Comply with manufacturer's load tables and the following design pressures and deflections:
 1. Stairs, Elevator Hoistways, and Vertical Shafts: 1/120 at 10 psf.
 2. Ground Floor Lobbies: 1/120 at 15 psf.
 3. Partitions Receiving Stone Cladding, Lath and Plaster, or Plaster Veneer: 1/360 at 15 psf.
 4. Partitions Receiving Monitors, Televisions, Heavy Audio/Visual Equipment: 1/360 at 15 psf.
 5. Typical Partitions: 1/240 at 5 psf.
 6. Other Partitions: 1/240 at 5 psf.
 - a. Maximum Deflection:
 - 1) L/240 at 5 lbf per sq. ft.
 - 2) L/120 at 5 lbf per sq. ft.
 - 3) L/120 at 7.5 lbf per sq. ft.
 - 4) L/120 at 10 lbf per sq. ft.
- B. Fire Resistance Rated Assemblies: For fire resistance rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- C. STC Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

1.4 SUBMITTALS

- A. Product Data: Submit For each type of drywall including calculations for loadings and stresses of exterior walls and specially fabricated framing based on manufacturer's load tables.
- B. Shop Drawings: Indicate locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.

1. Submit joint layout. Determine any anticipated areas of cracking or diminished resistance of cracking.
- C. Samples:
 1. Trim Accessories: Full size Sample in 12 inch (300 mm) long length for each trim accessory indicated.
 2. Textured Finishes: 12 inch by 12 inch (300 mm by 300 mm) for each textured finish indicated and on same backing indicated for Work.
- D. Calculations: Submit calculations verifying steel partition stud minimum base metal thickness and depth compliance with Code and ASTM C645 for height, load, and deflection.
- E. Evaluation Reports: ICC-ES reports for steel studs and runners and firestop tracks.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 1. Comply with applicable requirements of IBC for interior finishes.
 2. Fire Resistance Rated Assemblies: For fire resistance rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. Single Source Responsibility:
 1. Framing Members: Obtain steel framing members from single manufacturer.
 2. Panel Products: Obtain each type of gypsum board and other panel products from single manufacturer.
 3. Finishing Materials: To the extent possible, obtain finishing materials from same manufacturer supplying gypsum board products. When not possible, obtain materials from manufacturer acceptable to gypsum board manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 for gypsum board manufacturer's written instructions, whichever are more stringent.
 1. Do not install paper faced gypsum panels until installation areas are enclosed and conditioned.
- B. Room Temperatures: Maintain minimum 40 degrees F (4 degrees C). For adhesive attachment and finishing of gypsum board, maintain minimum 50 degrees F (10 degrees C) for 48 hours before application and continuously after until dry. Do not exceed 95 degrees F (35 degrees C) when using temporary heat sources.
- C. Ventilation: Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too rapidly.
- D. Do not install panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

1.8 WARRANTY

- A. Warrant the work specified for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
- B. In addition, provide warranty from the manufacturer for the following products:
 1. Exterior sheathing weathering warranty covering in-place exposure damage to exterior sheathing for twelve (12) months.
 2. Exterior sheathing warranty against manufacturing defects for five (5) years.
 3. Abuse Resistant Panel weathering warranty covering in-place exposure damage to sheathing for six (6) months.
 4. Abuse Resistant Panel warranty against manufacturing defects for three (3) years.
 5. Glass-mat sheathing weathering warranty covering in-place exposure damage to sheathing for three (3) months.
 6. Glass-mat sheathing warranty against manufacturing defects for three (3) years.
 7. Tile backer board warranty against manufacturing defects for 20 years.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Manufacturers: Listed manufactures whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
 1. Steel Studs and Tracks:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) ClarkDietrich; (888) 437-3244.
 - 2) CEMCO; California Expanded Metal Products Co.; (800) 775-2362.
 - 3) MBA Building Supplies; (888) 248-8076.
 - 4) Mill Steel Framing; (800) 247-6455.
 - 5) MRI Steel Framing, LLC.; (630) 616-1850.
 - 6) Phillips Manufacturing Co.; (800) 822-5055.
 - 7) Steel Network, Inc. (The); (888) 474-4876.
 - 8) Telling Industries; (866) 372-6384.
 2. Ceiling Grid:
 - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
 - b. Chicago Metallic Corporation; 640-C.
 - c. CertainTeed Corporation.
 - d. USG Corporation; Drywall Suspension System.
 3. Gypsum Board:
 - a. Certainteed Corporation.
 - b. Georgia Pacific.
 - c. National Gypsum Company.
 - d. USG Corporation.

4. Tile Backer Board: Fiberock Interior Aqua-Tough; USG Corporation or comparable product.
5. Base Trim:
 - a. Waterguard; www.keepsdrywalldry.com, (800) 653-8785.
 - b. Substitutions, refer to Division 1.
- B. Framing Members: ASTM C 754 for component sizes and conditions under specified maximum deflection and lateral loading conditions indicated.
 1. Steel Sheet Components: Comply with AISI S220 requirements for metal.
 2. Protective Coating: ASTM A 653/A 653M, G60 (Z180), hot dip galvanized.
- C. Steel Framing Components: ASTM C 754 for conditions indicated; hot dip galvanize complying with ASTM A 653M Z180.
 1. Steel Studs and Runners: AISI S220, 0.0179 inch (0.45 mm) minimum base metal thickness; Depth indicated on Drawings.
 2. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
 3. Cold Rolled Channel Bridging: 0.0538 inch (1.37 mm) bare steel thickness, with minimum 1/2 inch (12.7 mm) wide flanges. Depth indicated on Drawings.
 4. Clip Angle: Not less than 1-1/2 inches by 1-1/2 inches (38.1 mm by 38.1 mm), 0.068 inch (1.73 mm) thick, galvanized steel.
 5. Hat Shaped, Rigid Furring Channels: ASTM C 645; 0.0179 inch (0.45 mm) minimum base metal thickness; Depth indicated on Drawings.
 6. Resilient Furring Channels: 1/2 inch (12.7mm) deep, steel sheet members designed to reduce sound transmission. Configuration: Asymmetrical or hat shaped.
 7. Cold Rolled Furring Channels: 0.0538 inch (1.37mm) bare steel thickness, with minimum 1/2 inch (12.7mm) wide flanges.
 - a. Depth: Indicated on Drawings.
 - b. Furring Brackets: Adjustable, corrugated edge type of steel sheet with minimum bare steel thickness of 0.0312 inch (0.79 mm).
 - c. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625 inch (1.59mm) diameter wire, or double strand of 0.0475 inch (1.21mm) diameter wire.
 8. Z Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (31.8 mm), wall attachment flange of 7/8 inch (22.2 mm), minimum bare metal thickness of 0.0179 inch (0.45 mm), and depth required to fit insulation thickness indicated.
 9. Auxiliary Framing Materials: Fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
 10. Slip Type Head Joints: Where indicated, provide one of the following:
 - a. Single Long Leg Runner System: ASTM C 645 top runner with 2 inch (50.8 mm) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging, located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
 - b. Double Runner System: ASTM C 645 top runners, inside runner with 2 inch (50.8 mm) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
 - c. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs. Provide one of the following:
 - 1) ClarkDietrich; MaxTrak Slotted Deflection Track.
 - 2) Steel Network Inc. (The); VertiClip SLD or VertiTrack VTD Series.
 - 3) Superior Metal Trim; Superior Flex Track System (SFT).

11. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire resistance rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs. Provide one of the following:
 - a. ClarkDietrich; BlazeFrame Fire Stop Deflection.
 - b. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
 - c. Grace Construction Products; FlameSafe FlowTrak System.
 - d. Metal-Lite, Inc.; The System.
 - e. Steel Network Inc. (The); VertiClip SLD or VertiTrack VTD Series as applicable.

- D. Ceiling Suspension Components:
 1. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625 inch (1.59 mm) diameter wire.
 2. Hanger Attachments to Concrete:
 - a. Anchors: Postinstalled, chemical anchor or postinstalled, expansion anchor fabricated from corrosion resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
 - b. Powder Actuated Fasteners: Suitable for application indicated, fabricated from corrosion resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.
 3. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162 inch (4.12 mm) diameter.
 4. Carrying Channels: Cold rolled, commercial steel sheet with base metal thickness of 0.0538 inch (1.37 mm) and minimum 1/2 inch (12.7 mm) wide flanges. Depth indicated on Drawings.
 5. Furring Channels (Furring Members):
 - a. Cold Rolled Channels: 0.0538 inch (1.37 mm) bare steel thickness, with minimum 1/2 inch (12.7 mm) wide flanges, 3/4 inch (19.1 mm) deep.
 - b. Steel Studs: ASTM C 645; minimum base metal thickness of 0.0312 inch (0.79 mm); Depth indicated on Drawings.
 - c. Hat Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22.2 mm) deep; Minimum base metal thickness of 0.0312 inch (0.79 mm).
 6. Resilient Furring Channels: 1/2 inch (12.7 mm) deep members designed to reduce sound transmission. Configuration: Hat shaped.
 7. Grid Suspension System for Ceilings: ASTM C 645, direct hung system composed of main beams and cross furring members that interlock.

- E. Gypsum Board: ASTM C 1396/C 1396M, applicable to type of gypsum board indicated and whichever is more stringent.
 1. Core: Use Type X throughout
 - a. Thickness: 5/8 inch (15.9 mm).
 - b. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
 2. Ceiling Type: Manufactured for sag resistance
 - a. Thickness: 1/2 inch (13mm).
 - b. Long Edges: Tapered.
 3. Moisture and Mold Resistant Type: Type X with moisture and mold resistant core and surfaces. Core:
 - a. Thickness: 5/8 inch (15.9 mm).

- b. Long Edges: Tapered.
- F. Impact Resistant Gypsum Board: ASTM C 1396/C 1396M gypsum board, tested according to ASTM C 1629/C 1629M.
- 1. Core and Thickness: 5/8 inch (15.9 mm), Type X.
 - 2. Surface Abrasion: ASTM C 1629/C 1629M, meets or exceeds Level 1 requirements.
 - 3. Indentation: ASTM C 1629/C 1629M, meets or exceeds Level 1 requirements.
 - 4. Soft Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 1 requirements.
 - 5. Hard Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 1 requirements according to test in Annex A1.
 - 6. Long Edges: Tapered.
 - 7. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
 - 8. Location: In Gymnasium.
- G. Acoustically Enhanced Gypsum Board: ASTM C 1396/C 1396M. Multilayer products constructed of two layers of gypsum boards sandwiching a viscoelastic sound-absorbing polymer core.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. National Gypsum Company; (704) 365-7300.
 - b. Quiet Solution; (800) 797-8159.
 - 2. Core: 1-3/8 inch (35 mm), regular type.
 - 3. Long Edges: Tapered.
- H. Reinforced Gypsum Sheathing (Tile Backer Board): ASTM C 1278/C 1278M, standard edges. Cellulose fiber reinforced panels may be used in lieu of cementitious board.
- 1. Core and Thickness: 1/2 inch (12.7 mm) or 5/8 inch (15.9 mm) to match conditions, Type X.
 - 2. Long Edge: Tapered.
 - 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- I. Base Trim: Installed continuously at floor level of all GDW throughout building.
- 1. Poly Vinyl Chloride (PVC) compound meeting the requirements of ASTM C1047. ASTM D3678, ASTM D3679, and ASTM D4216.
 - 2. Sizes:
 - a. 1/2 inch (12.7 mm) height X 1/2 inch (12.7 mm) depth or 1/2-inch (12.7 mm) X 5/8 inch (15.875 mm).
- J. Exterior Trim: ASTM C 1047, hot dip galvanized steel sheet, plastic, or rolled zinc.
- 1. Shapes:
 - a. Cornerbead.
 - b. LC Bead: J shaped; exposed long flange receives joint compound.
 - c. Expansion (Control) Joint: One piece, rolled zinc with V shaped slot and removable strip covering slot opening.
- K. Interior Trim: ASTM C 1047; galvanized or aluminum coated steel sheet, rolled zinc, plastic, or paper faced galvanized steel sheet.
- 1. Poly Vinyl Chloride (PVC) compound meeting the requirements of ASTM C1047. ASTM D3678, ASTM D3679, and ASTM D4216.
 - 2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC Bead: J shaped; exposed long flange receives joint compound.
 - d. L Bead: L shaped; exposed long flange receives joint compound.
 - e. U Bead: J shaped; exposed short flange does not receive joint compound.
 - f. Expansion (control) joint.

3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fry Reglet Corporation; (800) 237-9773.
 - b. Gordon, Inc.; (888) 877-8746.
 - c. Pittcon Industries; (301) 927-1000.
 - d. USG Corporation.

- L. Continuous Corner: Extruded Aluminum; continuous integral fin for surface contact with gypsum board; 7/8 inch (22 mm) wide, tapered to edge; punched with holes staggered to accept screw fastening. Prime with corrosion resistant primer. Provide Pittcon Softforms SO-HSE-90 or Schluter.
 1. Basis of Design: Pittcon Softforms SO-HSE-90; Subject to compliance with requirements, provide basis of design or comparable by one of the following:
 - a. Fry Reglet Corporation; (800) 237-9773.
 - b. Pittcon Industries; (301) 927-1000.
 - c. Schluter; (888) 472-4588.

- M. Joint Treatment: ASTM C 475/C 475M.
 1. Joint Tape:
 - a. Exterior Gypsum Soffit Board: Paper.
 - b. Joint Compound for Exterior Applications, Glass Mat Gypsum Sheathing Board: Recommended by sheathing board manufacturer.
 - c. Joint Tape, Interior Gypsum Board: Paper.

 2. Joint Compound:
 - a. Gypsum Board: Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting type taping compound.
 - 1) Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting type taping compound.
 - a) Use setting type compound for installing paper faced metal trim accessories.
 - 2) Fill Coat: For second coat, use setting type, sandable topping compound.
 - 3) Finish Coat: For third coat, use setting type, sandable topping compound.
 - 4) Skim Coat: For final coat of Level 5 finish, use setting type, sandable topping compound.
 - b. Cementitious Units: Recommended by backer unit manufacturer.
 - c. Tile Backing Panels: Recommended by backer unit manufacturer.
 - d. Water Resistant Gypsum Backing Board: Use setting type taping compound and setting-type, sandable topping compound.
 - e. Joint Compound, Glass Mat Sheathing Board: Recommended by sheathing board manufacturer.

- N. Auxiliary Gypsum Materials: Comply with referenced installation standards and manufacturer's written recommendations.
 1. Steel Drill Screws: ASTM C 1002, use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
 2. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - a. Fire Resistance Rated Assemblies: Comply with mineral-fiber requirements of assembly.

3. Control Joints: Metal (USG #093 / Dietrich 093 Control Joint) type with 1/4 inch open joint, perforated flanges for floating in place.
4. Acoustical Sealant: Nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hilti, Inc.;(800) 879-8000.
 - 2) Pecora Corporation; (800) 523-6688.
 - 3) Specified Technologies, Inc.; (800) 992-1180.
 - 4) United States Gypsum Company; (800) 950-3839.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow metal frames, cast in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION

- A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.
- B. Gypsum Board Assemblies: Comply with requirements in ASTM C 840 applicable to framing installation.
- C. Control joints shall be located 30 feet-0 inches on center maximum and along building expansion joints, unless noted otherwise on drawings. Locations shall be reviewed with Architect prior to final placement.
- D. Suspension System: Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
 1. Suspend hangers from building structure:
 - a. Install hangers plumb and free from contact with insulation or objects within ceiling plenum that are not part of supporting structural or suspension system. Splay hangers where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - b. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - 1) Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 - c. Do not attach hangers to steel roof deck.

- d. Do not attach hangers to permanent metal forms. Furnish cast in place hanger inserts that extend through forms.
 - e. Do not attach hangers to rolled in hanger tabs of composite steel floor deck.
 - f. Do not connect or suspend steel framing from ducts, pipes, or conduit.
2. Fire Resistance Rated Assemblies: Wire tie furring channels to supports.
- E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross furring members to each other and butt cut to fit into wall track. Do not install rivets.
- F. Framing Assembly: Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
1. Install studs so flanges within framing system point in same direction. Space studs in single layer application as indicated on drawings.
 2. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 - a. Acoustical Sealant: Install continuous ribbon of acoustical sealant under floor track. Refer to Section 07 92 00.
 - b. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - 1) Install two studs at each jamb, unless otherwise indicated.
 - 2) Install cripple studs at head adjacent to each jamb stud, with minimum 1/2 inch (12.7mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
 - 3) Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - c. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 3. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.
- G. Gypsum Panels: Comply with ASTM C 840. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
1. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
 2. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
 3. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
 4. Form control and expansion joints with space between edges of adjoining gypsum panels.
 5. Cover both faces of support framing with gypsum panels in concealed spaces, except in chases braced internally.
 - a. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 - b. Fit gypsum panels around ducts, pipes, and conduits.

- c. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4 inch to 3/8 inch (6.4 mm to 9.5 mm) wide joints to install sealant.
 6. Isolate perimeter of gypsum board applied to nonload bearing partitions at structural abutments and floors. Provide 1/4 inch to 1/2 inch (6.4mm to 12.7mm) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
 7. Acoustical Sealant: Install continuous ribbon of acoustical sealant under floor track. Refer to Section 07 92 00.
 8. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- H. Gypsum Board: Install interior gypsum board where indicated on drawings.
1. Single Layer Application:
 - a. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
 - b. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire resistance rated assembly, and minimize end joints. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - c. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
 2. Multilayer Application:
 - a. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 - b. On Z shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
 - c. Fastening Methods: Fasten base layers and face layers separately to supports with screws.
- I. Backing Panels:
1. Cementitious Backer Units: ANSI A108.11; install where indicated with 1/4 inch (6.4 mm) gap where panels abut other construction or penetrations. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.
- J. Trim Accessories: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Attach trim according to manufacturer's written instructions.
1. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
 2. Exterior Trim: Install in the following locations:
 - a. Cornerbead: Use at outside corners.
 - b. LC Bead: Use at exposed panel edges.
 3. Interior Trim: Install in the following locations:
 - a. Cornerbead: Use at outside corners, unless otherwise indicated.
 - b. Bullnose Bead: Use at outside corners.
 - c. LC Bead: Use at exposed panel edges.
 - d. L Bead: Use where indicated or necessary.
 - e. U Bead: Use at exposed panel edges.

- K. Gypsum Board Finishing: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
1. Prefill open joints, rounded or beveled edges, and damaged surface areas.
 2. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
 3. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - a. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - b. Level 2: Panels that are substrate for tile.
 - c. Level 3: Surfaces be coated with drywall primer prior to final finishes. Heavy or medium texture finishes before final painting, or where heavy-grade wall coverings are to be applied as the final decoration. This level of finish is not recommended where smooth painted surfaces, or light to medium weight wall coverings as specified. Janitorial, Electrical, Technology, & Mechanical Rooms.
 - d. Level 4: For surfaces receiving wall coverings of semigloss and eggshell paints. Hallways, Classrooms & Offices with ceilings 10' or lower
 - e. Level 5: For surfaces receiving semigloss and eggshell paint and surfaces subjected to severe lighting. At Library, Cafeteria areas scheduled to receive writable surface, writable projectable surface & at above walls scheduled to Receive PSI panels 48" AFF. At Flex Spaces & Hallways with Ceilings higher than 10'.

3.4 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

3.5 WORKMANSHIP TOLERANCES

- A. Visual: Correct any nicks, bumps, out-of-level or out - of-plumb areas detectable to the naked eye.
- B. Walls: 3/8 inch maximum deviation from vertical.
- C. Bumps in Boards: Maximum 1/8 inch in 24 inches.
- D. Corners: Maximum out-of-square 1/8 inch in 16 inches.
- E. Float solid between corner beads less than 36 inches apart. Surfaces that appear concave are not acceptable.
- F. Provide "J" mold and continuous 1/4 inch reveal wherever gypsum board directly abutts other material or when end is exposed. All reveals to be caulked.
- G. Float Control Joints flush with wall surface so that ceiling wall mold specified separately will align with wall surface flat and straight.

3.6 COMMENCEMENT RESTRICTIONS

- A. Interior gypsum wallboard and ceiling board installation may not commence until all exterior dampproofing and roofing are completed and roof top equipment is fully installed and flashed and exterior wall openings are protected.

END OF SECTION 09 21 16

SECTION 09 24 00 - CEMENT PLASTERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 1. Exterior plasterwork (stucco).
 2. Metal framing and accessories.
 3. Metal lath and furring.
 4. Accessories necessary for a complete installation.

1.3 SUBMITTALS

- A. Product Data: Submit technical data for product and accessory, including construction details and material descriptions.
- B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.
- C. Samples: Submit samples for each type of factory prepared finish coat and for each color and texture specified, 12 inches by 12 inches (305 mm by 305 mm), and prepared on rigid backing.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 1. Building Code: Comply with applicable provisions of the IBC and the IECC for building enclosures.
 2. Fire Resistance Ratings: Where indicated, provide cement plaster assemblies identical to those of assemblies tested for fire resistance according to ASTM E 119 by a qualified testing agency.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 1. Build mockup of typical wall area as shown on Drawings.
 2. Perform testing on mockups according to specified requirements.
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
 5. When directed, remove mockups from site.
- C. Preinstallation Conference: Conduct conference at site.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver cementitious materials in original packages, containers, or bundles, labeled with manufacturer's name, product brand name, and lot number.

- B. Store materials inside under cover, and keep them dry and protected against damage from weather, moisture, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

1.6 PROJECT CONDITIONS

- A. Comply with applicable requirements of ASTM C 926.
- B. Environmental Requirements: Comply with requirements of referenced plaster application standards and recommendations of plaster manufacturer for environmental conditions before, during, and after plaster application.
- C. Cold Weather Requirements: Provide heat and protection, temporary or permanent, as required to protect each coat of plaster from freezing for at least 24 hours after application. Distribute heat uniformly to prevent concentration of heat on plaster near heat sources; provide deflection or protective screens.
- D. Warm Weather Requirements: Protect plaster against uneven and excessive evaporation and from strong flows of dry air, both natural and artificial. Apply and cure plaster as required by climatic and job conditions to prevent dry out during cure period. Provide suitable coverings, moist curing, barriers to deflect sunlight and wind, or combinations of these, as required.
- E. Ventilation: Provide natural or mechanical means of ventilation to properly dry interior spaces after portland cement plaster has cured.
- F. Exterior Plasterwork:
 - 1. Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.
 - 2. Apply plaster when ambient temperature is greater than 40 degrees F (4.4 degrees C).
 - 3. Protect plaster coats from freezing for not less than 48 hours after set of plaster coat has occurred.
- G. Protect contiguous Work from soiling and moisture deterioration caused by plastering. Provide temporary covering and take precautions necessary to minimize spattering of plaster on adjacent Work.
- H. Factory Prepared Finishes: Comply with manufacturer's written recommendations for environmental conditions for applying finishes.

1.7 WARRANTY

- A. Warrant the work specified for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
- B. Defects shall include, but not be limited to the following:
 - 1. Cracking excessively without external causes.
 - 2. Delaminating or releasing from substrate.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Manufacturers: Listed manufactures whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
1. Metal Lath and Accessories:
 - a. Alabama Metal Industries; (205) 366-2642.
 - b. CEMCO; (800) 775-2362.
 - c. ClarkDietrich Building Systems; (800) 543-7140.
 - d. Marino/WARE; (800) 627-4661.
 - e. Phillips Manufacturing; (800) 822-5055.
 2. Wire Fabric Lath:
 - a. Davis Wire; (800) 350-7851.
 - b. C.E. Shephard Co., L.P.; (713) 924-4300.
 - c. Keystone Steel and Wire Co.; (309) 697-7607.
 - d. K-Lath; (800) 663-0955.
 3. Plastic Accessories:
 - a. Alabama Metal Industries; (205) 366-2642.
 - b. Phillips Manufacturing; (800) 822-5055.
 - c. Plastic Components; (800) 327-7977.
 - d. Vinyl Corp.; (305) 477-6464.
 4. Acrylic Based Finish Coat:
 - a. California Stucco Product; (201) 457-1900.
 - b. Dryvit Systems; (800) 556-7752.
 - c. El Rey Solutions; A Parex Company; (877) 547-8822.
 - d. Finestone, BASF Corp; (800) 669-2273.
 - e. Omega Products International; (800) 600-6634.
 - f. Senergy, BASF Corp.; (800) 669-2273.
 - g. Sto Corp.; (800) 221-2397.
- B. Cold Formed Steel Framing: Refer to Section 05 40 00 for steel framing for exterior plaster (stucco).
- C. Steel Studs and Runners: Refer to Section 09 21 16 for steel partition framing for interior plaster.
- D. Soffit Framing: Refer to Section 05 40 00.
- E. Metal Lath:
 1. Expanded Metal Lath: ASTM C 847, cold rolled carbon steel sheet with ASTM A 653/A 653M, G60 (Z180), hot dip galvanized zinc coating.
 - a. Diamond Mesh Lath: Self furring, 3.4 lb/sq. yd. (1.8 kg/sq. m).
 2. Paper Backing: FS UU-B-790, Type I, Grade D, Style 2 vapor-permeable paper
 - a. Provide paper backed lath at exterior locations.
- F. Accessories: Comply with ASTM C 1063, and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.
1. Metal Accessories:

- a. Foundation Weep Screed: Fabricated from hot dip galvanized steel sheet, ASTM A 653/A 653M, G60 (Z180) zinc coating.
 - b. Cornerite: Fabricated from metal lath with ASTM A 653/A 653M, G60 (Z180), hot dip galvanized-zinc coating.
 - c. Outside Corner Reinforcement: Fabricated from metal lath with ASTM A 653/A 653M, G60 (Z180), hot dip galvanized zinc coating.
 - d. Cornerbeads: Fabricated from zinc or zinc coated (galvanized) steel.
 - 1) Smallnose cornerbead with expanded flanges; use unless otherwise indicated.
 - 2) Smallnose cornerbead with expanded flanges reinforced by perforated stiffening rib; use on columns and for finishing unit masonry corners.
 - e. Casing Beads: Fabricated from zinc or zinc coated (galvanized) steel; square edged style; with expanded flanges.
 - f. Control Joints: Fabricated from zinc or zinc coated (galvanized) steel; one piece type, folded pair of unperforated screeds in M shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
 - g. Expansion Joints: Fabricated from zinc or zinc coated (galvanized) steel; folded pair of unperforated screeds in M shaped configuration; with expanded flanges.
 - h. Two Piece Expansion Joints: Fabricated from zinc or zinc coated (galvanized) steel; formed to produce slip joint and square edged reveal adjustable from 1/4 to 5/8 inch (6 to 16 mm) wide; with perforated flanges.
 - i. Ventilation: Provide trims with vent slot where specified or required to provide the needed ventilation. Vent Slots are 1/8 inch wide and 1 inch long and configured at 1-1/2 inches o.c. lengthwise and 1/2 inches o.c. laterally. Each row of vent slots lengthwise provides approximately one-square inch of vented area per lineal foot.
2. Plastic Accessories: Manufactured from high impact PVC.
- a. Cornerbeads: With perforated flanges.
 - 1) Smallnose cornerbead; use unless otherwise indicated.
 - 2) Bullnose cornerbead, radius 3/4 inch (19 mm) minimum; use at locations indicated on Drawings.
 - b. Casing Beads: With perforated flanges in depth required to suit plaster bases indicated and flange length required to suit applications indicated.
 - 1) Square edge style; use unless otherwise indicated.
 - 2) Bullnose style, radius 3/4 inch (19 mm) minimum; use at locations indicated on Drawings.
 - c. Control Joints: One piece type, folded pair of unperforated screeds in M shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
 - d. Expansion Joints: Two piece type, formed to produce slip joint and square edged 1 inch (25 mm) wide reveal; with perforated concealed flanges.
- G. Miscellaneous Materials:
1. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.
 2. Fiber for Base Coat: Alkaline resistant glass or polypropylene fibers, 1/2 inch (13 mm) long, free of contaminants, manufactured for use in cement plaster.
 3. Bonding Compound: ASTM C 932.
 4. Fasteners for Attaching Metal Lath to Substrates: ASTM C 1063.
 5. Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, not less than 0.0475 inch (1.21 mm) diameter unless otherwise indicated.

6. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - a. Fire Resistance Rated Assemblies: Comply with mineral-fiber requirements of assembly.

H. Plaster Materials:

1. Portland Cement: ASTM C 150/C 150M, Type I.
 - a. Color for Finish Coats: Match existing.
2. Colorants for Job Mixed Finish Coats: Colorfast mineral pigments that produce finish plaster color selected by Architect.
3. Lime: ASTM C 206, Type S; or ASTM C 207, Type S.
4. Sand Aggregate: ASTM C 897.
 - a. Color for Job Mixed Finish Coats: White.
5. Exposed Aggregates for Finish Coats: Match existing.
6. Acrylic Based Finish Coatings: Factory mixed acrylic emulsion coating systems formulated with colorfast mineral pigments and fine aggregates; for use over cement plaster base coats. Include manufacturer's recommended primers and sealing topcoats for acrylic based finishes.
 - a. Color: Selected by Architect.

2.2 PLASTER MIXES

- A. Comply with ASTM C 926 for applications indicated.
 1. Fiber Content: Add fiber to base coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed 1 lb of fiber/cu. yd. (0.6 kg of fiber/cu. m) of cementitious materials.
- B. Base Coat Mixes for Use over Metal Lath: Scratch and brown coats for three coat plasterwork:
 1. Portland Cement Mix:
 - a. Scratch Coat: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 - b. Brown Coat: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.
- C. Job Mixed Finish Coat Mixes:
 1. Portland Cement Mix: For cementitious materials, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 1-1/2 to 3 parts aggregate per part of cementitious material.
- D. Factory Prepared Finish Coat Mixes: For ready mixed finish coat plasters or acrylic based finish coatings, comply with manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

- A. Protect adjacent Work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.
- B. Prepare smooth, solid substrates for plaster according to ASTM C 926.

3.3 INSTALLATION

- A. Metal Lath: Install according to ASTM C 1063.
 - 1. Partition Framing and Vertical Furring: Flat diamond mesh lath.
 - 2. Horizontal Framing: Flat diamond mesh lath.
- B. Accessories: Install according to ASTM C 1063 and at locations indicated on Drawings.
 - 1. Reinforcement for External (Outside) Corners:
 - a. Install [lath type, external corner reinforcement] [cornerbead] at exterior locations.
 - b. Install cornerbead at interior locations.
 - 2. Control Joints: Locate as approved by Architect for visual effect:
 - a. As required to delineate plasterwork into areas (panels) of the following maximum sizes:
 - 1) Vertical Surfaces: 144 sq. ft. (13.4 sq. m).
 - 2) Horizontal and Other Nonvertical Surfaces: 100 sq. ft. (9.3 sq. m).
 - b. At distances between control joints of not greater than 18 feet (5.5 m) o.c.
 - c. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.
 - d. Where control joints occur in surface of construction directly behind plaster.
 - e. Where plasterwork areas change dimensions, to delineate rectangular shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.

3.4 PLASTER APPLICATION

- A. Comply with ASTM C 926.
 - 1. Do not deviate more than plus or minus 1/4 inch in 10 feet (6 mm in 3 m) from a true plane in finished plaster surfaces when measured by a 10-foot (3-m) straightedge placed on surface.
 - 2. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.
 - 3. Provide plaster surfaces ready to receive field applied finishes indicated.
- B. Flat Surface Tolerances: Do not deviate more than plus or minus 1/8 inch in 10 feet (3 mm in 3 m) from a true plane in finished plaster surfaces, measured by a 10 foot (3m) straightedge placed at any location on surface.
- C. Walls; Base Coat Mixes for Use over Metal Lath: For scratch and brown coats, for three coat plasterwork with 1 inch (26 mm) total thickness:
 - 1. Portland cement mixes.
- D. Plaster Finish Coats: Apply to provide dash finish.

- E. Acrylic Based Finish Coatings (Contractor Option to Plaster Finish Coat): Apply coating system, including primers, finish coats, and sealing topcoats, according to manufacturer's written instructions.
- F. Concealed Exterior Plasterwork: Where plaster application is used as a base for adhered finishes, omit finish coat.

3.5 PLASTER REPAIRS

- A. Repair or replace Work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.
- B. Cut, patch, replace, repair, and point up plaster as necessary to accommodate other Work. Repair cracks and indented surfaces. Point up finish plaster surfaces around items that are built into or penetrate plaster surfaces. Repair or replace Work to eliminate blisters, buckles, check cracking, dry outs, efflorescence, excessive pinholes, and similar defects. Repair or replace work as necessary to comply with required visual effects.

3.6 TOLERANCES

- A. Maximum Variation from True Lines and Levels: 1/8 inch in 10 feet (3mm in 3 m).
- B. Maximum Variation from True Position: 1/8 inch (3mm).

3.7 CLEANING AND PROTECTION

- A. Remove temporary protection and enclosure of Work after plastering is complete. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.
- B. Remove unused materials, containers, equipment, and plaster debris.
- C. Protect plaster and maintain conditions ensuring finished plaster is without damage or deterioration at time of Substantial Completion.

END OF SECTION 09 24 00

SECTION 09 30 13 - CERAMIC TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Thin set glazed wall and floor tile, base and necessary trim shapes, mortar and grout, expansion joints, sealants, transition strips, and accessories shown or required to complete work.

1.3 RELATED SECTIONS

- A. Section 09 65 13 – Resilient Base.

1.4 PERFORMANCE REQUIREMENTS

- A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with values determined by testing identical products per ASTM C 1028:
 - 1. Level Surfaces: Minimum 0.6.
 - 2. Ramp Surfaces: Minimum 0.8.

1.5 SUBMITTALS

- A. Product Data: Technical data including data sheets, installation recommendation, and recommended joint widths.
- B. Shop Drawings: Show locations of each type of tile and tile pattern.
 - 1. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples: Submit samples showing full range of color and texture variations expected.
 - 1. Full size units of each type and composition of tile and for each color and finish required.
 - 2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required; minimum 12 inches (300 mm) square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
 - 3. Waterproof membrane in 6 x 6-inch sample.
 - 4. Thresholds in 6 inch (150 mm) lengths.
- D. Test Reports: Submit test reports from qualified independent testing laboratory indicating and interpreting test results relative to compliance of tile products with requirements for slip resistance.
- E. Maintenance Instructions: Submit maintenance instructions for each type of product specified.
- F. Certifications:
 - 1. Provide Master Grade Certificate as specified in ANSI A137.1.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
1. Building Code: Comply with applicable requirements for the IBC for interior finishes.
 2. Surface Burning Characteristics: ASTM E 84; identify products with appropriate markings of applicable testing agency.
 - a. Flame Spread Index: 25 or less.
 - b. Smoke Developed Index: 450 or less.
 3. Accessibility Requirements: Comply with applicable requirements.
 - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
 - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
 - c. Texas Accessibility Standards (TAS) 2012.
- B. Source Limitations for Tile: Obtain tile of same type and color or finish from one source or producer. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- C. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.
- D. Source Limitations for Other Products: Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:
1. Stone thresholds.
 2. Waterproofing.
 3. Joint sealants.
 4. Cementitious backer units.
 5. Metal edge strips.
- E. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products. Contractor shall provide certified moisture testing results per ASTM F2170 (*Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes*) in new construction or ASTM F1869 (*Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride*) in renovations to Architect and Owner prior to floor installation. Acceptable moisture content of concrete sub floor shall be within approved manufacture limits or lower prior to installation.
- F. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Build mockup of each type of floor tile installation.
 2. Build mockup of each type of wall tile installation.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location. Store aggregates where grading and other required characteristics can be maintained and

contamination can be avoided. Store liquid materials in unopened containers and protected from freezing.

- C. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.
- B. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products.
- C. Maintain temperatures at 50 degrees F or more in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

1.9 EXTRA STOCK

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full size units equal to three (3) percent of amount installed for each type, composition, color, pattern, and size indicated.
 - 2. Grout: Furnish quantity of grout equal to three (3) percent of amount installed for each type, composition, and color indicated.

1.10 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 00 – Project Management and Coordination.

1.11 WARRANTY

- A. Warrant the Work specified herein for five (5) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to, the following:
 - 1. Damaged tile, including broken or chipped edges.
 - 2. Loose or missing tile.
 - 3. Noticeable deterioration or discoloring of tile or grout.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed whose product meets or exceed the specifications may be used on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions in order to be considered.
 - 1. Ceramic Tile:

- a. American Marazzi Tile, Inc.; (972) 226-0110.
 - b. American Olean Tile Co.; (214) 398-1411.
 - c. American Tile; (713) 939-1077.
 - d. Dal-Tile Corp.; (713) 481-5893.
 - e. Interceramic, USA; (800) 496-8453.
 - f. United States Ceramic Tile Co.; (800) 321-0684.
2. Tile Setting and Grout Materials: Those manufactured by the approved tile manufacturers named above or any of the following as approved by the tile manufacturer for use with his tile and to suit application.
- a. Custom Building Products, Seal Beach, CA; (562) 598-8808.
 - b. Laticrete International, Inc., Bethany, CT; (800) 243-4788.
 - c. MAPEI Corp, Deerfield Beach, FL; (954) 246-8888.

2.2 INTERIOR TILES

- A. Ceramic Tile:
1. Floor Tile:
 - a. Type/Size: Non-glazed 2 inch by 2 inch ceramic mosaic tile, with cushion edge.
 - b. Base: Cove type to match floor tile type and size.
 - c. Colors: As selected by Architect from manufacturer's available colors, but for pricing purposes, Offerors may use 25 percent from the fourth most expensive price group, 25 percent from the third most expensive price group, 25 percent from the second most expensive price group, 25 percent from the least expensive price group.
 - d. Pattern(s): Factory mounted patterns as selected by Architect.
 2. Wall Tile:
 - a. Type/Size: Bright or matte glazed 4-1/4 inch by 4-1/4 inch ceramic tile, with cushion edge.
 - b. Shapes: Provide necessary trim shapes to terminate tile with a bullnose edge and rounded external corners. Provide square internal vertical corners and ceiling - wall joints. Provide built-up cove base at showers as shown or required.
 - c. Colors: As selected by Architect from manufacturer's available colors, but for pricing purposes, Offerors may use 40 percent from Price Group I, 20 percent from Price Group II, 20 percent from Price Group III, 20 percent from Price Group IV.
 - d. Pattern(s): Factory mounted patterns as selected by Architect.
- B. Mortar Adhesive: LATICRETE® 254 Platinum Thin-Set Mortar as manufactured by Laticrete International, Inc., Bethany, CT; (800) 243-4788, FlexBond Premium Flexible Bonding Mortar as manufactured by Custom Building Products, Seal Beach, CA; (562) 598-8808, (800)-933-8453, Ultraflex 3 as manufactured by Mapei Americas, Deerfield Beach, FL; (800)-426-2734. No substitutions.
- C. Grout: LATICRETE® Perma Color Select as manufactured by Laticrete International, Inc., Prism Sure Color as manufactured by Custom Building Products, Ultracolor Plus FA as manufactured by MAPEI, or Architect approved equal by any one (1) of the approved manufacturers listed above. No substitutions. Color shall be as selected by Architect from manufacturer's standard colors.
- D. Epoxy Grout (At wet areas and restroom floors & Health Care applications): Use one (1) of the following 100 percent solids epoxy grout in accordance with ANSI A118.3. No substitutions. Color shall be as selected by Architect from manufacturer's full line of available colors:
1. CEG Lite as manufactured by Custom Building Products; (562) 598-8808.

2. LATICRETE® SpectraLOCK PRO Premium Stainless Grout manufactured by Laticrete International, Inc.; (800) 243-4788.
 3. Kerapoxy CQ, Epoxy Grout manufactured by Mapei Americas; (800)-426-2734.
- E. Crack Isolation Membrane:
1. Sheet membrane used to eliminate transmission of substrate cracks from one (1) of the following approved Products/Manufacturers:
 - a. DalSIM 500EX manufactured by Dal-Tile.
 - b. Crackbuster manufactured by Custom Building Products.
 - c. Mapeguard 2 manufactured by Mapei.
 - d. Nobleseal CIS manufactured by The Noble Company.
 - e. Fracture Ban manufactured by Laticrete.
 2. Liquid membrane with fiberglass mesh from one (1) of the following approved Products/Manufacturers in accordance with ANSI A118.12:
 - a. Blue 92 manufactured by Laticrete International, Inc.
 - b. Fracturefree manufactured by Custom Building Products.
 - c. Mapelastick CI manufactured by Mapei.

2.3 THRESHOLDS

- A. White Italian Marble thresholds shall be 1/2 inch thick by 2 inches wide by required length, with double 1/4 inch bevel.

2.4 EXPANSION JOINTS

- A. Expansion Joint Filler: Flexible and compressible, closed-cell type, rounded at surface to contact sealant as instructed by sealant manufacturer to suit intended use.
- B. Silicone compound sealant over filler. ASTM C920, Uses M and A, single component, mildew resistant. Sanded to match grout. Provide at all wall corners, ceilings, control joints and changes in materials, where floor tile abuts perimeter walls, curbs, columns, and pipes; and 24 feet to 36 feet elsewhere.

2.5 MISCELLANEOUS MATERIALS

- A. Cement-based Floor Leveling Material: ARDEX K-15 Self-Leveling Underlayment Concrete manufactured by Ardex Engineered Cements, Aliquippa, PA; Ultraplan 1 Plus manufactured by MAPEI Corp., or equal. Gypsum-based products are prohibited.
- B. Transition Strips: Of type and size recommended to suit application. Color shall be as selected by Architect from manufacturer's standard colors.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examination: Examine substrates for expansion joints and defects which may affect the work. Do not start work until defects have been corrected. Ensure that surfaces are:
 1. Dry, clean, free of oily or waxy films, free of curing compounds.
 2. Firm and level within specified tolerances.
 3. Minimum of 40 degrees and rising.
- B. Tile contractor shall examine preparatory work by others and notify Architect of any imperfections which would affect a satisfactory completion of this tile work. Verify that slab is free of cracks,

waxy or oily films, and is well cured. Absence of such notification shall constitute acceptance of responsibility by tile contractor.

3.2 INSTALLATION

- A. Align joints (no staggering)
- B. Set interior floor tile and grout in accordance with TCA F113 and shower floor in accordance with TCA B415. Set marble thresholds in accordance with TCA TR611 and manufacturer's instructions.
- C. Set interior wall tile and grout in accordance with TCA W244 on tile backer cement board at wet areas, showers, and restrooms, TCA W243 on tile backer gypsum board at dry areas not exposed to water or moisture, and TCA W202 on concrete masonry unit (CMU) substrates.
- D. Allow minimum of 24 hours after tile is set before grouting.
- E. Lay out tile so that the minimum size tile used is 1/2 size.
- F. Form internal angles square.
- G. Install expansion joints in accordance with TCA publication EJ171.
- H. Slope tile within three (3) foot diameter of a floor drain, unless otherwise noted.
- I. Damp cure grout in accordance with manufacturer's recommendations.

3.3 CLEANING AND PROTECTION

- A. Clean work at completion of installation, remove excess grout from tile surfaces. Clean tile and grout surfaces prior to installation of plumbing fixtures.
- B. Wipe all tile with a clean damp cloth, and buff lightly, leaving tile surfaces clean and ready to use.
- C. Remove grout from adjacent finish surfaces.
- D. Protect finished installation until final acceptance.

END OF SECTION 09 30 13

SECTION 09 30 19 - PORCELAIN TILE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Thin set porcelain tile, mortar and grout, sealants, and accessories shown or required to complete work.

1.3 SUBMITTALS

- A. Product Data: Technical data including data sheets, installation recommendation, and recommended joint widths.
- B. Shop Drawings: Show locations of each type of tile and tile pattern.
 - 1. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples: Submit samples showing full range of color and texture variations expected.
 - 1. Full size units of each type and composition of tile and for each color and finish required.
 - 2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required; minimum 12 inches (300 mm) square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
 - 3. Waterproof membrane in 6 x 6-inch sample.
 - 4. Thresholds in 6 inch (150 mm) lengths.
- D. Test Reports: Submit test reports from qualified independent testing laboratory indicating and interpreting test results relative to compliance of tile products with requirements for slip resistance.
- E. Maintenance Instructions: Submit maintenance instructions for each type of product specified.
- F. Certifications:
 - 1. Provide Master Grade Certificate as specified in ANSI A137.1.
 - 2. Manufacturer's affidavits that materials used contain no asbestos.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Building Code: Comply with applicable requirements for the IBC for interior finishes.
 - 2. Surface Burning Characteristics: ASTM E 84; identify products with appropriate markings of applicable testing agency.
 - a. Flame Spread Index: 25 or less.
 - b. Smoke Developed Index: 450 or less.
 - 3. Accessibility Requirements: Comply with applicable requirements.
 - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
 - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.

- c. Texas Accessibility Standards (TAS) 2012.
 - B. American National Standards Institute (ANSI)
 1. Installation Specifications:
 - a. A108, Ceramic Tile Installed with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.
 - b. A108.10, Installation of Grout in Tilework.
 2. Material Specifications:
 - a. A118.4, Modified Dry Set Cement Mortar.
 - b. A118.6, Ceramic Tile Grouts.
 - c. A137.1, Ceramic Tile.
 - C. Source Limitations for Tile: Obtain tile of same type and color or finish from one source or producer. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.
 - D. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.
 - E. Source Limitations for Other Products: Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:
 1. Stone thresholds.
 2. Waterproofing.
 3. Joint sealants.
 4. Cementitious backer units.
 5. Metal edge strips.
 - F. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products. Contractor shall provide certified moisture testing results per ASTM F2170 (*Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes*) in new construction or ASTM F1869 (*Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride*) in renovations to Architect and Owner prior to floor installation. Acceptable moisture content of concrete sub floor shall be within approved manufacture limits or lower prior to installation.
 - G. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Build mockup of each type of floor tile installation.
 2. Build mockup of each type of wall tile installation.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- 1.5 DELIVERY, STORAGE, AND HANDLING**
- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
 - B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided. Store liquid materials in unopened containers and protected from freezing.

- C. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.
- B. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products.
- C. Maintain temperatures at 50 degrees F or more in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full size units equal to 10 percent of amount installed for each type, composition, color, pattern, and size indicated.
 - 2. Grout: Furnish quantity of grout equal to 10 percent of amount installed for each type, composition, and color indicated.

1.8 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 00 – Project Management and Coordination.

1.9 WARRANTY

- A. Warrant the Work specified herein for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to, the following:
 - 1. Damaged tile, including broken or chipped edges.
 - 2. Loose or missing tile.
 - 3. Noticeable deterioration or discoloring of tile or grout.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Specifications are based on products of manufacturers specified. Manufacturers listed below who produce equivalent products to those specified are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions in order to be considered.
 - 1. Porcelain Tile:
 - a. American Marazzi Tile, Inc.; (972) 226-0110.
 - b. American Olean Tile Co.; (214) 398-1411.

- c. American Tile; (713) 939-1077.
 - d. Crossville Ceramics Co.; (931) 484-2110.
 - e. Concept Surfaces; (972) 386-4900.
 - f. Dal-Tile Corp., Dallas, TX; (713) 481-5893.
 - g. Interceramic, USA; (800) 496-8453.
 - h. Trinity Surfaces.
2. Tile Setting and Grout Materials: Those manufactured by any one (1) of the following. No substitutions.
- a. Custom Building Products; (562) 598-8808.
 - b. Dal-Tile Corp.; (713) 481-5893.
 - c. Laticrete International, Inc., Bethany, CT; (800) 243-4788.
 - d. Mapei Americas; (800) 426-2734.

2.2 MATERIALS

- A. Floor Type **(PFT-1 & 2)**: 12 inches by 24 inches by 5/16 inch thick sealed porcelain tile with cushioned edge and manufacturer's standard slip resistant finish.
1. Basis of Design: Modern Oasis as manufactured by American Marazzi Tile, Inc.
 2. Color: Refer to the Drawings.
 3. Finish: Matte finish where shown on drawings or as directed by Architect.
 4. Locations: Refer to the Drawings.
 5. Shapes: Provide necessary trim shapes to terminate tile with a bullnose edge and rounded external corners. Provide square internal vertical corners and ceiling - wall joints.
 6. Base: Four (4) inch high porcelain tile base to match porcelain tile.
 7. Outside corners: To have aluminum Schluter Quadec finishing edge
 8. Borders and Patterns: As selected by Architect.
- B. Floor Type **(PFT-3)**: Sealed porcelain tile with cushioned edge and manufacturer's standard slip resistant finish.
1. Basis of Design: Forest Park as manufactured by Dal-Tile Corp.
 2. Size: To match existing.
 3. Color: Refer to the Drawings.
 4. Finish: Matte finish where shown on drawings or as directed by Architect.
 5. Locations: Refer to the Drawings.
 6. Shapes: Provide necessary trim shapes to terminate tile with a bullnose edge and rounded external corners. Provide square internal vertical corners and ceiling - wall joints.
 7. Base: Four (4) inch high porcelain tile base to match porcelain tile.
 8. Outside corners: To have aluminum Schluter Quadec finishing edge
 9. Borders and Patterns: As selected by Architect.
- C. Floor Type **(PFT-5 & 6)**: 2 inches by 2 inches by 1/4 inch thick sealed porcelain tile with cushioned edge and manufacturer's standard slip resistant finish.
1. Basis of Design: Keystones as manufactured by Dal-Tile Corp.
 2. Color: Refer to the Drawings.
 3. Finish: Matte finish where shown on drawings or as directed by Architect.
 4. Locations: Refer to the Drawings.
 5. Shapes: Provide necessary trim shapes to terminate tile with a bullnose edge and rounded external corners. Provide square internal vertical corners and ceiling - wall joints.
 6. Base: Four (4) inch high porcelain tile base to match porcelain tile.
 7. Outside corners: To have aluminum Schluter Quadec finishing edge
 8. Borders and Patterns: As selected by Architect.

- D. Floor Type **(PFT-7 & 8)**: 2 inch Hexagon, sealed porcelain tile with cushioned edge and manufacturer's standard slip resistant finish.
1. Basis of Design: Soho Unglazed Mosaics as manufactured by Crossville.
 2. Color: Refer to the Drawings.
 3. Locations: Refer to the Drawings.
 4. Shapes: Provide necessary trim shapes to terminate tile with a bullnose edge and rounded external corners. Provide square internal vertical corners and ceiling - wall joints.
 5. Base: Four (4) inch high porcelain tile base to match porcelain tile.
 6. Outside corners: To have aluminum Schluter Quadec finishing edge
 7. Borders and Patterns: As selected by Architect.
- E. Floor Type **(PFT-9)**: 12 inches by 24 inches by 5/16 inch thick sealed porcelain tile with cushioned edge and manufacturer's standard slip resistant finish.
1. Basis of Design: Exhibition as manufactured by Dal-Tile Corp.
 2. Color: Refer to the Drawings.
 3. Locations: Refer to the Drawings.
 4. Shapes: Provide necessary trim shapes to terminate tile with a bullnose edge and rounded external corners. Provide square internal vertical corners and ceiling - wall joints.
 5. Base: Four (4) inch high porcelain tile base to match porcelain tile.
 6. Outside corners: To have aluminum Schluter Quadec finishing edge
 7. Borders and Patterns: As selected by Architect.
- F. Floor Type **(PFT-10)**: 12 inches by 24 inches by 5/16 inch thick sealed porcelain tile with cushioned edge and manufacturer's standard slip resistant finish.
1. Basis of Design: Modern Linear as manufactured by Dal-Tile Corp.
 2. Color: Refer to the Drawings.
 3. Locations: Refer to the Drawings.
 4. Shapes: Provide necessary trim shapes to terminate tile with a bullnose edge and rounded external corners. Provide square internal vertical corners and ceiling - wall joints.
 5. Base: Four (4) inch high porcelain tile base to match porcelain tile.
 6. Outside corners: To have aluminum Schluter Quadec finishing edge
 7. Borders and Patterns: As selected by Architect.
- G. Wall Type **(WT-1,2, &3)**: 2 inches by 2 inches by 1/4 inch thick sealed porcelain tile with cushioned edge and manufacturer's standard slip resistant finish.
1. Basis of Design: Keystones manufactured by Dal-Tile Corp.
 2. Color: Refer to the Drawings.
 3. Locations: Refer to the Drawings.
 4. Shapes: Provide necessary trim shapes to terminate tile with a bullnose edge and rounded external corners. Provide square internal vertical corners and ceiling - wall joints.
 5. Borders and Patterns: As selected by Architect.
- H. Wall Type **(WT-4)**: Hexagon Mosaic sealed porcelain tile with cushioned edge and manufacturer's standard slip resistant finish.
6. Basis of Design: Native Metal as manufactured by Crossville.
 7. Color: Refer to the Drawings.
 8. Locations: Refer to the Drawings.
 9. Shapes: Provide necessary trim shapes to terminate tile with a bullnose edge and rounded external corners. Provide square internal vertical corners and ceiling - wall joints.
 10. Borders and Patterns: As selected by Architect.

- I. Tile Base (**TB-1 & 2**): 4 inch high sealed porcelain tile base with cushioned edge and manufacturer's standard slip resistant finish.
 1. Basis of Design: Tile Base as manufactured by Dal-Tile Corp.
 2. Color: Refer to the Drawings.
 3. Locations: Refer to the Drawings.
 4. Base: Four (4) inch high porcelain tile base to match porcelain tile.

- J. Type D: Trim and Deco Strips porcelain tile in various sizes and finishes.
 1. Color: To be selected by Architect from manufacturer's full color line.
 2. Locations: Each type shall be as shown on drawings.
 3. Borders and Patterns: As shown on drawings.

- K. Mortar Adhesive: LATICRETE® 254 Platinum Thin-Set Mortar as manufactured by Laticrete International, Inc., Bethany, CT; (800) 243-4788, FlexBond Premium Flexible Bonding Mortar as manufactured by Custom Building Products, Seal Beach, CA; (562) 598-8808, or 1300 Universal Bonding Mortar as manufactured Dal-Tile Corp., Dallas, TX; (800)-933-8453, Ultraflex 3 as manufactured by Mapei Americas, Deerfield Beach, FL; (800)-426-2734. No substitutions.

- L. Grout: LATICRETE® Tri-Poly Fortified Grout as manufactured by Laticrete International, Inc., or Architect approved equal by any one (1) of the approved manufacturers listed above. No substitutions. Color shall be as selected by Architect from manufacturer's standard colors.

- M. Epoxy Grout (At wet areas and restroom floors): Use one (1) of the following 100 percent solids epoxy grout in accordance with ANSI A118.3. No substitutions. Color shall be as selected by Architect from manufacturer's full line of available colors:
 1. ARDEX L.P., WA Epoxy Grout; (724) 203-5000.
 2. Polyblend® Tile Grout with 100 percent Solids Epoxy manufactured by Custom Building Products; (562) 598-8808.
 3. LATICRETE® SpectraLOCK PRO Stainless Grout manufactured by Laticrete International, Inc.; (800) 243-4788.
 4. Kerapoxy IEG, 100% Solids, Industrial-Grade Epoxy Grout manufactured by Mapei Americas; (800)-426-2734.

- N. Crack Isolation Membrane:
 1. Sheet membrane used to eliminate transmission of substrate cracks from one (1) of the following approved Products/Manufacturers:
 - a. Dalseal CIS manufactured by Dal-Tile.
 - b. Crackbuster manufactured by Custom Building Products.
 - c. Mapelastc SM manufactured by Mapei.
 - d. Nobleseal CIS manufactured by The Noble Company.
 - e. Tileguard manufactured by Polyguard Products, Inc.

 2. Liquid membrane with fiberglass mesh from one (1) of the following approved Products/Manufacturers in accordance with ANSI A118.12:
 - a. Blue 92 manufactured by Laticrete International, Inc.
 - b. Fracturefree manufactured by Custom Building Products.

- O. Expansion Joint:
 1. Filler: Flexible and compressible, closed-cell type, rounded at surface to contact sealant as instructed by sealant manufacturer to suit intended use.
 2. Typical Conditions except as specified below: Silicone compound sealant over filler. ASTM C920, Uses M and A, single component, mildew resistant. Sanded to match grout. Provide at all wall corners, ceilings, control joints and changes in materials, where floor tile abuts perimeter walls, curbs, columns, and pipes; and 24 feet to 36 feet elsewhere.

3. Conditions exposed to chemicals, food processing, etc.: Polysulfide sealant over filler. ASTM C920, Grade P, Class 25, Uses T and M. Polyspec Thiokol, or Architect approved equal. Self-leveling and flexible sealant over filler of type instructed by manufacturer to suit application. Sealant shall match grout color. Expansion joints shall conform to TCA EJ171.
- P. Latex Floor Leveling Material: ARDEX K-15 Self-Leveling Underlayment Concrete manufactured by ARDEX ENGINEERED CEMENTS; (724) 203-5000 or comparable product approved by Architect.
- Q. Edge Protection and Transition Strips:
 1. Porcelain Tile to Gyp. Bd.: Schluter® - QUADDEC transition strips in aluminum finish at all porcelain tile wainscot to gyp board transition locations.
 2. Porcelain Tile to Porcelain Tile: Schluter® - QUADDEC transition strips in aluminum finish at all porcelain tile wall outside corner locations.
 3. Porcelain Tile to Carpet: Schluter® - SCHIENE transition strips in aluminum finish at porcelain tile to carpet transition locations.
 4. Porcelain Tile to Sealed Concrete: Schluter® - RENO-U edge protection in satin aluminum finish at porcelain tile to sealed concrete.
 5. Stair nosing: Schluter® - TREP-E/EK.
 6. Edge Protection: Schluter® - DECO-DE. Brushed Stainless.
 7. Basis of Design: Schluter® Systems LP, Plattsburg, NY; (800) 472-4588.
 8. Provide all corners and connectors as required for a complete and detailed finished installation.

2.3 EXTRA TILE

- A. Deliver four (4) unopened boxes of tile of each color tile and base from the same tile production run to the Owner at Substantial Completion.

PART 3 - EXECUTION

3.1 PREPARATION

- A. By General Contractor:
 1. Protect surrounding work from damage or disfiguration.
 2. Vacuum clean and damp clean existing substrate surfaces.
- B. By Tile Contractor:
 1. Examine preparatory work by others and notify Architect of any imperfections which would affect a satisfactory completion of this tile work.
 2. Examine substrates defects which may affect the work. Do not start work until defects have been corrected. Ensure that surfaces are:
 - a. Free of cracks, dry, clean, free of oily or waxy films, free of curing compounds.
 - b. Well cured, firm and level within TCA specified tolerances.
 - c. Minimum of 40 degrees F and rising.
- C. Absence of such notification shall constitute acceptance of responsibility by tile contractor.

3.2 INSTALLATION

- A. Crack Isolation Membrane:
 1. Install crack isolation membrane under tile over building control joints and substrate cracks up to 1/8 inch. Apply a 30 inch wide strip centered on control joint or crack. Install in accordance with TCA F125 and manufacturer's instructions.

2. Install joint sealant in joint of first tile on both sides of control joint and crack.
 3. Install membrane with products or methods approved by membrane manufacturer when joining, sealing, fastening, or adhering sheet membranes.
- B. Install porcelain wall tile and porcelain pavers with aligned joints (no staggering), 1/8 inch to 3/16 inch joint width.
 - C. Install porcelain pavers over crack isolation membrane in locations shown on drawings in accordance with TCA F125 and ANSI A108.5 recommendations and manufacturer's instructions.
 - D. Do not use damaged porcelain tile, including those with broken or cracked edges.
 - E. Lay out all work so that, where possible, no tiles less than half size occur.
 - F. Install expansion joints in accordance with TCA publication EJ171. Install porcelain tile joints aligned with floor joints.
 - G. Install grout in accordance with ANSI A108.10 and manufacturer's instructions.
 - H. Install edge protection and transition strips in accordance with manufacturer's instructions.
 - I. Damp cure grout in accordance with manufacturer's recommendations. Clean all porcelain tile surfaces upon completion. Protect finish porcelain tile work from damage.

3.3 CLEANING AND PROTECTION

- A. Clean work at completion of installation, remove excess grout from porcelain tile surfaces. Wipe all tile with a clean damp cloth, and buff lightly, leaving tile surfaces clean and ready to use.
- B. Remove grout from adjacent finish surfaces.
- C. Protect finished installation until final acceptance.
- D. Do not permit traffic over finished floor surface.

3.4 REPAIR

- A. Repair or replace damaged porcelain tile, including those with broken or cracked edges at no expense to Owner.

END OF SECTION 09 30 19

SECTION 09 51 00 - ACOUSTICAL CEILING PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Acoustical panels.
 - 2. Concealed and exposed suspension systems for ceilings.
 - 3. Accessories necessary for a complete installation.

1.3 SUBMITTALS

- A. Product Data: Technical data for each product including installation instructions.
- B. Samples:
 - 1. Acoustic Panel: Set of 6 inch (150 mm) square samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension System Members, Moldings, and Trim: Set of 12 inch (300 mm) long samples of each type, finish, and color.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Structural members to which suspension systems will be attached.
 - 3. Size and location of initial access modules for acoustical panels.
 - 4. Items penetrating finished ceiling including but not limited to the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - 5. Perimeter moldings.
- D. Maintenance Data: Manufacturer data for finishes for inclusion in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Building Code: Comply with applicable requirements of the IBC for interior finishes.
 - 2. Acoustical Panel Standard: ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance.
 - a. Mounting Method for Measuring NRC: Plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface according to ASTM E 795.

3. Surface Burning Characteristics: Ceiling panels with surface burning characteristics complying with IBC Chapter 8 and ASTM E 1264 for Class A materials determined by testing identical products in accordance with ASTM E 84:
 - a. Flame Spread Index : 25 or less
 - b. Smoke Developed Index: 450 or less.
 4. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Source Limitations:
1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
 2. Suspension System: Obtain each type through one source from a single manufacturer.
- C. Comply with applicable regulations regarding toxic and hazardous materials.
1. Coating Based Antimicrobial Treatment: Provide acoustical panels with face and back surfaces coated with antimicrobial treatment; and showing no mold or mildew growth when tested in accordance with ASTM D3273.
 2. Panel Based Antimicrobial Treatment: Provide acoustical panels manufactured with antimicrobial treatment in the panels.
- D. Preinstallation Conference: Conduct conference at site.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension system components, and accessories to site in original, unopened packages and store in a fully enclosed, conditioned space protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, allow panels to attain room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

1.7 WARRANTY

- A. Standard Ceiling Panels: Warrant ceiling panels to be free from sagging, warping, shrinking, buckling, or delaminating as a result of manufacturing defects for a period of one (1) year from the date of Substantial Completion.
- B. Sag Resistant Ceiling Panels: warrant products to be free from sagging, warping, shrinking, buckling, or delaminating as a result of manufacturing defects for a period of fifteen (15) years from the date of Substantial Completion.

- C. Standard Suspension System: Suspension systems shall be warranted to be free from defects in material or factory workmanship and shall not incur 50 percent red rust as defined by ASTM B117 test procedures for a period of fifteen (15) years from the date of Substantial Completion.
- D. Suspension system / ceiling panels: Provide manufacturers standard fifteen (15) years warranty for suspension systems when used in combination with same manufacturers sag resistant ceiling panels. Ceiling panels to be free from sagging, warping, shrinking, buckling, or delaminating as a result of manufacturing defects. Suspension systems shall not incur 50 percent red rust as defined by ASTM b117 test during the period of the warranty, extra materials.

1.8 EXTRA STOCK

- A. Furnish extra materials matching products installed and packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Panels: Full size panels equal to five (5) percent of quantity installed or 2 full unopened containers, whichever is greater.
 - 2. Suspension System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
 - 3. Hold Down Clips: Equal to five (5) percent of quantity installed.
 - 4. Impact Clips: Equal to five (5) percent of quantity installed.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Manufacturer: Subject to compliance with requirements, provide ceiling panels and grid systems by one of the following:
 - 1. Concealed and Exposed Suspension Grid:
 - a. Armstrong World Industries, Inc.
 - b. CertainTeed Corporation.
 - c. Chicago Metallic; Rockfon (Roxul Inc.).
 - d. Hunter Douglas.
 - e. USG Interiors.
 - 2. Acoustical Ceiling Panel:
 - a. Armstrong World Industries, Inc.
 - b. CertainTeed Corporation.
 - c. Rockfon (Roxul Inc.).
 - d. Tectum Inc.
 - e. USG Interiors.
 - 3. Molding and Edge Trim:
 - a. Armstrong World Industries, Inc.
 - b. CertainTeed Corp.
 - c. Chicago Metallic Corporation.
 - d. Fry Reglet Corporation.
 - e. Gordon, Inc.
 - f. USG Interiors, Inc.; Subsidiary of USG Corporation.
 - 4. Acoustical Sealant for Exposed and Concealed Joints:
 - a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
 - b. USG Corporation; SHEETROCK Acoustical Sealant.
 - 5. Acoustical Sealant for Concealed Joints:
 - a. Henkel Corporation; OSI Pro-Series SC-175 Acoustical Sound Sealant.

b. Pecora Corporation; AIS-919.

- B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.2 METAL SUSPENSION SYSTEM

- A. Metal Suspension System: Direct hung metal suspension systems of types, structural classifications, and finishes indicated complying with applicable requirements in ASTM C 635/C 635M.
1. High Humidity Finish: Comply with ASTM C 635/C 635M requirements for *Coating Classification for Severe Environment Performance* where high humidity finishes are indicated.
 2. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1 *Direct Hung*, unless otherwise indicated. Comply with seismic design requirements.
 - a. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
 - 1) Type: Cast in place, postinstalled expansion or postinstalled bonded anchors.
 - 2) Corrosion Protection: Carbon steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
 - 3) Corrosion Protection: Stainless steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
 - 4) Corrosion Protection: Components fabricated from nickel copper alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.
 - b. Power Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.
 3. Wire Hangers, Braces, and Ties:
 - a. Zinc Coated, Carbon Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - b. Stainless Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
 - c. Nickel Copper Alloy Wire: ASTM B 164, nickel copper alloy UNS No. N04400.
 - d. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1 Direct Hung) will be less than yield stress of wire, but provide not less than 0.106 inch (2.69 mm) diameter wire.
 4. Hanger Rods and Flat Hangers: Mild steel, zinc coated or protected with rust inhibitive paint.
 5. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04 inch (1 mm) thick, galvanized steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16 inch (8 mm) diameter bolts.

6. Hold Down Clips: Provide hold down clips spaced 24 inches (610 mm) o.c. on all cross tees in areas with exterior opening larger than 48" x 96".
 7. Impact Clips: Provide impact clip system designed to absorb impact forces against acoustical panels in Gymnasiums.
 8. Aluminum cap for use over steel grid in kitchen areas or where shown on drawings or required.
- B. Metal Suspension Systems:
1. Wide Face, Steel Capped, Double Web, Steel Suspension System: Main and cross runners roll formed from cold rolled steel sheet; prepainted, electrolytically zinc coated, or hot dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation; with prefinished 15/16 inch (24 mm) wide metal caps on flanges.
 - a. Structural Classification: Heavy duty system.
 - b. Face Design: Flat, flush.
 - c. Cap Finish: Color selected by Architect.
 - d. Corrosion resistant.
 2. Narrow Face, Steel Capped, Double Web, Steel Suspension System: Main and cross runners roll formed from cold rolled steel sheet; prepainted, electrolytically zinc coated, or hot dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation; with prefinished, cold rolled, 9/16 inch (15 mm) wide metal caps on flanges.
 - a. Structural Classification: Intermediate-duty system.
 - b. Face Design: Flat, flush.
 - c. Cap Finish: Color selected by Architect.
 - d. Corrosion resistant.

2.3 ACOUSTICAL PANELS

- A. Acoustic Panel Type **ACT-1**: (Standard):
1. Basis of Design Product: Matching existing products as manufactured by Armstrong World Industries.
 2. Color: White.
 3. Modular Size: 24 by 24 inches (610 by 610 mm).
 4. Humidity/ Sag Resistance: The resistance of interior coatings to mold and mildew growth is useful in estimating the performance of coatings designed for use in interior environments that promote mold growth and in evaluating compounds that may inhibit such growth and the aggregate levels for their use when tested according to ASTM D 3273.

2.4 MOLDING, TRIM AND ACCESSORIES

- A. Shadow Molding: Where an acoustical lay in ceiling abuts a gypsum board ceiling in the same plane, provide a "W" shaped reveal or "shadow" molding similar to Armstrong Shadow Molding No. 7873.
- B. Roll Formed, Sheet Metal Edge Moldings and Trim: Type and profile for standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color used for exposed flanges of suspension system runners.
1. Provide edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
 2. For lay in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
 3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

- C. Extruded Aluminum Edge Moldings and Trim: Where indicated, provide extruded aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements and the following:
 - 1. Aluminum Alloy: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of aluminum extrusions complying with ASTM B 221 (ASTM B 221M) for Alloy and Temper 6063-T5.
 - 2. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
 - 3. Baked Enamel or Powder Coat Finish: Minimum dry film thickness of 1.5 mils (0.04 mm). Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

- D. Acoustical Sealant: Comply with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 - 1. Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant.
 - 2. Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic rubber sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut for compliance with requirements specified that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

- C. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less than half width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA *Ceiling Systems Handbook*.
 - 1. Fire Rated Assembly: Install fire-rated ceiling systems according to tested fire rated design.

- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers where required and, if permitted with fire resistance rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast in place hanger inserts, postinstalled mechanical or adhesive anchors, or power actuated fasteners that extend through forms into concrete.
 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 8. Do not attach hangers to steel deck tabs.
 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast in place or postinstalled anchors.
- D. Panel Accessibility: Install panels downward accessible by disengaging hinge support rail on one side of panel from the T Bar Flange or optional A Mount rail flange without the use of tools, for access without removal of panel from the ceiling.
- E. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- F. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- G. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. Arrange directionally patterned acoustical panels with pattern running in one direction parallel to long axis of space.
 2. For square edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.

3. For reveal edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
4. For reveal edged panels on suspension system members with box shaped flanges, install panels with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.
5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
6. Install hold-down clips in areas indicated, in areas with exterior opening larger than 48" x 96", where required by authorities having jurisdiction; space as recommended by panel manufacturer's written instructions unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections: Compliance of seismic design.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.
- C. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations show compliance with requirements.
 1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
 - a. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.
 - b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
- D. Acoustical panel ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.5 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 00

SECTION 09 62 33 - RUBBER SPORT FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's technical data and specifications for flooring.
 - 2. Manufacturer's storage, installation, and finishing instructions.
 - 3. Manufacturer's maintenance instructions.
- B. Samples:
 - 1. Flooring:
 - a. Actual samples of specified flooring in adequate size in manufacturer's complete color and finish range for Architect's selection and approval.
 - b. Actual specified flooring in color and finish selected and approved by Architect.
 - c. Approved color and finish sample will be basis for which work will be judged.
- C. Certification: Manufacturer's affidavit that materials used in contain no asbestos.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Flooring contractor shall not deliver products to jobsite until the work of other trades have been completed (especially overhead trades).
- B. Store flooring products in accordance with manufacturer's recommendations.

1.4 PROJECT / SITE CONDITIONS

- A. Environmental Requirements: The building shall be dry and enclosed. Permanent heat, light and ventilation shall be installed and operable. Flooring installation shall not begin until the installer is familiar with existing subfloor conditions. All work which would cause damage, dirt, dust or interruption of normal installation pace shall be completed at least one (1) week prior to and during installation the room temperature must be maintained at a minimum of 65 degrees F. The installation area shall be closed to all traffic and activity for a period to be set by the flooring contractor.

1.5 QUALITY ASSURANCE

- A. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products. Contractor shall provide certified moisture testing results per ASTM F2170 (*Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes*) to Architect and Owner prior to floor installation. Acceptable moisture content of concrete sub floor shall be within approved manufacture limits or lower prior to installation.

1.6 SPECIAL WARRANTY

- A. Warrant the work specified herein for two (2) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to the following:
 - 1. Shrinking, cracking, or otherwise deteriorating excessively.
 - 2. Becoming loose from substrate.
 - 3. Failure due to unusual exposure to moisture or other abusive forces or elements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER/PRODUCT

- A. Specifications are based on Revolution by Regupol America, LLC.. Other manufacturer's must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 01 requirements for substitutions to be considered.

2.2 MATERIALS

- A. Leveling Compound: As approved by manufacturer to correct minor subfloor deviations.
- B. Adhesive: Water-resistant type recommended and supplied by flooring manufacturer.
 - 1. VOC Content: Not more than 60 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Flooring (RSF-1):
 - 1. Roll Dimension Size: As indicated on the Drawings.
 - 2. Gauge (Thickness): 3/8 inch
 - 3. Color/Patterns: As selected by Architect from manufacturer full range.
 - 4. Physical Properties:
 - a. Hardness - Shore A - (ASTM D2240) 60 plus or minus 5 pts
 - b. Tear Strength (ASTM D624) 70 pli min.
 - c. Flexibility, 1/4 inch mandrel (ASTM D412) Pass.
 - d. Tensile Strength (ASTM D412) > 200 PSI.
 - e. Elongation (ASTM D412) > 145%
 - f. Coefficient of Friction (ASTM D2047) > 0.96
- D. Reducer Strip: Provide reducer strips at edges as required for juncture with adjacent floor surfaces of type and size recommended by manufacturer.
- E. Resilient Base: Furnished under Section 09 65 13.
- F. Provide other materials, not specifically described but required for a complete and proper installation.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.
- B. Before beginning installation, verify that the subfloor is properly cured, clean and dry.

3.2 PREPARATION

- A. Subfloors:
 - 1. Verify that substrate is smooth, level, at required finish elevation, and without more than 1/8 inch in 10 feet-0 inches variation from level or slopes shown on the Drawings.
 - 2. Prior to laying materials, broom clean or vacuum the surfaces to be covered, and inspect the subfloors.

3.3 INSTALLATION

- A. Install flooring in accordance with flooring manufacturer's instructions.
- B. Install flooring using manufacturer's recommended freshly applied adhesive.
- C. Install all accessories as recommended in flooring manufacturer's installation manual.

3.4 CLEANING AND PROTECTING

- A. Upon completion of work herein, clean all finish flooring surfaces so they are free of foreign matter.
- B. Remove all excess and waste materials from the area of work.
- C. Protect the finish work until acceptance by the Owner.

END OF SECTION 09 62 33

SECTION 09 64 66 - WOOD GYMNASIUM FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide gymnasium flooring, with sanding and finishing of flooring at each area, game lines, and accessories to complete work as shown on drawings or required.

1.3 RELATED WORK

- A. Section 03 30 00 - Cast-in-place Concrete.
- B. Section 06 10 00 - Rough Carpentry.
- C. Section 11 66 23 - Gymnasium Equipment; floor inserts.

1.4 REFERENCES

- A. American Plywood Association (APA)
- B. Maple Flooring Manufacturers Association, Inc. (MFMA)

1.5 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's technical data, specifications and instructions for each type of wood flooring.
 - 2. Manufacturer's storage, installation, and finishing instructions.
 - 3. Manufacturer's maintenance instructions.
- B. Shop Drawings: Submit gym floor court game line layout, and floor insert locations for Architect's approval.
- C. Samples:
 - 1. Flooring:
 - a. Samples of specified flooring in adequate size, in manufacturers complete color and finish range, for Architect's selection and approval.
 - b. 12 inch x 12 inch sample of actual specified flooring in color and finish selected and approved by Architect.
 - c. Approved color and finish sample will be basis for which work will be judged.
 - 2. Wall Base:
 - a. Six (6) inch long samples of each actual specified wall base in manufacturer's complete color range for Architect's selection and approval.
 - 3. Aluminum Coverplate:
 - a. Six (6) inch long samples of actual specified aluminum coverplate at gymnasium floor transitions in manufacturer's complete color range for Architect's selection and approval.

- D. Evidence of installer's qualifications if not manufacturer.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in installing flooring systems of the type specified for this Project, with a minimum of five (5) years experience and approved by manufacturer.
- B. Uniformity: To maximum extent possible, obtain flooring materials from one manufacturer to ensure uniformity of quality and color.
- C. Verify, document, and notify architect of moisture content of maple and plywood prior to installation and finishing. Moisture content of maple and plywood must comply with Manufacturers guidelines given the geographical area and job site conditions prior to installation.
- D. Before starting installation verify, document and notify architect of moisture content of concrete slab. Do not commence with installation if concrete slab exceeds 4.5 pounds per 1000 square feet. Calcium Chloride tests are to be done in accordance with ASTM. Correction of substrate moisture issues and additional testing shall be the responsibility of the General Contractor.
- E. Manufacturer's representative shall be notified prior to commencement of flooring installation, and offered the opportunity to visit the site during flooring installation to supervise and provide training if requested by the Contractor, Manufacturer, Owner, or Architect.
- F. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products. Contractor shall provide certified moisture testing results per ASTM F2170 (*Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes*) to Architect and Owner prior to floor installation. Acceptable moisture content of concrete sub floor shall be within approved manufacture limits or lower prior to installation.

1.7 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 00 – Project Management and Coordination.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Do not deliver materials until all masonry, plastering, tile, marble and terrazzo work is completed, and overhead mechanical trades and painters have finished in wood floor area.
- B. Flooring materials must be allowed to acclimate to building conditions on the job site in a dry, well-ventilated area, not in contact with concrete or masonry seven (7) days minimum prior to final placement.

1.9 PROJECT CONDITIONS

- A. General contractor is to provide the following: The building must be dry and all openings must be closed in. Permanent heat, light and air conditioning shall be installed and operating a week prior to, during and after installation, maintaining a temperature range of 65 degrees F to 75 degrees F. Humidity conditions within the building shall

approximate humidity conditions which will prevail when building is occupied, but shall not be allowed to fall below 35 percent or be higher than 50 percent.

1.10 COORDINATION

- A. Verify and coordinate concrete slab depression prior to pouring of slab to ensure appropriate height determined by manufacturer and flooring system provided.
- B. Coordinate Work of this Section with work built-in or penetrating flooring, such as inserts (sleeves) for volleyball equipment, etc. as indicated on the Drawings or as noted herein.

1.11 WARRANTY

- A. Warrant the work specified herein for three (3) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
- B. Defects shall include, but not be limited to the following:
 - 1. Shrinking, warping, cracking, chipping, splitting, or deteriorating excessively.
 - 2. Becoming loose from.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Connor Sports Flooring Corporation, Amasa, MI; ("NeoShok" with Neoshok pads). Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.
 - 1. Wood Flooring:
 - a. Action Floor Systems, LLC., Mercer, WI; ("ProAction Thrust" with ProAction resilient pads).
 - b. Horner Flooring Co., Dollar Bay, MI; ("SAFE" panel system with SAFE pads).
 - c. Aacer Flooring LLC, Peshtigo, WI; ("AnchorFlex" with BioPower resilient pads).
 - d. Robbins Sports Surfaces Inc. Cincinnati, OH, BioCushion with BioCushion pads.

2.2 MATERIALS

- A. Flooring: 23/32 inch thick by 2-1/4 inches wide, northern hard maple Second & Better; continuous tongue and groove, end-matched RL or FJ, kiln dried, MFMA grade marked.
- B. Sub-floor: two continuous layers of engineered 3-ply (minimum) 15/32 inch (4 feet by 8 feet) APA structural rated plywood sheathing, CDX Exterior Grade, stapled and adhered together with construction adhesive using Box X pattern.
- C. Resilient Cushion/Pads: 3/4 inch high, EPDM, (poly)urethane, natural rubber, or Architect's approved equivalent; 55-70 durometer for primary use as basketball court with multi-use capabilities as instructed by manufacturer. PVC is not acceptable.
- D. Vapor Barrier: Refer to Section 03 30 00 – Cast In Place Concrete.

- E. Fasteners:
 - 1. Subfloor: One (1) inch length with 7/16 inch crown, coated staples as recommended by the manufacturer.
 - 2. Flooring: Two (2) inch barbed cleats or 15 gauge coated staples as recommended by the manufacturer.
- F. Wall Base: Three (3) inch by Four (4) inch vented cove base with premolded outside corners, color: Black.
- G. Finish: Transparent water based polyurethane finish.
- H. Accessories:
 - 1. Adhesive: Type recommended by manufacturer to adhere layers of plywood subfloor.
 - 2. Tape: 4 inch wide type recommended by manufacturer for sealing vapor barrier edges.
 - 3. Floor inserts (sleeves): See Section 11 66 23 – Gymnasium Equipment, of types shown on drawings or required.
 - 4. Continuous Extruded Aluminum Threshold/Sill Plates: C/S Group, Div. of Conspec Systems, Inc., Muncy, PA (717) 546-5941 (“Model No. GYMF”), or equal by Pemko Manufacturing Co., or National Guard Products, Inc., (NGP); of size and shape as indicated on drawings or required.

2.3 EXTRA STOCK

- A. Replacement Material: At completion of work, deliver and store at site as directed by Architect not less than two (2) percent of the quantity of wood flooring material installed.

PART 3 - EXECUTION

3.1 CONCRETE SLAB PLACEMENT

- A. Concrete subfloors on or below grade shall be adequately waterproofed beneath and at the perimeter of the slab and on the earth side of below grade walls by concrete contactor. Sand-poly-sand slab construction is not an acceptable construction. Provide under slab vapor barrier per section 03 30 00 – Cast-in-Place Concrete.
- B. General contractor is to provide concrete slab in acceptable condition by grinding down high areas and filling low areas with approved leveling compound.
- C. Acceptable concrete tolerance: 1/8 inch in 10 foot radius, steel troweled.
- D. Inspect concrete slab for proper tolerance, dryness, and depression, and report any discrepancies for correction.
- E. Do not begin work until discrepancies are corrected.

3.2 PREPARATION

- A. General contractor to clean concrete slab of all debris so flooring contractor will have adequate access to work surface.
- B. Commencement of work shall mean acceptance of existing conditions.

3.3 INSTALLATION

- A. General: Moisture content of maple and plywood must comply with Manufacturers guidelines given the geographical area and job sight conditions prior to installation.
- B. Vapor Barrier: Cover concrete slab with vapor barrier, lapping edges a minimum of six (6) inches and sealing with adhesive or tape.
- C. Subfloor:
 - 1. Install cushion pads at 12 inches on center on underside of lower plywood subfloor, as required by manufacturer.
 - 2. Install the lower plywood subfloor perpendicular to the intended floor finish direction. All joints to be staggered and spaced 1/4 inch apart.
 - 3. Install the upper plywood subfloor diagonal to the lower subfloor panels staggering joints and spacing 1/4 inch apart. Secure these panels using adhesive and 1 inch staples placed 6 inch on center at panel perimeter and 12 inch on center throughout field interior.
 - 4. Machine nail maple finish flooring with end joints properly driven up and proper spacing provided for humidity conditions in specific regions. Provide expansion voids at the perimeter and at all vertical obstructions.
- D. Finish Flooring:
 - 1. Install finish flooring in accordance with MFMA and manufacturer's instructions.
 - 2. Machine nail finish flooring.
 - 3. End joints must be properly driven up and proper spacing provided for the humidity conditions of the area as recommended by the installer.
 - 4. Provide two (2) inch expansion voids at the perimeter and at all vertical obstructions.
 - 5. Provide 1/16" expansion rows every 2' or 1/64 milled expansion at every board.
- E. Floor inserts (sleeves):
 - 1. Install per manufacturers instructions in locations indicated or required. Finish plate to be installed after floor finishing providing flush, recessed plate with no jagged or offset edges.

3.4 FLOOR SANDING

- A. Sanding shall be in accordance with MFMA and manufacturer's procedures.
- B. Machine sand with coarse, medium and fine paper to a smooth, even and uniform surface.
- C. Remove sanding dust from entire surface by tack or vacuum.

3.5 FINISHING

- A. Inspect entire area of floor to insure that surface is acceptable for finishing, completely free from sanding dust and perfectly clean.
- B. Apply one (1) coat of sealer and three (3) coats of finish in accordance with MFMA and manufacturer's instructions.
- C. Buff and clean floor between each coat.
- D. Paint game lines as shown on drawings or required, between sealer and first coat of finish.

3.6 ACCESSORIES

- A. Install base anchoring to walls with base cement or screws and anchors in accordance with manufacturer's instructions. Neatly miter inside corners. Use pre-molded outside corners.
- B. Install coverplates at floor finish transitions in accordance with manufacturer's instructions.

3.7 MAINTENANCE

- A. Upon completion of floor installation, the Owner's maintenance staff, responsible for the upkeep of the building, is to be trained in the proper care and maintenance of the flooring in accordance with instructions of the MFMA and manufacturer.

END OF SECTION 09 64 66

SECTION 09 65 13 - RESILIENT BASE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Rubber base
 - 2. Accessories necessary for a complete installation.

1.3 SUBMITTALS

- A. Product Data: Technical data for each type of product including manufacturer's installation instructions.
- B. Samples: Sample of Base Selected or Color Chart if none selected.
- C. Maintenance Data: Submit for inclusion in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Entity having minimum 5 years documented experience who employs workers competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store base and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 degrees F (10 degrees C) or more than 85 degrees F (29 degrees C). Store floor tiles on flat surfaces.

1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 degrees F (21 degrees C) or more than 85 degrees F (29 degrees C), in spaces to receive floor tile during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 degrees F (13 degrees C) or more than 95 degrees F (35 degrees C).
- C. Close spaces to traffic for 48 hours after installation.

1.7 EXTRA STOCK

- A. Furnish extra materials matching products installed and packaged with protective covering for storage and identified with labels describing contents.
 - 1. Resilient Base: 1 percent of quality installed or 2 full unopened containers, whichever is greater.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Basis of Design (**RB-1**): Roppe. Other manufacturers are subject to compliance with requirements or comparable product by one of the following:
 - 1. Flexco Floors.
 - 2. Johnsite, a division of Tarkett Group.
 - 3. Mannington Commercial.
- B. Rubber Base: ASTM F1861.
 - 1. Material: Rubber, vulcanized, Type TS, Group I, Styles A and B.
 - 2. Manufacturing Method: Group I (solid, homogeneous).
 - 3. Style: Topset cove; minimum 100 foot coil, cut to length required.
 - 4. Minimum Thickness: 0.125 inch (3.2 mm).
 - 5. Color: Refer to the Drawings.
 - 6. Height: 4 inches, unless indicated otherwise.
 - 7. Outside Corners: Job formed.
 - 8. Inside Corners: Job formed.
- C. Adhesives: Water resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for maximum moisture content and other conditions affecting performance of the work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified for other work and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- B. Proceed with installation after correcting unsatisfactory conditions. Installation of resilient flooring and accessories indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Immediately before installation, sweep clean substrates to be covered by resilient base.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for installing flooring. Scribe and cut flooring to butt neatly and tightly to vertical surfaces, permanent fixtures, and built in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Extend flooring into toe spaces, door reveals, closets, and similar openings.

- B. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on flooring as marked on substrates. Use chalk or other nonpermanent marking device.

- C. Resilient Base: Comply with manufacturer's written instructions for installing resilient base. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
 - 1. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
 - 2. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
 - 3. Do not stretch resilient base during installation.
 - 4. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
 - 5. Preformed Corners: Install preformed corners before installing straight pieces.
 - 6. Job Formed Corners:
 - a. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
 - b. Form without producing discoloration (whitening) at bends.
 - c. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
 - 1) Miter or cope corners to minimize open joints.

END OF SECTION 09 65 13

SECTION 09 65 16 – VINYL SHEET FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Resilient sheet vinyl flooring

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Manufacturer Certifications:
 - 1. Provide certification that accurately identifies the Original Equipment Manufacturer (OEM) of flooring furnished for this project including manufacturer's name, address and factory location.
 - a. Suppliers of Private-Label flooring for this project must identify themselves as such and fully disclose the OEM information listed above.
 - b. All "manufacturer" requirements in these specifications must be complied with by the OEM, including warranties, certifications, qualifications, product data, test results, environmental requirements, performance data, etc.
 - 2. Provide ISO 9001 certification for the OEM of the specified products.
 - 3. Provide ISO 14001 certification for the OEM of the specified products.
- C. Shop Drawings: Showing installation details and locations of borders, patterns, locations of floor inserts and seams.
- D. Samples:
 - 1. Manufacturer's color chart for selection of available floors
 - 2. Color samples:
 - a. Samples to be a minimum of 4" x 8"
- E. Qualification Data:
 - 1. For a qualified resilient flooring Manufacturer.
 - 2. For a qualified resilient flooring Installer.
- F. Submit three copies of the following:
 - 1. Manufacturer maintenance instructions.
 - 2. Manufacturer material warranty.
 - 3. Installer installation warranty.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. ISO 9001 Certified.
 - 2. ISO 14001 Certified.
 - 3. At least ten years active experience in the manufacture and marketing of commercial resilient flooring.

4. A provider of authorized installer training.
- B. Installer Qualifications:
 1. At least five years experience in the installation of resilient flooring.
 2. Experience on at least five projects of similar size, type and complexity as this project.
 3. Employer of workers for this Project who are competent in techniques required by manufacturer for resilient flooring installation indicated.
- C. Fire Test Characteristics: As determined by testing identical products according to ASTM E 648, Class 1, by a qualified testing agency acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store flooring and installation materials in protected dry spaces, with ambient temperatures maintained within range recommended by manufacturer, but not less than 55 deg F (13 deg C) nor more than 85 deg F (29 deg C).
- B. Store the indoor resilient surfacing rolls in an upright position on a smooth flat surface immediately upon delivery to Project.

1.6 FIELD CONDITIONS

- A. Product Installation:
 1. Maintain temperatures during installation within range recommended by manufacturer, but not less than 65 deg F (18 deg C) and 85 deg F (29 deg C) in spaces to receive flooring one week before installation, during installation, and thereafter installation.
 2. After installation, maintain temperatures within range recommended by manufacturer, but not less than 65 deg F (18 deg C) or more than 85 deg F (29 deg C).
 3. Prohibit traffic during flooring installation and for at least 48 hours after flooring installation.
- B. Install flooring only after all other trades, including painting and overhead work, has been completed.

1.7 WARRANTY

- A. Special Limited Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace flooring that fails within specified warranty period.
 1. Material warranty must be direct from the product manufacturer.
 - a. Material warranties from separate or third-party insurance providers are not valid.
 - b. Material warranties from private label distributors are not valid.
 2. Failures include, but are not limited to, the following:
 - a. Material manufacturing defects.
 - b. Surface abrasion and deterioration to the point of wear-through where normal foot and wheeled traffic is occurring or where the material is being properly maintained
 - c. Failure due to substrate moisture not exceeding 90% relative humidity (RH) (when tested in accordance with ASTM F2170) or 8 pounds moisture vapor emission rate (MVER) (when tested in accordance with ASTM F1869).
 3. Warranty Period:
 - a. For materials: 2 years from date of Substantial Completion.
 - b. For surface wear: 10 years from date of Substantial Completion.
 - c. For moisture vapor tolerance: 1 year from date of Substantial Completion.

- B. Special Limited Warranty: Installer's standard form in which installer agrees to repair or replace flooring that fails due to poor workmanship or faulty installation within the specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

1.8 COORDINATION

- A. Coordinate layout and installation of flooring with other equipment.

PART 2 - PRODUCTS

2.1 COMMERCIAL SHEET VINYL FLOORING

- A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide Gerflor Premium Compact
 - 1. Gerflor Premium Compact is a 6'6" wide multilayered sheet flooring that features a 40mil (1mm) homogeneous wearlayer made of 100% pure vinyl colored chips densely pressed. Its construction is reinforced with a fiberglass grid and supported by a 100% recycled compact backing. Featuring the UV and laser cured Evercare surface treatment to provide best chemical & stain resistance and a No Wax for Life surface. Flooring installed with full-spread standard adhesive.
- B. Substitution Limitations:
 - 1. All other manufacturers: Submit formal substitution request prior to bid in accordance with Section 01 25 00 - "Substitution Procedures".
 - 2. Approval by Architect of other manufacturers does not relieve Contractor of responsibility to provide products which comply with all requirements of this specification.
- C. Product Description: Resilient vinyl sheet floor covering with backing complying with ASTM F1303.
 - 1. Overall Thickness: 0.08 inch (2.0 mm)
 - 2. Homogeneous top layer: 40 mil pure colored wearlayer
 - 3. Roll Size:
 - a. Roll Width: 6'-6" wide.
 - b. Roll Length: 60 feet.
 - 4. Seaming Method: Heat welded.
 - 5. Adhesive Method:
 - a. Full-spread adhesive to completely adhere flooring to substrate.
 - b. Complete adhesive coverage to eliminate the possibility of gaps or space between the slab and flooring material where moisture could accumulate and create an environment conducive to mold growth.
 - c. Flooring to be adhered to the concrete slab in all locations eliminating the possibility of waves or wrinkles forming caused by the floor shifting, moving or by rolling loads displacing it.
 - 6. 100% REACH Compliant.
 - 7. Applied Finish: Manufacturer's, factory-applied, permanent, laser and UV-cured.
 - a. No-Wax finish: Published product literature identifying factory applied finish as, "No-Wax, Just clean and rinse"
 - b. Basis-of-Design Product: Gerflor Evercare
 - 8. Field-Applied Finishes: None required.
 - 9. Color and Pattern:

- a. As selected by Owner from manufacturer's standard colors and patterns.

D. Performance Criteria:

1. Meets ASTM F1303 for resilient / vinyl sheet flooring: Type 1 Grade 1 Class B
2. Meets ASTM F970 static load limit or better: less than 0.005"
3. Meets ASTM F1914 or better: less than 0.012"
4. Provides excellent results for Chemical & Stain Resistance: ASTM F925
5. Impact Insulation Class: (ASTM E989) 40dB
6. Fire Performance: ASTM E 648; Class 1
7. Slab Moisture Design Tolerance: See type of adhesives at 2.2 Accessories.

2.2 ACCESSORIES

- A. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by the flooring manufacturer.
- B. Adhesives: Acrylic type recommended by flooring manufacturer for substrate and conditions indicated.
 - a. Basis-of-Design Product: Gerflor Gerfix Spray.
 - b. Coverage Type: Full-surface application.
 - c. Maximum relative humidity of 95% when tested in accordance with ASTM F 2170.
 - d. Maximum moisture vapor emission rate of 8 pounds per 1000 sq. ft. in 24 hours when tested in accordance with ASTM F1869.
- C. Heat Welding Rod: As supplied by indoor flooring manufacturer. Color shall blend with resilient flooring color.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify the Following:
 1. The area in which the indoor resilient flooring will be installed is dry, weather-tight and in compliance with specified requirements.
 2. Permanent heat, lighting and ventilation systems are installed and operable.
 3. Other work, including overhead work, that could cause damage, dirt, dust or otherwise interrupt installation has been completed or suspended.
 4. No foreign materials or objects are present on the substrate and that it is clean and ready for preparation and installation.
 5. Tests to verify that the moisture vapor emission rate or substrate relative humidity is within the specified ranges.
 6. The concrete slab surface pH level is within the specified range.
 7. The surface of concrete floors shall be flat to within the equivalent of 3/16 in. (3.9 mm) in 10 ft (as described in ACI 117R).
 8. The concrete slab complies with ACI 302.2R for concrete design including use of a low-permeance vapor barrier directly beneath the concrete subfloor with sealed penetrations.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written recommendations to ensure proper adhesion of resilient flooring system.
- B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of sealers, curing compounds and other additives. Remove coatings and other substances that are incompatible with adhesives using mechanical methods recommended by manufacturer.
 2. Alkalinity Testing: Perform pH testing according to ASTM F 710. Proceed with installation only if pH readings are between 7.0 and 11.
- C. Moisture Testing: Perform ASTM F 2170 relative humidity test; proceed with installation only after it is confirmed that the concrete relative humidity does not exceed 90% (TPS+) or 95% (Gerfix Spray) RH. Or perform ASTM F 1869 calcium chloride test and proceed with installation only after substrates have maximum moisture-vapor-emission rate of 8 lb/1000 sq. ft. in 24 hours
- D. Use cementitious based leveling and patching compound with the same moisture vapor tolerance as the adhesive to fill depressions, holes, cracks, grooves or other irregularities in substrate.
- E. Place flooring and installation materials into spaces where they will be installed at least 48 hours before installation. Install flooring materials only after they have reached the same temperature as space where they are to be installed.
- F. Prepare the surface per ASTM F710.
- G. Sweep and then vacuum substrates immediately before installation. After cleaning, examine substrate for moisture, alkaline salts, grit, dust or other contamination. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 VINYL SHEET FLOORING INSTALLATION

- A. General:
1. Comply with resilient flooring manufacturer's installation instructions.
 2. Take necessary precautions to minimize noise, odors, dust and inconvenience during installation.
 3. Fit flooring neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.
 4. Extend flooring into toe spaces, door reveals, closets, and similar openings unless otherwise indicated.
- B. Lay out flooring as follows:
1. Minimize number of seams and place them inconspicuous areas.
 2. Locate seams as shown on approved Shop Drawings
- C. Adhered Flooring to substrates using a full surface application of adhesive to the substrate to comply with adhesive and flooring manufacturer instructions.
- D. Vinyl Sheet Flooring Seams: Finish seams to produce surfaces flush with adjoining flooring surfaces. Comply with ASTM F 1516. Rout joints and use heat welding rod to permanently and seamlessly fuse sections together.

3.4 CLEANING AND PROTECTION

- A. Perform cleaning 72 hours after completing resilient flooring installation:
1. Remove marks and blemishes from flooring surfaces.
 2. Sweep and then vacuum flooring.
 3. Damp-mop flooring to remove soiling.

- B. Protect flooring from abrasions, indentations, and other damage from subsequent operations and placement of equipment, during remainder of construction period.

END OF SECTION 09 65 16

SECTION 09 65 19 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Vinyl composition floor tile.
 - 2. Accessories necessary for a complete installation.

1.3 RELATED SECTIONS

- A. Section 09 65 13 – Resilient Base.

1.4 REFERENCES

- A. ASTM F 710: Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- B. ASTM E 648: Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.
- C. ASTM E 662: Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
- D. ASTM F 1869: Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- E. ASTM F 2170: Determining Relative Humidity in Concrete Floor Slabs Using in Situ Probes.

1.5 SUBMITTALS

- A. Product Data: Technical data for each type of product including manufacturer's installation instructions.
- B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built in furniture, cabinets, and cutouts.
 - 1. Show details of special patterns.
- C. Samples: Full size units of each color and pattern of floor tile required.
 - 1. Vinyl Composition Tile (VCT) flooring 12 inch by 12 inch (300 mm by 300 mm) tile in each color selected and 12 inch long piece of base material in each color selected for approval.
 - 2. Luxury Vinyl Tile (LVT) flooring: 18 inch by 18 inch (460 mm by 460 mm) tile in each color selected and 12 inch long piece of base material in each color selected for approval.
- D. Product Schedule: Submit for floor tile using same designations indicated on Drawings.
- E. Maintenance Data: Submit for inclusion in maintenance manuals.
- F. Reports: Certified Moisture Testing Results.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Fire Test Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - a. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
 - b. Smoke Density: Maximum specific optical density of 450 per ASTM E 662 or NFPA 258.
 - 2. Accessibility Requirements: Comply with applicable requirements.
 - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
 - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
 - c. Texas Accessibility Standards (TAS) 2012.
- B. Installer Qualifications: Entity having minimum 5 years documented experience who employs workers competent in techniques required by manufacturer for floor tile installation and seaming method indicated.
- C. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products. Contractor shall provide certified moisture testing results per ASTM F2170 (*Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes*) to Architect and Owner prior to floor installation. Acceptable moisture content of concrete sub floor shall be within approved manufacture limits or lower prior to installation.
- D. Source Limitations:
 - 1. Tile: Obtain floor products of same type and color or finish from one source or producer. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.
 - 2. Setting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 degrees F (10 degrees C) or more than 85 degrees F (29 degrees C). Store floor tiles on flat surfaces.

1.8 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 degrees F (21 degrees C) or more than 85 degrees F (29 degrees C), in spaces to receive floor tile during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 degrees F (13 degrees C) or more than 95 degrees F (35 degrees C).
- C. Close spaces to traffic during floor tile installation.

- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Where demountable partitions, cabinets, and similar items are indicated for installation on top of resilient tile flooring, install tile before these items are installed.
- F. Do not install flooring over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive, as determined by flooring manufacturer's recommended bond and moisture test.
- G. Install flooring after other finishing operations, including painting, have been completed.

1.9 WARRANTY

- A. Manufacturer warrants that the resilient products will not wear through the wear layer from normal foot traffic for a period of twenty (20) years from the date of invoice. Wear is defined as completely wearing through the enhanced urethane, wear layer and impacting the print layer.
- B. Acceptable Manufacturer Warranties will not require special conditions to maintain Warranty including, but not limited to, the following:
 - 1. Polish at any time of the warranty
 - 2. rH% below 99%
- C. Defects shall include, but not be limited to, the following:
 - 1. Damaged tile, including broken or chipped edges.
 - 2. Loose or missing tile.
 - 3. Noticeable deterioration or discoloring of tile or grout.

1.10 WARRANTY

- D. Manufacturer warrants that the resilient products will not wear through the wear layer from normal foot traffic for a period of twenty (20) years from the date of invoice. Wear is defined as completely wearing through the enhanced urethane, wear layer and impacting the print layer.
- E. Acceptable Manufacturer Warranties will not require special conditions to maintain Warranty including, but not limited to, the following:
 - 1. Polish at any time of the warranty
 - 2. rH% below 99%
- F. Defects shall include, but not be limited to, the following:
 - 4. Damaged tile, including broken or chipped edges.
 - 5. Loose or missing tile.
 - 6. Noticeable deterioration or discoloring of tile or grout.

1.11 EXTRA STOCK

- A. Furnish extra materials matching products installed and packaged with protective covering for storage and identified with labels describing contents.
 - 1. Resilient Tile Flooring: 1 percent of quality installed or 2 full unopened containers, whichever is greater.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Basis of Design Product: Manufacturers and tile series, pattern, and color selections are indicated in the Finish Schedule and are a basis of design. Subject to compliance with requirements, provide product indicated in Finish Schedule or comparable product by one of the following:
 - 1. Rubber Tile (RF-1):
 - a. Basis of Design: Color Splash 11684 manufactured by Tarkett, or comparable product as approved by Architect.
- B. Rubber Tile (RF-1): ASTM F 1066, Class 2, through pattern tile
 - 1. Size: 2' by 2'.
 - 2. Color: VF4 Husk WG; 32 Pebble WG.
 - 3. Thickness: 1/8 inch (3.17 mm).
 - 4. Location: Refer to Drawings.
- C. Trowelable Leveling and Patching Compounds: Latex modified, portland cement based formulation provided or approved by floor tile manufacturer for applications indicated.
- D. Adhesives: Water resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
- E. Floor Polish: Provide protective, liquid floor polish products recommended by floor tile manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified for other Work and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- B. Proceed with installation after correcting unsatisfactory conditions. Installation of resilient flooring and accessories indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 - 4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:

- a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum **95** percent relative humidity level.
5. Bond Test: Bond 3' x 3' panels spaced 50 feet apart throughout subfloor area. After moisture test proves floor acceptably dry, install panels using adhesive. If panels are securely bonded after 72 hours, subfloor is sufficiently clean of foreign materials for satisfactory installation of resilient flooring.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until they are the same temperature as the space where they are to be installed.
1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for installing flooring. Scribe and cut flooring to butt neatly and tightly to vertical surfaces, permanent fixtures, and built in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Extend flooring into toe spaces, door reveals, closets, and similar openings.
- B. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on flooring as marked on substrates. Use chalk or other nonpermanent marking device.
- C. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one/half tile at perimeter.
1. Lay tiles square with room axis.
- D. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
1. Lay tiles with grain running in one direction.
- E. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built in furniture, cabinets, pipes, outlets, and door frames.
- F. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- H. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

- I. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- J. Floor Tile: Comply with manufacturer's written instructions for installing floor tile.
 - 1. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one/half tile at perimeter.
 - a. Lay tiles square with room axis unless pattern indicated for an area.
 - 2. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles. Lay tiles with grain running in one direction.
- K. Resilient Accessories: Comply with manufacturer's written instructions for installing resilient accessories.
 - 1. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp mop surfaces to remove marks and soil.
- C. Protect floor tile from mars, marks, indentations, and damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish. Apply two coat(s).
- E. Sealers and Finish Coats: Remove soil, visible adhesive, and surface blemishes from resilient terrazzo floor tile surfaces before applying liquid cleaners, sealers, and finish products.
 - 1. Sealer: Apply two base coats of liquid sealer.
 - 2. Finish: Apply two coats of liquid floor finish.
- F. Cover floor tile until Substantial Completion.
- G. Clean floor surfaces not more than 4 days before dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean products according to manufacturer's written recommendations.
 - 1. Before cleaning, strip protective floor polish.
 - 2. Reapply polish to floor surfaces to restore protective floor finish according to flooring manufacturer's written recommendations.

END OF SECTION 09 65 19

SECTION 09 68 00 - CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Carpet and pad.
 - 2. Accessories necessary for a complete installation.

1.3 DEFINITIONS

- A. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

1.4 SUBMITTALS

- A. Product Data: Technical data including installation recommendations for each type of substrate:
 - 1. Carpet: For each type indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
- B. Samples: For each products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet: 12 inch (300 mm) square Sample from approved color and product of carpet.
 - 2. Exposed Edge, Transition, and Other Accessory Stripping: 12 inch (300 mm) long Samples.
 - 3. Carpet Seam: 6 inch (150 mm) Sample.
 - 4. Mitered Carpet Border Seam: 12 inch (300 mm) square Sample. Show carpet pattern alignment.
 - 5. Carpet base and accessory samples.
- C. Product Test Reports: For carpet and carpet cushion, for tests performed by a qualified testing agency.
- D. Shop Drawings: Showing extent of product, seam direction, and location and type of carpet accessories. Submittal to indicate columns, doorways, enclosing walls or partitions, casework, and locations where cutouts are required.
- E. Maintenance Data: For carpet to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet and carpet cushion.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Building Code: Comply with applicable requirements for the IBC for interior finishes.
 - 2. Fire Test Response Characteristics: Provide products with the critical radiant flux classification determined by testing identical products in accordance with ASTM E 648. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
 - 3. Accessibility Requirements: Comply with applicable requirements.
 - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
 - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
 - c. Texas Accessibility Standards (TAS).
- B. Installer Qualifications: Installer having minimum 5 years documented experience as a commercial carpet installer, who is certified by the International Certified Floorcovering Installers Association at the Commercial II or higher certification level.
- C. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products.
- D. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products. Contractor shall provide certified moisture testing results per ASTM F2170 (*Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes*) to Architect and Owner prior to floor installation. Acceptable moisture content of concrete sub floor shall be within approved manufacture limits or lower prior to installation.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.
- B. Store in a dry location between 65 degrees F and 90 degrees F and a relative humidity below 65%. Protect from damage and soiling. Stack carpet rolls horizontally, elevated above slab level on a flat surface, stacked no higher than two rolls.
- C. Store materials in area of installation for minimum period of 48 hours prior to installation.
- D. Protect carpet from damage, dirt, stains, and moisture.

1.7 FIELD CONDITIONS

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet and carpet cushion until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.
- C. Do not install carpet and carpet cushion over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, and have pH range recommended by carpet manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

1.8 COORDINATION

- A. Contractor's responsibility to hire movers to move furniture as required for flooring installation. Coordinate with Owner and Architect regarding temporary furniture relocation.

1.9 WARRANTY

- A. Carpet: Written warranty in which manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, dimensional stability, excessive surface wear, excess static discharge, and delamination.
 - 3. Warranty Period: 25 years from date of Substantial Completion.

1.10 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 00 – Project Management and Coordination.

1.11 EXTRA STOCK

- A. Extra Carpet: After completion of the carpet installation, the carpet subcontractor shall provide an additional five (5) percent of total yards installed of each carpet specified to the Owner for future carpet replacement that may be required. This extra stock is to be unused rolls, tiles, and mats and does not include scraps.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Basis of Design Manufacturer: Tarkett; (800) 248-2878 or approved equal.
- B. Carpet **(CPT-1 & 2)** (Roll Carpet):
 - 1. Basis of Design Product/Manufacturer: Nano, #04359, as manufactured by Tarkett; (800) 248-2878.
 - 2. Construction: Patterned Loop.
 - 3. Gauge: 5/64 inch.
 - 4. Pile Thickness: 0.101 inch.
 - 5. Fiber System: TDX Nylon.
 - 6. Dye Method: Solution Dyed.
 - 7. Roll Backing: Power Bond.
 - 8. Color(s): As selected by Architect from manufacturer's extended color line.
 - 9. Locations: As shown on drawings.
- C. Carpet **(CPT-3)** (Walk-Off):
 - 1. Basis of Design Product/Manufacturer: Assertive Action, as manufactured by Tarkett; (800) 248-2878.
 - 2. Construction: Symtex.
 - 3. Gauge: 1/10 inch.
 - 4. Pile Thickness: 0.095 inch.
 - 5. Fiber System: TDX Nylon.
 - 6. Dye Method: Solution Dyed.
 - 7. Primary Backing: Synthetic Non-woven.
 - 8. Color(s): As selected by Architect from manufacturer's extended color line.
 - 9. Locations: As shown on drawings.

- D. Applied Soil Resistance Treatment: Standard with manufacturer.
- E. Antimicrobial Treatment: Standard with manufacturer.
- F. Adhesives: Water resistant, mildew resistant, nonstaining, pressure sensitive type to suit products and subfloor conditions indicated, complying with flammability requirements for installed carpet and is recommended by carpet manufacturer for releasable installation.
- G. Trowelable Leveling and Patching Compounds: Latex modified, hydraulic cement based formulation provided or recommended by carpet cushion manufacturer.
- H. Adhesives: Water resistant, mildew resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by carpet and carpet cushion manufacturers.
- I. Seam Adhesive: Hot melt adhesive tape or similar product recommended by carpet manufacturer for sealing and taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.
- J. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.
 - 1. Basis of Design: Schluter® Systems LP, Plattsburg, NY; (800) 472-4588.
 - 2. Schluter® - RENO-U edge protection in satin aluminum finish at porcelain tile to sealed concrete.
 - 3. Provide all corners and connectors as required for a complete and detailed finished installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Examine carpet for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet and cushion manufacturer.
 - 2. Subfloor finishes comply with requirements specified in Section 03 30 00 for slabs receiving carpet.
 - 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

- A. Comply with CRI 104, Section 7.3 *Site Conditions; Floor Preparation* and with carpet manufacturer's written installation instructions for preparing substrates.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks,

holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm), unless more stringent requirements are required by manufacturer's written instructions.

- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet and cushion manufacturer.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet.

3.3 INSTALLATION

- A. Comply with CRI 104 and carpet and carpet cushion manufacturer written installation instructions for the following:
 - 1. Direct Glue Down Installation: Comply with CRI 104, Section 9 *Direct Glue Down Installation*.
 - 2. Stair Installation: Comply with CRI 104, Section 13 *Carpet on Stairs* for glue down installation.
- B. Comply with carpet manufacturer's written recommendations and Shop Drawings for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.
 - 1. Do not bridge building expansion joints with carpet.
 - 2. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.
 - 3. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- C. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- D. Install pattern parallel to walls and borders to comply with CRI 104, Section 15, *Patterned Carpet Installations* and with carpet manufacturer's written recommendations.

3.4 CLEANING AND PROTECTING

- A. Perform cleaning operations immediately after installing carpet:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
 - 2. Remove yarns that protrude from carpet surface.
 - 3. Vacuum carpet using commercial machine with face beater element.
- B. Protect installed carpet to comply with CRI 104, Section 16, *Protecting Indoor Installations*.
- C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer and carpet cushion manufacturer.

END OF SECTION 09 68 00

SECTION 09 84 13 - FIXED SOUND-ABSORPTIVE PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

- A. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

1.3 SUBMITTALS

- B. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- C. Shop Drawings: Show panel joints, detail references, dimensions and methods of attachment.
- D. Samples: 12 inch x 12 inch sample of actual material and color charts showing manufacturer's full range of colors for Architect's selection.

1.4 QUALITY ASSURANCE

- A. Provide acoustical panels, diffusers and fabrics of each type required from one (1) manufacturer, of uniform texture and color.
- B. Installer. Provide evidence of appropriate experience in system installation and that installation method proposed is acceptable to panel manufacturer.
- C. Single Source Responsibility: Obtain acoustical panel materials from a single manufacturer.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Carefully protect work during shipment, storage and installation.
- B. Deliver materials to job site and store elevated above floor in an enclosed space with proper ventilation and protection from damage.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers listed who produce equivalent products to those specified may be used on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
 - 1. Acoustical Panels:
 - a. AVL Systems, Inc.

- b. Benton Brothers Solutions, Inc.
- c. Conwed Designscapes
- d. Decoustics
- e. Golterman & Sabo, Inc.
- f. Lamvin, Inc.
- g. MBI Products Company
- h. MDC Interior Solutions.
- i. Sound Concepts
- j. Soelberg.
- k. Wall Technology, Inc.
- l. Guilford of Maine
- m. TRI-KES
- n. Carnegie
- o. Wenger.

2.2 MATERIALS

A. Acoustical Absorption Panels:

1. Graphic Acoustical Panel Type (**GAP-1**):
 - a. Basis of Design: Muto Slab Panels as manufactured by Soelberg or Architect approved equal.
 - b. Type: Absorber Panels.
 - c. Composition : 100% Polyester Felt (PET).
 - d. Flame Spread: Class A, 25 or less.
 - e. NRC: 0.40 – 0.85.
 - f. Size: Refer to Drawings.
 - g. Color: Custom Graphic.
 - h. Location: Refer to Interior Elevations.
2. Mounting Accessories:
 - a. Top Clips and Brackets:
 - 1) Factory mounted concealed mechanical “Z” clips screw fastened to the back of resin hardened spots on panel at maximum 24 inch on center spacing.
 - 2) Set clips inboard one (1) to two (2) inches from panel edges.
 - 3) “Z” clips shall engage on galvanized single or double wall brackets with closed ends to prevent lateral panel movement.
 - 4) Clips shall be fabric covered if exposed to view.
 - b. Bottom: 6 inch hook & loop brackets shall be shimmed on stacked spacer panels to provide even face alignment.

B. Tectum Standard Interior Panels:

1. Material: Aspen wood fibers bonded with inorganic hydraulic cement.
2. Thickness: Two (2) inches.
3. Edge: Long edge beveled.
4. NRC: 0.70.
5. Size:
 - a. Walls: 47-3/4 inches wide by 8-foot length.
 - b. Ceilings: 59-3/4 inches by 59-3/4 inches.
6. Frame: 2 inch by 4 inch painted wood at walls only
7. Color: Factory painted white.
8. Mounting Style: Mount on 3/4 inch furring strips at 24 inch on center both ways on walls, and provide Unitstrut channels and hangers at 24 inches both ways at ceiling attached to steel angles and girders. Type instructed by manufacturer to suit application. Provide all

fasteners, and furring strips for a complete single source installation. Fasteners and anchorage accessories shall be corrosive resistant.

9. Location: As shown on Drawings.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify dimensions to insure proper fabrication of materials.

3.2 INSTALLATION

- A. Install wall panels, ceiling diffusers, and fabrics only after all wet work has been completed and temperature conditions approximate conditions when space will be occupied.
- B. Install wall panels, ceiling diffusers, and fabrics in accordance with manufacturer's instructions and approved shop drawings.
- C. Install Tectum Wall Panels with venting space between the wall and panels in accordance with manufacturer's instructions.
- D. Install wall panels, and ceiling diffusers in proper alignment. Shim wall track as necessary to provide a level frame work.
- E. Arrange wall panels symmetrically on each wall, unless otherwise indicated.
- F. Remove wall panels, ceiling diffusers, and fabrics are damaged and unacceptable to Architect and replace with new undamaged materials at no expense to Owner.

END OF SECTION 09 84 13

SECTION 09 90 00 - PAINTINGS AND COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 1. Surface preparation and field painting of exposed items and surfaces.
 2. Field preparation and painting of factory primed metal products and fabrications.
 3. Accessories necessary for a complete installation.

1.3 DEFINITIONS

- A. Standard coating terms defined in ASTM D 16 apply.
 1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85 degree meter.
 2. Eggshell refers to low sheen finish with a gloss range between 20 and 35 when measured at a 60 degree meter.
 3. Semigloss refers to medium sheen finish with a gloss range between 35 and 70 when measured at a 60 degree meter.
 4. Full gloss refers to high sheen finish with a gloss range more than 70 when measured at a 60 degree meter.

1.4 SUBMITTALS

- A. Product Data: Submit technical data and information for block fillers, primers, paints, and coatings, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
 1. Indicate manufacturer's instructions for special surface preparation procedures, substrate conditions requiring special attention.
 2. Material List: Provide inclusive list of required coating materials. Indicate each material and cross reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number, series, and general classification.
- B. Samples: Submit for each type of paint system and in each color and gloss of topcoat.
 1. Provide stepped samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing samples for review. Resubmit until required sheen, color, and texture are achieved.
 2. Provide list of material and application for each coat of each sample. Label each sample as to location and application.
 3. Submit samples on following substrates for review of color and texture only:
 - a. Concrete: Provide two 4 inch square samples for each color and finish.
 - b. Concrete Masonry: Provide two 4" x 8" samples of masonry, with mortar joint in the center, for each finish and color.
 - c. Painted Wood: Provide two 12 inch square samples of each color and material on hardboard.
 - d. Ferrous and Nonferrous Metals: Provide two 4 inch square samples of flat metal and two 8 inch long samples of solid metal for each color and finish.

- C. Product List: Submit list of including each paint system, color, and location of application. Use same product and location designations indicated in Finish Schedule.
- D. Coating Maintenance Manual: Upon conclusion of the project, the Contractor or paint manufacturer/supplier shall furnish a coating maintenance manual, such as Sherwin-Williams "Custodian Project Color and Product Information" report or equal. Manual shall include an Area Summary with Finish Schedule, Area Detail designating where each product/color/finish was used, product/color/finish was used, product data pages, Manual Safety Data sheets, care and cleaning instructions, touchup procedures, and color samples of each color and finish used.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with Federal and local toxicity and air quality regulations and with Federal requirements on content of for heavy metals including but not limited to: lead and mercury. Do not use solvents in paint products that contribute to air pollution.
 - 2. Performance and Durability:
 - a. ASTM D 16 – "Standard Test Method for Load Testing Refractory Shapes at High Temperatures."
 - b. ASTM D 2486 – "Standard Test Method for Scrub Resistance of Interior Wall Paint."
 - c. ASTM D 2805 – "Standard Test Method for Hiding Power of Paints by Reflectometry."
 - d. ASTM D 4828 – "Standard Test Method for Practical Washability of Organic Coatings."
 - e. ASTM D 3363 – "Standard Test Method for Film Hardness by Pencil Test."
- B. Applicator Qualifications: A firm or individual having minimum 5 years documented experience in applying paints and coatings similar in material, design, and extent to those indicated.
- C. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well ventilated areas with ambient temperatures continuously maintained at not less than 45 degrees F (7 degrees C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

- A. Apply waterborne paints when temperatures of surfaces to be painted and surrounding air are between 50 degrees F and 90 degrees F (10 degrees and 32 degrees C).
- B. Do not thin or add water to waterbased paints, including waterbased alkyds.
- C. Weather Conditions:
 - 1. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
 - 2. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 degrees F (3 degrees C) above dew point; or to damp or wet surfaces.
 - 3. Minimum Application Temperatures for Water based Paints: Between 50 degrees F (10 degrees C) and 90 degrees F (32 degrees C).

- D. Apply solvent thinned paints when temperatures of surfaces to be painted and surrounding air are between 45 degrees F. and 95 degrees F (7 degrees F and 35 degrees C).
 - 1. Minimum Application Temperature for Varnish Finishes: 65 degrees F (18 degrees C) for interior or exterior, unless required otherwise by manufacturer's instructions.
 - 2. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.
- E. Provide lighting level of 80 foot candles (860lx) measured midheight at substrate surface.
- F. Labels: Do not paint over Underwriters Laboratories, Factory Mutual, other code required labels, or equipment name, identification, performance rating, or nomenclature plates.

1.8 WARRANTY

- A. Written warranty signed by the manufacturer and the installer in which the manufacturer and installer agree to repair or replace paint and primers that fail within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Flaking or delamination of paint with the substrate.
 - b. Rust, scale, similar imperfections due to improper surface preparation.
 - c. Thinning or watering of paint beyond that considered acceptable of paint manufacturer.
 - d. Failure to achieve dry film thickness (DFT) recommended by manufacturer for each coat in a paint system.
 - e. Deterioration or loss of color of paint beyond normal weathering.
 - 2. Warranty Period: Two (2) years from date of Substantial Completion.

1.9 EXTRA MATERIALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 2 percent, but not less than 1 gallon (3.8 L) of each material and color applied.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Basis of Specifications: Sherwin Williams paints. Subject to compliance with requirements, provide first quality, 100% acrylic, commercial or industrial products of one of the specified manufacturers. Residential products are not permitted.
 - 1. Proprietary Names: Paint Schedule is based on a single manufacturer for convenience. Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that named products are required to the exclusion of comparable products of specified manufacturers. Furnish product technical data, including per cent solids by weight and volume; VOC content limits and emissions data; and certificates of performance for comparable paint products of specified manufacturer.
 - 2. Paint Products:
 - a. Sherwin-Williams Co.
- B. Material Compatibility: Provide each paint system including block fillers, primers, and finish coats, that are compatible with one another and with substrates indicated under conditions of service and application, demonstrated by manufacturer based on testing and field experience.

- C. **Material Quality:** Provide manufacturer's best quality commercial paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint material containers not displaying manufacturer's product identification will not be acceptable. Residential quality paint products are not permitted.
- D. **Chemical Components of Interior Paints and Coatings:** Provide products complying with limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 1. **Aromatic Compounds:** Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
 - 2. **Restricted Components:** Paints and coatings shall not contain components restricted by the EPA.
- E. **Accessories:** Materials not specifically indicated but required to achieve the finishes specified, of commercial quality.
- F. **Patching Materials:** Latex filler compatible with paint systems.
- G. **Fastener Head Cover Materials:** Latex filler.

2.2 SOURCE QUALITY CONTROL

- A. **Testing of Paint Materials:** Owner reserves the right to invoke to engage the services of a qualified testing agency to sample paint materials.
 - 1. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to site, samples may be taken at the site. Samples will be identified, sealed, and certified by testing agency.
 - 2. Testing agency will perform tests for compliance with product requirements.
 - 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for maximum moisture content and conditions affecting performance of the work.
- B. Test substrates after repairing and cleaning substrates but prior to application of paint and coatings.
 - 1. **Maximum Moisture Content of Substrates:** When measured with an electronic moisture meter as follows:
 - a. Concrete: 12 percent.
 - b. Masonry (Clay and CMUs): 12 percent.
 - c. Gypsum Board: 12 percent.
 - 2. Test cementitious and plaster cement/stucco for alkalinity (pH).
- C. **Gypsum Board Substrates:** Verify joints are taped and finishing compound is sanded smooth.
- D. **Spray Textured Ceiling Substrates:** Verify surfaces are dry.

- E. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
 - 1. Verify previously painted surfaces can be stripped to bare substrate, repaired if necessary, and prepared to receive new paint system consisting of primer and two top coats at a minimum.
 - a. Note: If previously painted surfaces have failed to accept new paint systems, determine cause of failure and take corrective measures to ensure each surface accepts new paint system. Failure of new paint system is not permitted.
- F. Commence paint and coating application after correcting unsatisfactory conditions and surfaces are dry. Application of coating indicates applicator's acceptance of surfaces and conditions.

3.2 ITEMS TO RECEIVE PAINT

- A. Generally, all new items that are normally painted in any typical building, including but not limited to the following list:
 - 1. All ferrous metal
 - 2. All exterior galvanized metal
 - 3. All exterior wood
 - 4. All interior wood
 - 5. All prime coated hardware
 - 6. All exposed pipe, plumbing, ductwork, conduit, outlet boxes and electrical cabinets, excluding those located in mechanical rooms.
 - 7. Aluminum and copper items, unless noted otherwise. (Painting of exposed pipe, including copper, brass, galvanized and black iron pipe and fittings, *is* included.)
 - 8. All metal grilles, except aluminum, unless otherwise indicated.
 - 9. All exposed gypsum board surfaces, including all mechanical rooms.
 - 10. Sealants of types which should not be painted and to which paint will not adhere.
 - 11. Aluminum, stainless steel, nickel and chrome plated piping and fittings.
 - 12. Miscellaneous other items which normally require painting or are scheduled to be painted.
 - 13. Consult plans, finish schedule, details and specifications for other trades as all items usually field painted or finish will be considered as part of the Contract.
 - 14. All exposed mechanical equipment and electrical equipment.
 - 15. Traffic lanes and parking spaces including fire lanes and crosswalks.
 - 16. Rolling doors.
 - 17. Bollards.
 - 18. Loose lintels.
 - 19. Wood Fiber Decks.
 - 20. Refer to MEP specifications for additional items to receive paint.
- B. All work where a coat of material has been applied must be inspected and approved by Architect before application of succeeding specified coat, otherwise no credit for coat applied will be given. Notify Architect when a particular coat has been completed for inspection and approval. Apply coats of material in strict accordance with manufacturer's specifications except where requirements of these specifications are in excess of manufacturer's requirements. Paint all sight exposed pipe and plumbing only after all mechanical work and tests have been completed.

3.3 PREPARATION

- A. Coordination of Work: Review work in which primers are provided to ensure compatibility of the total system for various substrates. Notify Architect of anticipated problems when using materials specified over substrates primed by others.
 - 1. Preprimed Substrates: Inspect existing conditions in which primers are factory applied to ensure compatibility of the total system for each substrate. Notify Architect of anticipated problems when using the materials specified over factory primed or preprimed substrates.

2. Existing Painted Surfaces: Inspect previously painted surfaces to ensure compatibility of the existing paints with new paint system for each substrate. Notify Architect of anticipated problems.
 3. Correct defects and clean surfaces affecting bond with paint system. Remove existing paints exhibiting loose surface defects showing signs of rust, scale, or delamination.
 4. Seal marks which may bleed through surface finishes.
- B. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified. Provide barrier coats over incompatible primers or remove and reprime. If removal is impractical or impossible because of size or weight of item, provide surface applied protection before surface preparation and painting
1. Remove hardware and hardware accessories, plates, lighting fixtures, and similar items that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface applied protection before surface preparation and painting. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
 2. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface applied protection if any.
 3. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 4. Clean and prepare surfaces to receive paint according to manufacturer's written instructions for each substrate condition and as specified. Provide barrier coats over incompatible primers, existing paint or coating, or remove and reprime.
 5. Correct defects and clean surfaces affecting bond with paint or coating system. Remove existing coatings exhibiting loose surface defects. Seal marks which may bleed through surface finishes.
- C. Cleaning: Before applying paint or surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning. Schedule cleaning and painting so dust and contaminants from the cleaning process will not fall on wet, newly painted surfaces.
1. Remove incompatible primers, including factory applied primers, and reprime substrate with compatible primers or apply barrier coat as necessary to produce paint systems indicated.
 2. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
 3. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
 4. Galvanized Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
 5. Aluminum Substrates: Remove surface oxidation.
 6. Glazed Brick: Scrub glazed brick with scrub brush and soapy water to remove any dirt or grease from the surface. Mix scouring powder and water together to form a paste and rub this paste onto your glazed brick with a scrub brush. The scouring powder will help clean and roughen the surface to help the paint adhere properly. Rinse the glazed brick thoroughly with clean water and dry it with a towel. Mix together the activator and liquid of a two part epoxy paint. Apply epoxy paint on the glazed brick with a short nap paint roller. A 3/8 inch nap roller. Wait for the epoxy paint to dry before you touch the surface. If the brick is still visible through the epoxy paint, apply a second paint.
- D. Mildew and Mold Removal: Remove mildew and mold by high power washing (pressure range of 1500 to 4000 psi) with solution of trisodium phosphate and bleach. If substrate is too soft for high power washing, scrub substrate with solution. Rinse with clean water and allow surface to dry.

- E. Protective Coverings: Provide protections for duration of the work, including covering furnishings and decorative items. Protect and mask adjacent finishes and components against damage, marking, overpainting, and injury. Clean and repair or replace damage caused by painting.
- F. Renovated Surfaces: Clean surface free of loose dirt and dust. Except at gypsum board surfaces, remove existing paint and coatings to bare substrate and prepare substrates to receive new paint system. Test substrate to verify it will bond with primer and receive new paint system without failure. If test fails, clean surface to base substrate and apply barrier coat. Retest to verify surface will accept new paint system.
 - 1. Remove surface film preventing proper adhesion and bond.
 - 2. Wash glossy paint with a solution of sal soda and rinse thoroughly.
 - 3. Remove loose, blistered, and defective paint and varnish; smooth edges with sandpaper.
 - 4. Clean corroded iron and steel surfaces.
 - 5. Repair and blend into portland cement plaster.
 - 6. Prime bare surfaces.
 - 7. Tone varnished surfaces with stain bringing to uniform color.
 - 8. If existing surfaces cannot be put in acceptable condition for finishing by customary cleaning, sanding, and puttying operations, notify Owner and do not proceed until correcting unsatisfactory conditions.
- G. Ferrous Metals: Clean ungalvanized ferrous metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC recommendations.
 - 1. Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No. 3.
 - 2. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 - 3. Touch up bare areas and shop-applied prime coats that have been damaged. Wire brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
- H. Galvanized Ferrous Metal Substrates: Clean galvanized surfaces with nonpetroleum based solvents leaving surface free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Shop Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop primed surfaces.
- J. Aluminum Substrates: Clean surfaces to remove oil, grease, surface oxidation, and contaminants in accordance with SSPC SP-1 Solvent Cleaning. Lightly abrade surface with a nonmetallic pad.
- K. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- L. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.
- M. Preparation of Substrates for Wallcovering: Prime and seal substrate with release coat in accordance with wallcovering manufacturer's recommendations for substrate.
 - 1. Assure compatibility with product of wall covering manufacturer.
 - 2. Fill indentations in substrate and prime with opaque white primer before applying release coat.
 - 3. Apply release coat in accordance with manufacturer's recommendations.

- N. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 3. Do not use thinners for water based paints.
 4. Tinting: Tint each undercoat a lighter shade to facilitate identification of each coat where multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.4 APPLICATION

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.
1. The term *exposed surfaces* includes areas visible when permanent or built in fixtures, grilles, convector covers, covers for finned tube radiation, and similar components are in place. Extend coatings in these areas to maintain system integrity and provide desired protection.
 2. Use applicators and techniques suited for paint and substrate indicated.
 3. Provide finish coats compatible with primers.
 4. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 5. Paint exposed surfaces. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces.
 - a. Field painting of exposed surfaces include bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory applied final finish.
 - b. Areas visible when permanent or built in fixtures, grilles, convector covers, covers for finned tube radiation, and similar components are in place.
 - c. Extend coatings in areas, as required, to maintain system integrity and provide desired protection.
 6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 7. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 8. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 9. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 10. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or surface imperfections. Cut in sharp lines and color breaks.
 11. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 12. Provide finish coats compatible with primers used.
 13. Sand lightly between each succeeding enamel or varnish coat.

- B. Items not to Receive Paint: Do not paint prefinished items, concealed surfaces, operating parts, and labels.
- C. Applicators: Apply paints and coatings by brush, roller, spray, or applicators recommended by manufacturer.
 - 1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
 - 2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool recommended by manufacturer for material and texture required.
 - 3. Spray Equipment: Use airless spray equipment with orifice size recommended by manufacturer for material and texture required.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
 - 1. Measure film thickness on magnetic surfaces by use of Elcometer thickness gauge and on nonmagnetic surfaces by pit gauge or Tooke Gauge.
- E. Application: Apply first coat to surfaces that have been cleaned, pretreated, or prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
 - 1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer.
 - 2. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished after removing rust and scale and priming or touching up surface sand if acceptable to topcoat manufacturers.
 - 3. If undercoats, stains, or conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive dry film thickness equivalent to that of flat surfaces.
 - 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried and cured to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- F. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.
 - 1. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
 - 2. Prime and paint uninsulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, heat exchangers, tanks, ductwork, conduit, switchgear, and paintable insulation except where items are prefinished.
 - 3. Paint interior surfaces of air ducts, and convector and baseboard heating cabinets visible through grilles and louvers with one coat of flat black paint, to visible surfaces. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
 - 4. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
 - 5. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated. Color band and identify with flow arrows, names, and numbering.
 - 6. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.
 - 7. Concealed Members: Wherever steel and metal parts to receive paint are built into and concealed by construction, paint as specified for exposed parts so finish painting is complete before members are concealed.

- G. Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work: Painting is limited to items exposed in equipment rooms and occupied spaces.
1. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
 2. Prime and paint uninsulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, heat exchangers, tanks, ductwork, conduit, switchgear, and paintable insulation except where items are prefinished.
 3. Paint interior surfaces of air ducts, and convector and baseboard heating cabinets visible through grilles and louvers with one coat of flat black paint, to visible surfaces. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
 4. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
 5. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated. Color band and identify with flow arrows, names, and numbering.
 6. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.
- H. Block Fillers: Apply block fillers to concrete masonry block at rate to ensure complete coverage with pores filled.
- I. Prime Coats: Before applying finish coats, apply prime coat, recommended by manufacturer, to material required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or defects due to insufficient sealing.
- J. Finish Coats: Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance without bleed through.
1. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or surface imperfections is not acceptable.
 2. Transparent (Clear) Finishes: Use multiple coats to produce glass smooth surface film of even luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections. Provide satin finish for final coats.
- K. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.
- L. Touch Up: Touch up marred, scraped, and blemished areas of surfaces which were factory primed or previously coated.
1. Prepare and touch up scratches, abrasions, and blemishes and remove foreign matter before proceeding with succeeding coats.
 2. Touch up marred, scraped, and blemished areas of factory primed or previously coated surfaces.
 3. Feather touch up coating overlapping minimum 2 inches onto adjacent unblemished areas producing smooth, uniform surface.
 4. As soon after erection and installation as possible, touch up fasteners, welded surfaces and surroundings, field connections, and areas on which shop coat has been abraded or damaged with specified primer before corrosion and other damage occurs from exposure.

3.5 FIELD QUALITY CONTROL

- A. Dry Film Thickness (DFT) Testing: Tests for dry film thickness may be determined by using a Tooke Scale and microgroover, an electronic scanner, or the Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
1. Contractor shall touch up and restore painted surfaces damaged by testing.
 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.6 CLEANING AND PROTECTION

- A. It is of the utmost importance to the client that the site remains in a safe, clean, and well maintained condition. At the end of each day, leave the site ready to use by staff and students. Protect staff and students and the learning environment throughout the work.
- B. Cleanup: At the end of each day, remove empty cans, rags, rubbish, and discarded paint materials from site. After completion of painting work, clean glass and paint splattered surfaces. Remove splattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. Provide *Wet Paint* signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work. After related work is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.
- E. At completion of painting activities, touch up and restore damaged or defaced painted surfaces.
- F. Waste Management: Legally dispose of unused paint and paint containers in accordance with manufacturer's recommendations and environmental regulations.

PART 4 - SCHEDULES

- A. The following is a schedule of typical painted items and does not specifically include every item that is to receive paint but should establish type and quality of finish for all items normally included in a complete paint job.
- B. Exterior Surfaces: Note: Exterior surfaces are divided into two (2) different categories, based upon color and level of graffiti resistance required. System 1 will be used when standard earthtone colors or neutral colors are specified, and System 2 will be used when bright colors (primary reds, yellows, and oranges) are specified and/or when a graffiti resistant coating is required.
1. Galvanized Metal:
 - a. Surface Preparation: Acid etch galvanized surfaces that have not weathered at least six (6) months prior to beginning painting operations.
 - b. Primer: One (1) coat Pro-Cryl Pro Industrial Universal Primer (B66W310)
 - c. Finish: Two (2) coats Sher-Cryl HPA High Performance Acrylic (B66W300)
 2. Un-galvanized Metal:
 - a. Primer: One (1) coat Pro-Cryl Pro Industrial Universal Primer (B66W310)
 - b. Finish: Two (2) coats Sher-Cryl HPA High Performance Acrylic (B66W300)

3. Concrete and CMU:
 - a. Primer/Finish: (2) coats Loxon XP Exterior Waterproofing System (LX11 Series), 14-18 mils wet, 6.4 – 8.3 mils dry per coat.
 4. Parking Line and Driveway Paint: Hotline Waterborne Yellow (TM2153) (meets Federal Specification (FS) TTP-1952-F).
 5. All piping in mechanical rooms shall be painted in their entirety, in the following colors:
 - a. Gas lines: Orange
 - b. Domestic cold water: White
 - c. Domestic hot water: Pink
 - d. Heating hot water: Red
 - e. Condenser water: Green
 - f. Chilled water: Blue
 6. Glazed Brick:
 - a. Primer: One (1) coat Extreme Bond B51W00150, 3.1 mils wet, .9 mils dry.
 - b. Finish: Two (2) coats Pro Industrial Water Based Catalyzed Epoxy (B73 Series).
- C. Interior Surfaces:
1. Gypsum Wallboard:
 - a. Primer: One (1) coat ProMar 200 Zero VOC Latex Primer (B28W2600).
 - b. Finish: Two (2) coats ProMar 200 Zero VOC Latex Eg-Shel (B20W2651 Series).
 2. Primer Concrete and CMU: (Enamel):
 - a. One (1) coat ProMar Block Filler (AB25W25).
 - b. Finish: Two (2) coats ProMar 200 Zero VOC Latex Semi-Gloss (B31W2651 Series).
- D. Paint Types:
1. Paint Type (PT-1): Field.
 - a. Number: SW7547.
 - b. Color: Sandbar.
 2. Paint Type (PT-2): Not used.
 3. Paint Type (PT-3): Not used.
 4. Paint Type (PT-4): Door Frame.
 - a. Number: SW7048.
 - b. Color: Urbane Bronze.
 5. Paint Type (PT-5): Not used.
 6. Paint Type (PT-6): HM Door – Match Existing.
 - a. Number: SW7066.
 - b. Color: Gray Matters.
 7. Paint Type (PT-7): Not used.
 8. Paint Type (PT-8): Not used.
 9. Paint Type (PT-9): Masonite at stage.
 - a. Number: SW6258.
 - b. Color: Tricorn Black.
 - c. Finish: Flat.

10. Paint Type (PT-10): Flat Accent Wall.
 - a. Number: SW6551.
 - b. Color: Purple Passage.

END OF SECTION 09 90 00

SECTION 09 93 00 – HARDWOOD FLOOR ADHESIVES, FINISHING, AND MAINTENANCE

PART 1- GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Hardwood floor adhesives, finishing and maintenance of the following types:
 - 1. Oil-modified finishes and sealers.

1.3 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM D2047 - Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine.
 - 2. ASTM E492 - Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine.
 - 3. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
 - 4. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
- B. Refer to Section 09 64 66 – Wood Gymnasium Flooring.

1.4 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- B. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- C. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Trained in application of the manufacturer's floor products.
- B. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - 1. Finish areas designated by Architect.
 - 2. Do not proceed with remaining Work until workmanship, color, and sheen are approved by Architect.
 - 3. Refinish mock-up area as required to produce acceptable Work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based

materials, in accordance with requirements of local authorities having jurisdiction.

1.7 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's limits.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Bona US; (303) 371-1411 or comparable product approved by Architect.

2.2 OIL-MODIFIED FINISHES AND SEALERS

- A. Quick-Dry Sealer:
 - 1. Product: Bona DriFast Sealer as manufactured by Bona US.
 - a. Ingredients: Mineral spirits (solvent), urethane resins, silica, driers.
 - b. Color: Wet, amber or dry, light amber as selected by Architect.
 - c. Clarity: Clear.
 - d. Solids: 37 percent.
 - e. Density: 7.21 lbs per gal (0.866 s.g.).
 - f. US Regulatory VOC: 550 g/L.
 - g. Odor: Mineral spirits.
 - h. Stability: 2-year shelf life in unopened container.
 - i. Flash Point: 115 degrees F (46 degrees C).
 - j. Leveling: Excellent.
 - k. Defoaming: Excellent/complete.
 - l. Drying Time: 1-1/2 to 2 hours.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Building climate control system shall be functioning with a temperature of 65 to 80 degrees F (18.3 to 26.7 degrees C) and maximum relative humidity of 70 percent for 72 hours before flooring is installed, during installation, and for 72 hours after installation. Acclimate flooring according to manufacturer's instructions.

3.2 PREPARATION

- A. Protection: Protect adjacent finish surface to prevent damage during sanding and finish system application.
- B. Substrate: Must be clean, smooth, dry, free of loose material and structurally sound, with the surface slightly textured for best adhesion (similar to a light broom finished concrete).
 - 1. Remove adhesive residue, paint, concrete curing compounds or other contaminants that may affect adhesive bond. Abrasive blasting, shot blasting or scarifying may be necessary to completely remove some of these residues.
 - 2. Surface cracks, grooves, depressions, control joints or other non-moving joints, and other irregularities must be filled or smoothed with a Portland Cement-based patching and/or leveling compound.

3. Levelness: To 3/16 inch (5 mm) in a 10 ft (3048 mm) span. If the concrete slab is to be leveled, primer/sealer shall be applied to the slab prior to application of the leveling compound.
 4. Slab Temperature: 55 to 95 degree F (12.8 to 35 degrees C).
- C. Other suitable substrates include wood and radiant heat flooring (refer to manufacturer's recommended installation instructions).

3.3 MOISTURE TESTING

- A. Concrete Floors:
1. Concrete Slabs: Conduct moisture testing per ASTM F1869 and/or ASTM F2170.
 2. Primer/Sealer: Two coats prior to installation of hardwood flooring with an adhesive when MVER using ASTM F1869 (Calcium Chloride test) exceeds 12 lbs per 24 hrs per 1000 sq ft (5.86 kg per 24 hrs per 100 sq m) or when using ASTM F2170 (RH probe test) exceeds 85 percent relative humidity.
 3. Moisture Content: Should not exceed 18 lbs per 24 hrs per 1000 sq ft (8.79 kg per 24 hrs per 100 sq m) or 95 percent relative humidity.
 4. When using a Tramex measuring device to identify moisture levels in cementitious based substrates, use the Tramex measuring device to find the highest reading in the area to be installed and then run the concrete moisture testing method at the location of the recorded highest reading.
 5. As a general guideline for floors with no in-floor heating system, if the Tramex is below 4 percent, primer/sealer will not be necessary; if between 4 and 6 percent, primer/sealer is required.
- B. Wood Subfloor:
1. For moisture content and quality of substrates, the guidelines of the wood floor manufacturer shall be followed.
 2. Wood Subfloor Moisture Content: 20 percent maximum.

3.4 SANDING AND PREPARATION OF NEW FLOORS:

- A. Sand and prepare floor using accepted industry association methods.
- B. Vacuum thoroughly.
- C. Stained Floors: Make final cut with 80 to 100 grit paper. Then multidisc with 80 to 120 grit paper.
- D. Unstained Floors: Make final cut with 80 to 120 grit paper. Then multidisc with 120 to 150 grit paper. This burnishing will reduce the amount of grain raise.
- E. Use a Tampico Brush on a buffer and vacuum thoroughly.
- F. Tack with a dry Bona Microfiber Tacking Pad or cloth to remove dust.
- G. Apply finish system.

3.5 FINISH APPLICATIONS, GENERAL

- A. Comply with instructions and recommendations of floor finish system manufacturer.
- B. Finish System: As scheduled or indicated on the drawings.

3.6 OIL MODIFIED FINISHES AND SEALERS APPLICATIONS

- A. Mixing: Shake or still well before applying. Do not thin.

- B. Application, Quick-Dry Sealer:
1. Pour sealer into paint tray. Wet the 3/16 inch (5 mm) mohair roller.
 2. Apply sealer to a 3 x 3 ft (914 x 914 mm) section of the floor against the grain at a coverage rate of 600 to 700 sq ft per gal (17.72 to 17.18 sq m per L)
 3. Without adding more sealer to roller, re-roll entire 3 x 3 ft (914 x 914 mm) section with the grain of the wood.
 4. Continue process throughout entire floor.
 5. Apply evenly. excessive amounts of sealer may cause floor failure.
 6. Drying: Allow sealer to dry thoroughly a minimum of 2 hours. Recommended Conditions: 60 to 80 degrees F (16 to 27 degrees C), 35 to 75 percent relative humidity.
 - a. High humidity and/or low temperature conditions extend dry time.
 - b. Increased ventilation and airflow reduces dry time.
 7. Abrade sealer using 120-grit or finer, screen or 1 to 2 (stacked) Bona Conditioning Pads and 1 to 2 Bona Diamond 180 to 240-grit abrasives.
 8. Thoroughly vacuum and dry tack with Bona Microfiber Tacking pads (or slightly dampened with water).
 9. Apply a Bona finish according to label directions.

3.7 PROTECTION

- A. After application, protect floor finish from damage during subsequent Work.

END OF SECTION 09 93 00

SECTION 09 96 46 - INTUMESCENT PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Surface preparation and field application of fire retardant intumescent paint to interior and exterior items and surfaces.
 - 2. Accessories necessary for a complete installation,

1.3 SUBMITTALS

- A. Product Data: Submit technical data and information for block fillers, primers, paints, and coatings, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
 - 1. Indicate manufacturer's instructions for special surface preparation procedures, substrate conditions requiring special attention.
 - 2. Material List: Provide inclusive list of required coating materials. Indicate each material and cross reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number, series, and general classification.
- B. Samples: For each type of coating system and each color and gloss of intumescent paint finish indicated.
 - 1. Submit Samples on rigid backing, not less than 8 inches (200 mm) square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- C. Product List: Cross reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.
- D. Material Test Reports: Submit for each intumescent paint.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with Federal and local toxicity and air quality regulations and with Federal requirements on content of for heavy metals including but not limited to: lead and mercury. Do not use solvents in paint products that contribute to air pollution.
 - 2. Surface Burning Characteristics of Fire-Retardant Systems: As tested according to ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame Spread Index: 25 or less.
 - b. Smoke Developed Index: 450 or less.
- B. Applicator Qualifications: A firm or individual having minimum 5 years documented experience in applying paints and coatings similar in material, design, and extent to those indicated.

- C. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.
- D. Mockups: Apply mockups of each paint system indicated to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each coating system.
 - a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Preinstallation Conference: Conduct conference at site.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well ventilated areas with ambient temperatures continuously maintained at not less than 45 degrees F (7 degrees C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

- A. Apply waterborne intumescent paints only when temperatures of surfaces to be painted and ambient air temperatures are between 50 degrees F and 90 degrees F (10 degrees C and 32 degrees C).
- B. Apply solvent thinned intumescent paints when temperatures of surfaces to receive paint and ambient air temperatures are between 45 degrees F and 95 degrees F (7 degrees C and 35 degrees C).
- C. Do not apply intumescent paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F (3 degrees C) above the dew point; or to damp or wet surfaces.
- D. Allow wet surfaces to dry thoroughly and to attain temperature and conditions specified before starting or continuing coating operation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Isolatek International; (713) 462-1709.
 - 2. Albi Manufacturing; (860) 828-0571.
 - 3. Benjamin Moore & Co.; (855) 724-6802.

4. Diamond Vogel Paints; (800) 72-VOGEL.
5. FireFree Coatings, Inc.; (415) 459-6488.
6. General Paint; (888) 578-5793.
7. PPG Architectural Coatings; (713) 672-8140.

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each material or coat, products and spreading rates shall be as recommended in writing by intumescent paint manufacturer for use on substrate indicated. Comply with requirements for fire-retardant coating classification and surface-burning characteristics indicated.

C. Colors and Gloss: Selected by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with manufacturer's requirements for surface treatments, shop primed surfaces, maximum moisture content, and other conditions affecting performance of the work.
- B. Test substrates after repairing and cleaning substrates but prior to application of paint and coatings.
 1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - a. Concrete: 12 percent.
 - b. Fiber Cement Board: 12 percent.
 - c. Masonry (Clay and CMUs): 12 percent.
 - d. Wood: 15 percent.
 - e. Gypsum Board: 12 percent.
 - f. Plaster: 12 percent.
 2. Test cementitious and plaster cement/stucco for alkalinity (pH).
- C. Begin coating no sooner than 28 days after substrate is constructed and is visually dry on both sides.
- D. Verify suitability of substrates, including surface conditions, and compatibility with existing finishes and primers.
- E. Proceed with coating application after correcting unsatisfactory conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions applicable to substrates and coating systems indicated.
- B. Remove hardware and hardware accessories, plates, machined surfaces, light fixtures, and similar items already installed that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.

1. After completing coating operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants. Do not coat surfaces if surface moisture content or alkalinity exceeds that permitted in manufacturer's written instructions.
1. Remove incompatible primers, and reprime substrate with compatible primers as required to produce coating systems indicated.
 2. Perform cleaning and coating application so dust and other contaminants from cleaning process do not fall on wet, newly coated surfaces.

3.3 APPLICATION

- A. Apply intumescent paints according to manufacturer's written instructions and to comply with requirements for listing and labeling for surface-burning characteristics specified.
1. Use equipment and techniques best suited for substrate and type of material being applied.
 2. Coat surfaces behind movable items the same as similar exposed surfaces.
 3. Apply each coat separately according to manufacturer's written instructions.
 4. Finish doors on faces with intumescent finish. Paint tops, bottoms, and side edges with fire inert finish.
- B. Apply coatings to prepared surfaces as soon as practical after preparation and before subsequent surface soiling or deterioration.
- C. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Produce sharp lines and color breaks.
1. Pigmented Finishes: If undercoats or other conditions show through pigmented topcoat/overcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
 2. Clear Finishes: Produce a smooth surface film of even sheen using multiple coats.

3.4 CLEANING AND PROTECTION

- A. At end of each day, remove rubbish, empty cans, rags, and other discarded materials from site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

END OF SECTION 09 96 46

SECTION 09 97 23 - CONCRETE FLOOR SEALER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Application of membrane type curing and sealing compound on concrete surfaces to remain exposed.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications, application instructions, and recommendations. Include data substantiating product complies with requirements of the contract documents.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Building Code: Comply with applicable requirements for the IBC for interior finishes.
 - 2. Accessibility Requirements: Comply with applicable requirements.
 - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
 - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
 - c. Texas Accessibility Standards (TAS) 2012.
- B. Manufacturer Qualifications: Provide products produced by a company specializing in production of concrete sealers for minimum of 5 years.

1.5 PROJECT CONDITIONS

- A. Environmental Requirements: Do not proceed with installation until areas to receive work are enclosed and temperature and relative humidity are stabilized and maintained for optimum quality control.
- B. Environmental Limitations: Comply with coating manufacturer's written instructions for substrate temperature, ambient temperature, humidity, ventilation, and conditions affecting floor treatment application. Do not apply coating until wet work in spaces is complete and dry; and overhead work, including installing mechanical systems, lighting, and athletic equipment, is complete.
 - 1. Apply floor coatings when substrate temperature and surrounding air temperatures are between 50 degrees F and 95 degrees F (10 degrees F and 35 degrees C).
 - 2. Do not apply floor coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F (3 degrees C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCT

2.1 APPROVED MANUFACTURER

- A. Manufacturers listed below whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience

manufacturing products meeting or exceeding the specifications, comply with Division 1 requirements regarding substitutions to be considered and have Architect's approval prior to its use on the Project.

1. Dayton-Superior Corp
2. Euclid Chemical Company
3. W.R. Meadows, Inc. (Basis of Specification)

2.2 MATERIALS

- A. Typical, except as noted: Membrane type curing and sealing compound conforming to ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete, Type I, Class B and complying with Sealtight "Vocomp-20" as manufactured by W.R. Meadows, Inc., Fort Worth, TX; (817) 834-1969.
- B. Exterior Non-slip Traffic Coating: "Vocomp-20" as specified above, with "Sure-Step" slip-resistant additive as manufactured by W.R. Meadows, Inc., Fort Worth, TX; (817) 834-1969.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Concrete slabs shall be smooth, dry, and free of any foreign materials.
- B. Apply two (2) coats of specified finish in accordance with manufacturer's instructions.
- C. Allow approximately 24 hours drying time between installation of coats. Do not apply second coat until Architect has inspected first coat application.
- D. Install coating after all painting operations are completed.

END OF SECTION 09 97 23

SECTION 10 01 00 – MISCELLANEOUS SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Furnish and install the following:
 - 1. Rapid Entry System (Fireman's Lock Box).

1.3 RELATED SECTIONS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 04 20 00 - Unit Masonry.
- C. Section 05 50 00 – Metal Fabrications: Metal bracing, fasteners and other support components.
- D. Section 06 10 00 - Rough Carpentry: Wood blocking.
- E. Section 09 21 16 - Gypsum Board Assemblies.
- F. Section 09 51 00 - Acoustical Ceiling Panels.
- G. Division 26 – Electrical Sections.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
 - 3. Manufacturer's operation and maintenance data, as applicable.
- B. Shop Drawings: Show sizes, locations and installation details. Include utility (electrical, water, gas) requirements.
- C. Samples: Color charts showing manufacturer's full range of colors.

1.5 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 00 – Project Management and Coordination.

1.6 COORDINATION

- A. Coordinate Work of this Section with Work of other sections in which items are to be installed.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

- A. Specifications are based on named products and manufacturers. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

2.2 MATERIALS

- A. Rapid Entry System (Fireman's Lock Box)
 - 1. Fire Department Lock Box (main entry): Knox Company No.3200 recessed and hinged door surface mounted, with recessed mounting kit. Provide five (5) in addition to the locations shown on Drawings – to be installed at locations determined by Fire Marshall. Architect to select from available finishes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify utility (electrical, water, and gas) requirements, where applicable, are installed and ready for connection.
- B. Verify items fastened to walls have proper blocking or support items installed.
- C. Verify locations for items are ready for their installation.

3.2 INSTALLATION

- A. Install all items in accordance with manufacturer's printed instructions in locations shown on drawings or otherwise indicated.

3.3 CLEANING AND ADJUSTING

- A. Make final adjustment after installation and clean all backstop support piping of dirt and other substances which may affect final finish.
- B. Clean all items of dirt and foreign matter which may affect appearance and operation.
- C. Adjust items for proper operation.
- D. Instruct Owner's personnel on proper operation and maintenance of items.

END OF SECTION 10 01 00

SECTION 10 11 00 – MARKERBOARD AND TACKBOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 1. Markerboards.
 2. Tackboard.
 3. Tackstrips.
 4. Display Rails.
 5. Accessories necessary for a complete installation.

1.3 DEFINITIONS

- A. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

1.4 SUBMITTALS

- A. Product Data: Technical data for each type of product including construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.
 1. Include electrical characteristics for motorized units.
- B. Shop Drawings: Submit plans, elevations, sections, details, and attachment to other work.
 1. Indicate sizes and layout, method of attachment, accessories, trim, details and finish.
 2. Show locations of panel joints. Show locations of field assembled joints for factory fabricated units too large to ship in one piece.
 3. Show locations and layout of special purpose graphics.
 4. Include sections of typical trim members.
 5. Include wiring diagrams for power and control wiring.
- C. Samples: Submit for each type of visual display unit indicated.
 1. Visual Display Panel: Not less than 8-1/2 inches by 11 inches (215 mm by 280 mm), with facing, core, and backing indicated for final work. Include one panel for each type, color, and texture required.
 2. Trim: 6 inch (150 mm) long sections of each trim profile.
 3. Display Rail: 6 inch (150 mm) long section of each type.
 4. Rail Support System: 6 inch (152 mm) long sections.
 5. Accessories: Full size Sample of each type of accessory.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 1. Surface Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

- a. Flame Spread Index: 25 or less.
 - b. Smoke Developed Index: 450 or less.
2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 3. Accessibility Requirements: Comply with applicable requirements.
 - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
 - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
 - c. Texas Accessibility Standards (TAS) 2012.
- B. Installer Qualifications: Entity having minimum 5 years documented experience that employs installers and supervisors who are trained and approved by manufacturer.
- C. Source Limitations: Obtain each type of visual display unit from single source from single manufacturer.
- D. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
 1. Build mockup of typical shown on Drawings. Include accessories.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Preinstallation Conference: Conduct conference at site.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of construction contiguous with visual display units by field measurements before fabrication.
 1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

1.8 WARRANTY

- A. Porcelain Enamel Face Sheets: Written warranty in which Manufacturer agrees to repair or replace porcelain enamel face sheets that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Surfaces lose original writing and erasing qualities.
 - b. Surfaces exhibit crazing, cracking, or flaking.
 - c. Noticeable deterioration of finish.

- d. Writing surface delamination.
- e. Fabric discoloration, tearing, or delamination.
- f. Unit releasing from substrate.

2. Warranty Period: Lifetime of Installation from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Porcelain Enamel Face Sheet: PEI-1002, with face sheet two or three coat process.
- B. High Pressure Plastic Laminate: NEMA LD 3.
- C. Natural Cork Sheet: Seamless, single layer, compressed fine grain cork sheet; bulletin board quality; face sanded for natural finish with surface burning characteristics indicated.
- D. Plastic Impregnated-Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto fabric backing; with washable vinyl finish and integral color throughout with surface-burning characteristics indicated.
- E. Vinyl Fabric: Mildew resistant, washable, complying with FS CCC-W-408D, Type II, burlap weave; weighing not less than 13 oz./sq. yd. (440 g/sq. m); with surface burning characteristics indicated.
- F. Polyester Fabric: Nondirectional weave, 100 percent polyester; weighing not less than 15 oz./sq. yd. (508 g/sq. m); with surface-burning characteristics indicated.
- G. Hardboard: ANSI A135.4, tempered.
- H. Particleboard: ANSI A208.1, Grade M-1.
- I. Medium Density Fiberboard: ANSI A208.2, Grade 130.
- J. Fiberboard: ASTM C 208 cellulosic fiber insulating board.
- K. Clear Tempered Glass: ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed before tempering.
- L. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063.
- M. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by visual display unit manufacturer.
- N. Primer/Sealer: Mildew resistant primer/sealer recommended in writing by visual display unit manufacturer for intended substrate.

2.2 MARKERBOARD AND TACKBOARD

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

1. Aarco Products, Inc.
 2. ADP Lemco Incorporated, (ALinc).
 3. ASI VDP.
 4. Best Rite Manufacturing.
 5. Claridge Products and Equipment, Inc.
 6. Marsh Industries, Inc.
 7. Platinum Visual Systems.
- B. Markerboard: Factory fabricated.
1. Basis of Design: Claridge LCS³
 2. Assembly: Indicated on Drawings.
 3. Corners: Square
 4. Width: As indicated on Drawings.
 5. Height: As indicated on Drawings.
 6. Mounting Method: Direct to wall, ensure wood blocking is provided in wall for mounting.
- C. Markerboard Panel: 24 gauge porcelain enamel steel LCS 24 face sheet on 7/16 inch MDF core with 0.015 inch aluminum back sheet.
1. Color: White.
 2. Magnetic.
- D. Tackboard Panel: Vinyl fabric faced panel on core indicated.
1. Basis of Design: Claridge Fabricork series #1550EW or comparable product.
 2. Fabric Wrapped Edge: Wrap edge of tackboard panel with fabric facing.
 3. Thickness: 1/2 inch (12.7 mm)
 4. Color and Pattern: Selected by Architect.
- G. Aluminum Frames: Fabricated from not less than 0.062 inch (1.57 mm) thick, extruded aluminum; standard size and shape
1. Basis of Design: Claridge Series 1 or comparable product
 2. Field Applied Trim: Snap on trim with no visible screws or exposed joints.
 3. Aluminum Finish: Clear anodic finish.
 4. Color and Pattern: Selected by Architect.
- H. Joints: Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board as indicated on approved Shop Drawings.
- I. Combination Assemblies: Provide H trim between abutting sections of visual display panels.
- J. Chalktray: Continuous.
1. Box Type: Extruded aluminum with slanted front, grooved tray, and cast aluminum end closures.
 2. Solid Type: Extruded aluminum with ribbed section and smoothly curved exposed ends.
- K. Display Rail: Extruded aluminum display rail with plastic impregnated cork insert, end stops, and continuous paper holder, designed to hold accessories.
1. Basis of Design Manufacturer/Product: Claridge 74 EZ Deluxe Map and Display Rail or comparable product.
 2. Size: 2 inches (50 mm).
 3. End Stops: Claridge 75ES or comparable product.
- L. Flag Holder: Claridge #76 FH or equal. Two for each room- total, not two per board.

- M. Flag Holders & Map Hooks:
 - 1. For 16'-0" marker boards: Two (2) aluminum flag holders & four (4) aluminum map hooks.
 - 2. For 8'-0" marker boards: Two (2) aluminum flag holders & four (4) aluminum map hooks.
 - 3. For 4'-0" marker boards: Four (4) aluminum map hooks.
- N. Tackboards: Four (4) aluminum map hooks.
- O. Tackboard Insert Color: Selected by Architect.
 - 1. Aluminum Color: Match finish of visual display assembly trim.
- P. Marker Trough: Similar to No. 371A marker trough with extended rear flange and endcaps under all markerboards.
- Q. Roller Brackets: Similar to No. 76 R.B.; provide two (2) per mediaboard.

2.3 FINISH REQUIREMENTS

- A. Comply with NAAMM *Metal Finishes Manual for Architectural and Metal Products* for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Aluminum Finishes:
 - 1. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the work.
- B. Examine roughing in for electrical power systems to verify actual locations of connections before installation of motorized, sliding visual display units.
- C. Examine walls and partitions for proper preparation and backing for visual display units.
- D. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.
- E. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation. Clean substrates of substances, such as dirt, mold, and mildew, that impair the performance of and affect the smooth, finished surfaces of visual display boards.

- B. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.
 - 1. Moisture Content: Maximum of 4 percent when tested with an electronic moisture meter.
 - 2. Prepare substrates indicated to receive glass writing surfaces required by manufacturer's written instructions to achieve a smooth, dry, clean, structurally sound surface that is uniform in color.
 - a. Gypsum Board: Prime gypsum board with primer as recommended in writing by primer/sealer manufacturer and glass writing surface manufacturer.
 - b. Painted Surfaces: Treat areas susceptible to pigment bleeding.
- C. Prime wall surfaces indicated to receive visual display units and as recommended in writing by primer/sealer manufacturer and visual display unit manufacturer.
- D. Prepare recesses for sliding visual display units as required by type and size of unit.

3.3 INSTALLATION

- A. Install visual display surfaces in locations and at mounting heights indicated on Drawings. Keep perimeter lines straight, level, and plumb. Provide clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- B. Install clear silicone caulk along entire top edge of all markerboards and tackboards where they meet the wall.
- C. Factory Fabricated Visual Display Board Assemblies: Adhere to wall surfaces with egg size adhesive gobs at 16 inches (400 mm) o.c., horizontally and vertically.
 - 1. Field Applied Aluminum Trim: Attach trim over edges of visual display boards and conceal clips. Attach trim to boards with fasteners at maximum 24 inches (610 mm) o.c.
 - 2. Mounting Height: Install visual display units at mounting heights indicated on Drawings, or if not indicated, at heights indicated.
 - a. Mounting Height for Grades K through 3: 24 inches (610 mm) above finished floor to top of chalktray.
 - b. Mounting Height for Grades 4 through 6: 28 inches (711 mm) above finished floor to top of chalktray.
 - c. Mounting Height for Grades 7 and Higher: 36 inches (914 mm) above finished floor to top of chalktray.

3.4 CLEANING AND PROTECTION

- A. Clean visual display units according to manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.
- B. Touch up factory applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display units after installation and cleaning.

END OF SECTION 10 11 00

SECTION 10 14 00 - GRAPHICS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 1. Panel signs.
 2. Room identification signs.
 3. Field applied, vinyl character signs.
 4. Cast character for exterior signage.
 5. Handicap parking signs.
 6. Accessories necessary for a complete installation.

1.3 SUBMITTALS

- A. Product Data: Technical data for each type of signage.
- B. Signage Shop Drawings: Submit fabrication and installation details and attachments to other Work.
 1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 2. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
- C. Dedication Plaque Shop Drawings: Submit fabrication and installation details and attachments to other Work.
 1. Indicating materials, sizes, and finishes, details of fabrication and installation, fasteners and hardware, attachments, related and adjacent Work.
 2. Rubbing of actual pattern of cast metal plaque for Architect's approval prior to casting.
- D. Certifications: Submit letter of certification from manufacturer that installer and manufacturer is in compliance and meets specified requirements.
- E. Samples:
 1. One (1) 6 inch x 6 inch sample of cast metal plaque material with specified finish.
 2. One (1) 4 inch actual sample of cast metal letter in specified letter style and finish.
 3. One (1) actual sample of each type room identification sign with specified finish.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 1. Building Code/City Code: Comply with building code and local ordinances for exterior signage.
 2. Accessibility Requirements: Comply with applicable requirements.
 - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
 - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
 - c. Texas Accessibility Standards (TAS) 2012.

- B. Installer Qualifications: Installer has minimum 5 Years documented experience in the manufacture of signage and who employs installers and supervisors trained and approved in installation methods for each type of signage.
- C. Thermal Movements: For exterior fabricated channel dimensional characters, allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

1.5 FIELD CONDITIONS

- A. Field Measurements: Verify locations of anchorage devices and electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.6 WARRANTY

- A. Written warranty signed by manufacturer in which manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image.
 - c. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Basis of Design Manufacturer: South Texas Graphics; (713) 467-4499. Other manufacturers shall have a minimum of five (5) years experience manufacturing products meeting or exceeding those specified and shall comply with Division 1 requirements for substitutions in order to be considered.
 - 1. A.R.K. Ramos Architectural Signage Systems; (405) 235-5505.
 - 2. InPro Corporation (IPC); (800) 222-5566.
 - 3. ProWorx Architectural Signage; (713) 666-3131.
 - 4. Riot Creative Imaging; (713) 988-9200.
 - 5. Stanley Signature Signs; (281) 395-6106.
 - 6. The Southwell Co.; (210) 223-1831.
 - 7. Aria Signs; (713) 259-3737.
- B. Aluminum Castings: ASTM B 26/B 26M, alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated.
- C. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- D. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- E. Acrylic Sheet: ASTM D 4802, category standard with manufacturer for each sign, Type UVF (UV filtering).
- F. Plastic Laminate Sheet: NEMA LD 3, general purpose HGS grade, 0.048-inch (1.2-mm) nominal thickness.

- G. Vinyl Film: UV resistant vinyl film of nominal thickness indicated, with pressure sensitive, permanent adhesive on back; die cut to form characters or images indicated and suitable for exterior applications.
- H. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.
- I. Accessories:
 - 1. Fasteners and Anchors: As necessary for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:
 - a. Use concealed fasteners and anchors unless indicated to be exposed.
 - b. Exposed Metal Fastener Components: Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
 - 2. Sign Mounting Fasteners:
 - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly, unless otherwise indicated.
 - 3. Adhesive: Recommended by sign manufacturer.
 - 4. Two Face Tape: High bond, foam core tape, 0.045 inch (1.14 mm) thick, with adhesive on both sides.
 - 5. Bituminous Paint: Cold applied asphalt emulsion complying with ASTM D 1187.

2.2 SIGNAGE

- A. General:
 - 1. Constructed of one (1) or two (2) high pressure laminate in colors selected by Architect, laminated to an 1/8" inch thick acrylic backer.
 - 2. Signage shall have radius or square corners with square cut edges painted a color as selected by Architect / Owner.
 - 3. Demarcation lines, if any, can be raised 1/32" inch to match copy or engraved and infilled with a color as selected by Architect / Owner.
 - 4. Signs shall comply with all state and federal codes, including but not limited to, the 2012 ADA and TAS requirements.
 - 5. Refer to drawings for details of types, dimensions, colors, graphic layouts and mounting/height specifications.
- B. Room Numbers, Symbols, Lower or Secondary Copy, and Pictograms:
 - 1. Copy shall be matte finished acrylic, raised 1/32" inch of a color contrasting to the face laminate.
 - 2. Characters and pictograms shall be chemically welded to the acrylic backing, through the face laminate, to assure permanent adhesion.
 - 3. Room numbers and restroom copy shall be copy shall be accompanied by Grade II Braille by means of 'VisiTouch DuraDot System'. Glass or metallic 'DuraDots' shall have .059 inch surface diameter with body of sphere pressure secured below face laminate. Routed boxes or glued on dots are not acceptable.
 - 4. Secondary copy shall be a minimum of 5/8" inch high, matte finished acrylic, raised 1/32" inch sans serif font.
 - 5. Acceptable ADA compliant fonts are Arial, Helvetica, Optima, Futura as selected by Architect, in all caps.
- C. Restroom Pictograms:
 - 1. Pictograms shall appear on a minimum 6" inch, unobstructed square.
- D. Window (Slotted) Signs:

1. Window / Slotted signs shall be open at both ends for changeable insert provided by Owner. Window shall be a non-glare Lexan acrylic lens, with an exposed color laminate behind in color as selected by Architect/Owner.
- E. Fasteners and Accessories:
 1. 1/8" inch thick, double-sided foam tape of type recommended to suite application and commercial grade silicone sealant.
 2. Back-up plates shall be supplied, when shown or required, for signage mounted on glass.
- F. Provide all materials required for a complete installation.
- G. Approved manufacturers:
 1. Signage:
 - a. Basis of Design: South Texas Graphic Specialties, Inc. Houston, TX 713.467.4499.
 - b. Refer to 2.1.A. of Section 10 14 00 for approved manufacturers.
 2. Plastic Laminate:
 - a. WilsonArt International, Temple, TX 800.433.3222
 - b. Nevamar Company, LLC, Shelton, CT 877.726.6526
 - c. Formica, 1.800.367.6422
 - d. Pionite, Shelton, CT 203.925.1556
- H. Cast Characters: Characters with uniform faces, sharp corners, and precisely formed lines and profiles:
 1. Character Material: Cast aluminum.
 2. Character Height: Indicated on Drawings.
 3. Finishes:
 - a. Baked Enamel or Powder Coat Finish: Color to match school colors and logo.
 - b. Overcoat: Baked on clear coating.
 4. Mounting: Concealed studs.
 5. Typeface: Selected by Architect.
- I. Field Applied, Vinyl Character Sign: Prespaced characters die cut from 3 mil to 3.5 mil (0.076 mm to 0.089 mm) thick, weather resistant vinyl film with release liner on the back and carrier film on the front for on site alignment and application.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allen Markings.
 - b. APCO Graphics, Inc.
 - c. Mohawk Sign Systems.
 - d. Seton Identification Products.
 2. Size: Indicated on Drawings.
 3. Substrate: Indicated on Drawings.
- J. Handicap Signs:
 1. Signage Materials: 0.080 inch thick aluminum or galvanized steel sign with 1-1/2 inch silk screen upper case letters, copy and border. Signs shall have 1-1/2 inch radius at corners typically. Sizes shall be as shown on drawings or required by authorities having jurisdiction.
 2. Post Materials: Provided by Section 05 50 00, Metal Fabrications.
 3. Graphics:

- a. Accessibility (“Handicapped Parking”) signs with lettering and graphics as detailed. All Work shall comply with local codes, ADA, and TAS standards and requirements.
4. Accessories:
 - a. Sign Mounting Hardware: Provide sign mounting hardware of galvanized steel of type and size instructed by manufacturer to suit intended use.
 - b. Provide concrete footings of 3,000 psi compressive strength at 28 days, unless noted or directed otherwise.
 - c. Provide all materials required for signage and proper installation.
- K. Illegally Parking Signs in Accessible Spaces:
 1. Sign for Illegally parking in a paved accessible parking space.
 2. Minimum state “Violators Subject to Fine and Towing” in a letter height of at least one inch.
 3. Mounted on a pole, post, wall or freestanding board as shown on the Drawings.
 4. No more than eight (8) inches below a sign required by ADA and TAS standards.
 5. Installed so bottom edge of sign is no lower than 48 inches and no higher than 80 inches above ground level.
- L. Door Vinyl Numbers:
 1. Composition: 11 inch x 13 inch white background with 8 inch black reflective numbering located on the transom above and outside door.
 2. Material: Vinyl.
 3. Font: Arial.
 4. Sequence: Start at main entry working clockwise. The Main Entry is door number 1, then next clockwise is 2, and so on.
 5. Locations: At multiple doors, add ~~one~~ TWO door sign and number in the vicinity. Do not number doors that cannot access the rest of the building.
- M. Driveway Entrance Paint and Signs:
 1. Composition: Entry drives are 24 inches diameter blue with 20 inches white number with striping paint, start with main entrance and work clockwise Each driveway needs to also have a sign, the size of a speed limit sign, with entry number matching the concrete drive number and below the driveway number the cardinal direction of that driveway, i.e. N for North drive, SE for Southeast drive, etc. The driveways signs will be galvanized steel with 3M™ Diamond Grade™ DG³ Reflective Sign Sheeting or comparable product with black number and letter and white background, similar to speed limit sign. The sign to be 12”W and 24”H. The letters on the sign to be 10” High and the number to be 10” High.
 2. Font: Arial.
 3. Location: Each driveway entrance numbered with paint on the concrete entrance. Refer to Section 09 90 00.

2.3 FABRICATION

- A. Provide sign assemblies according to requirements indicated.
 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
 4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 5. Internally brace signs for stability and for securing fasteners.

6. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing Work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
 7. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.
- B. Brackets: Fabricate brackets, fittings, and hardware for bracket mounted signs to suit sign construction and mounting conditions indicated. Modify brackets as necessary.
1. Aluminum Brackets: Factory finish brackets with baked enamel or powder coat finish to match sign background color unless otherwise indicated.

2.4 FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.
- D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.
- E. Aluminum Finishes:
1. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.
 2. Baked Enamel or Powder Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of signage Work. Verify sign support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- B. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

- A. Install signs using mounting methods indicated and according to manufacturer's written instructions.
1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 3. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent

- walls. Locate to allow approach within 3 inches (75 mm) of sign without encountering protruding objects or standing within swing of door.
- a. Comply with all applicable accessibility requirements for mounting height and location of each sign.
4. Before installation, verify sign surfaces are clean and free of materials or debris that impair installation.
 5. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Mounting Methods:
1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
 2. Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position so that signage is correctly located and aligned.
 3. Shim Plate Mounting: Provide 1/8 inch (3 mm) thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other direct mounting methods are impractical. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach signs to plate using method specified above.
- C. Field Applied, Vinyl Character Signs: Clean and dry substrate. Align sign characters in final position before removing release liner. Remove release liner in stages, and apply and firmly press characters into final position. Press from the middle outward to obtain good bond without blisters or fishmouths. Remove carrier film without disturbing applied vinyl film.
- D. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 10 14 00

SECTION 10 14 33 – ELECTRONIC SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Programmable LED electronic signage.
 - 2. Accessories necessary for a complete installation.

1.3 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.
- B. Illuminated: Illuminated by lighting source integrally constructed as part of the sign unit.

1.4 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

1.5 SUBMITTALS

- A. Product Data: Technical data including description of components, wiring and electrical requirements, installation instructions, and maintenance parts.
- B. Shop Drawings: Submit fabrication and installation details and attachments to other work.
 - 1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 - 2. Show message list, typestyles, graphic elements and layout for each sign at least half size.
 - 3. Show locations of electrical service connections.
 - 4. Include diagrams for power, signal, and control wiring.
- C. Samples: Submit sign assembly showing components and with the required finish, in manufacturer's standard size unless otherwise indicated:
 - 1. Exposed Accessories: Half size Sample of each accessory type.
- D. Permit Documentation: Provide permit document from the jurisdiction.
- E. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On USB media or compact disk, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.
- F. Maintenance Data: Submit data to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Building Code: Comply with requirements of AHJ and signage ordinance requirements.
 - 2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 3. Welding: Qualify procedures and personnel according to AWS D1.2 Structural Welding Code - Aluminum.
 - 4. Accessibility Requirements: Comply with applicable requirements.
 - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
 - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
 - c. Texas Accessibility Standards (TAS) 2012.
- B. Installer Qualifications: Manufacturer of electronic signage or an entity that employs installers and supervisors who are trained and approved by manufacturer, having minimum 5 years documented experience in manufacture and installation of electronic signage and the related computer software.
- C. Source Limitations: Obtain each electronic signage from single source from single manufacturer.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify locations of anchorage devices and electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.8 COORDINATION

- A. Furnish templates for placement of sign anchorage devices embedded in permanent construction by other installers.
- B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.9 WARRANTY

- A. Written warranty signed by manufacturer in which manufacturer agrees to repair or replace electronic signage and software or signage components that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Faulty operation of software, LED, and fans.
 - b. Deterioration of finishes beyond normal weathering.
 - c. Deterioration of embedded graphic image.
 - d. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Five (5) years from date of Substantial Completion.
 - 3. Lifetime free technical support and training.

PART 2 - PRODUCTS

2.1 ELECTRONIC SIGNAGE

- A. Basis of Design: as manufactured by Spectrum Scoreboards. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and Comply with Division 1 requirements regarding substitutions to be considered:
1. Daktronics, Inc.
 2. Poblocki Sign Company.
 3. PolyVision Corporation.
- B. Double Sided Full Color LED Display:
1. Dimensions: As indicated on Drawings.
 2. Composition: Internally, illuminated identification cabinet with Makrolon SL Faces Decorated Internally.
 3. Cover: UL Listed LED Vandal Cover.
 4. UV Inhibitor infused sign face:
 - a. Protect graphics for life of the sign.
 5. Trim: Aluminum, matte finish
 - a. Colors: Architect to select color from manufacturer's full range.
 6. LED Display: Color 32 X 144 Pixel Matrix.
 - a. Available Colors: Over 281 Quintillion colors.
 - b. Font: Arial.
 - c. Displays 4 lines of 5.5 inches tall characters with approx. 24-30 characters per line.
 - d. Capable of displaying 1-4 lines of text.
 - e. Variable fonts and text sizes up to 25.2 inches tall.
 - f. Cloud-Based Software:
 - 1) SignCommand.com.
 - g. Graphics: 3M Vinyl Photo-Real Graphics.
 7. Electrical: 100,000 hour average LED useful life. Refer to Division 26 – "Electrical."
 - a. LED Cabinet:
 - 1) Circuit: 2 – 20 amp (1 per side).
 - 2) Volts: 120 V.
 - 3) Max Draw: 10.8 amps per circuit.
 - b. ID Cabinet:
 - 1) Circuit: 1-20 amp.
 - 2) Volts: 120-277 V.
 - 3) Max Draw: .9 amps per circuit.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for, installation tolerances, electrical conduit location, and other conditions affecting performance. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

- A. Install electronic LED signage in accordance with manufacturer's written instructions.

- B. Set anchor bolts and other embedded items required for installation. Use templates furnished by suppliers of items to be attached.
- C. Run wires into wall construction through conduit. Exposed to view wiring or conduit on wall face is not permitted. Connect wiring to power supply.
- D. Install signage level, plumb, and at height indicated, with surfaces free from distortion or other defects in appearance.
- E. Program electronic LED signage. Test each component of system and software for glitches or malfunctions. Correct and retest until system runs without glitches or malfunctions.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. At complete of installation, clean soiled surfaces of electronic signs according to manufacturer's written instructions.
- B. Remove and replace damaged or deformed signage and signage that does not comply with specified requirements. Replace signage with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- C. Remove temporary protective coverings and strippable films as signs are installed.
- D. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signage in a clean condition during construction and protect from damage until acceptance by Owner.

3.4 DEMONSTRATION

- A. Engage a factory authorized service representative to train Owner's staff in programming electronic LED signage and maintenance personnel to adjust, operate, and maintain electronic signs. Provide one set of basic tools necessary for routine maintenance.

END OF SECTION 10 14 33

SECTION 10 14 53 TRAFFIC SIGNAGE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Refer to Harris County Engineering Department (HCED) Specifications, dated October 10, 2023 or City of Humble specifications when working in public right of way.
- C. This section contains HCED items:
 - 1. 502 – Traffic Signs, Roadside Signs, and Mailboxes
 - 2. 644 – Roadside Sign Supports
 - 3. 860 – Sign Face Materials

ITEM 502

TRAFFIC SIGNS, ROADSIDE SIGNS, AND MAILBOXES

502.1 DESCRIPTION.

This Item shall govern for the removal and relocation or disposal of traffic signs, roadside signs, and mailboxes.

502.2 REFERENCES.

A. TMUTCD

502.3 MATERIALS.

Hydraulic Cement Concrete. Hydraulic cement concrete for traffic signs, roadside signs, and mailbox foundations shall meet the requirements of Item 421 "Hydraulic Cement Concrete" and shall be Class A concrete or as indicated on the Contract Documents.

502.4 CONSTRUCTION.

Traffic signs, roadside signs, and mailboxes shall be relocated as shown on the Contract Documents. Traffic signs and roadside signs shall be relocated in accordance with TMUTCD. They shall be relocated with the foundation standard required by the applicable jurisdictional agencies. When relocating specialty/custom mailboxes, they shall be replaced with approved standard mailboxes.

For any location on the project site that is to remain open to traffic, the Contractor is required to furnish and install temporary poles, fittings, fixtures, signals, signs or other incidentals necessary to construct permanent traffic control systems. Such temporary installation shall remain in place until the relocated systems are operational or when directed by HCED.

502.5 SUBMITTAL.

Hydraulic Cement Concrete. The Contractor shall submit the concrete mix design and certification that the concrete used meets the requirements of this Item.

502.6 MEASUREMENT.

Traffic signs, roadside signs, and mailboxes shall be measured by the lump sum or by each removed and relocated or disposed.

502.7 PAYMENT.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" shall be paid for at the unit price bid for "Traffic Signs, Roadside Signs, and Mailboxes (Remove and Relocate or Disposal)." This price is full compensation for installing approved standard mailboxes as needed; preparing foundation surfaces; furnishing and placing concrete; and equipment, labor, tools, and incidentals necessary to complete the work.

There are item code(s), description(s), and unit(s) for this Item.

NOTE: This Item requires other Standard Specifications

Item 421 "Hydraulic Cement Concrete"

END OF ITEM 502

ITEM 644

ROADSIDE SIGN SUPPORTS

644.1 DESCRIPTION.

This Item shall govern for furnishing and installing supports of steel tubing which are used for traffic signs normally erected to a minimum height of 7 feet from top of pavement edge to the bottom of the lowest sign on the support, in accordance with the Latest Edition of the "Texas Manual on Uniform Traffic Control Device" (TMUTCD). Placement of roadside sign supports shall also provide appropriate lateral clearance to signs in accordance with the TMUTCD.

644.2 REFERENCES.

- A. ASTM A153 "Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware"
- B. ASTM A307 "Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength"
- C. ASTM A513 "Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing"
- D. ASTM A653 "Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process"
- E. ASTM B117 "Standard Practice for Operating Salt Spray (Fog) Apparatus"
- F. ASTM D522 "Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings"
- G. ASTM D1735 "Standard Practice for Testing Water Resistance of Coatings Using Water Fog Apparatus"
- H. TMUTCD

644.3 MATERIALS.

High visibility yellow coated galvanized sign posts shall be as shown in Table 1:

TABLE 1
GALVANIZED SIGN POST

	PIPE	SQUARE TUBING
Nominal Size	2"	1-3/4" x 1-3/4"
Outside Diameter	2.375" (2-3/8")	1-3/4" x 1-3/4"
Wall Thickness	0.065"	0.083"
Weight per Foot	1.604 lbs.	1.75 lbs.
Length	10 Feet, 11 Feet, or as specified	10 Feet, 11 Feet, or as specified
Holes	3/8" holes punched or as specified	3/8" holes punched or as specified
Hardware	5/16" hex bolt with nut, lock washer, 2 flat washers per ASTM A307 galvanized per ASTM A153	5/16" hex bolt with nut, lock washer, 2 flat washers per ASTM A307 galvanized per ASTM A153

Tubing shall be manufactured from steel sheeting conforming to ASTM A513. The tubing shall be hot dipped galvanized per ASTM A653 to obtain a zinc weight of 1.8 ounces per square foot inside and outside of the tube. Galvanizing shall be done after fabrication and punching or drilling of any holes.

Coating color shall be high visibility traffic yellow. Yellow coating shall be applied over the galvanized post to an average minimum dry mil thickness of 2.0. The tubing shall be properly cleaned and pre-treated to achieve the coating properties below as shown in Table 2.

TABLE 2
COATING PROPERTIES

Damage Resistance	Coating flexibility shall conform to ASTM D522, 1/8 inch mandrel, with no cracking
Corrosion Resistance	Salt spray tested, scribed to meet ASTM B117, 500 hours, salt spray 1/8 inch creepage

Humidity Cabinet	Coating shall meet the requirements of ASTM D1735, 500 hours - no blisters
Weathering Resistance	QUV weathering, 50% gloss at 60% after 500 hours

There shall be no loss of integrity of adhesion. Color retainage shall be with a minimum of chalking. There shall be no effect on the coating for the following substances:

- A. Gasoline
- B. Motor Oil
- C. Alcohol
- D. Thirty-percent Sodium Hydroxide
- E. Thirty-percent Hydrochloric Acid
- F. Thirty-percent Nitric Acid
- G. Thirty-percent Sulfuric Acid

644.4 MEASUREMENT AND PAYMENT.

Roadside sign supports shall not be paid for directly, but shall be incidental to Item 636 "Signs."

There are no item code(s), description(s), or unit(s) for this Item.

NOTE: This Item requires other Standard Specifications.

Item 636 "Signs"

END OF ITEM 644

ITEM 860

SIGN FACE MATERIALS

860.1 DESCRIPTION.

This Item shall govern for furnishing and installing sign face material fabricated from flexible, colored, wide angle prismatic retroreflective sheeting and related processing materials to be used for traffic control signs.

860.2 REFERENCES.

- A. ASTM B117 "Standard Practice for Operating Salt Spray (Fog) Apparatus"
- B. ASTM B209 "Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate"
- C. ASTM D523 "Standard Test Method for Specular Gloss"
- D. ASTM E284 "Standard Terminology of Appearance"
- E. ASTM E308 "Standard Practice for Computing the Colors of Objects by Using the CIE System"
- F. ASTM E810 "Standard Test Method for Coefficient of Retroreflection of Retroreflective Sheeting Utilizing the Coplanar Geometry"
- G. ASTM E1164 "Standard Practice for Obtaining Spectrometric Data for Object-Color Evaluation"
- H. International Commission on Illumination (CIE) Publication Number 39.2 "Recommendations for Surface Colours for Visual Signalling"

860.3 REQUIREMENTS.

The retroreflective sheeting for sign faces/finished signs shall have a smooth surface with a distinctive interlocking diamond seal pattern and orientation marks visible from the face. The sheeting shall be precoated with a pressure sensitive adhesive backing protected by a removable liner.

The adhesive shall require no heat for proper bonding when applied in accordance with the manufacturer's recommendations to substrates 65° F or above.

860.4 TEST METHODS.

Test Conditions. Unless otherwise specified herein, all applied and unapplied test samples and specimens shall be conditioned at the standard conditions of 73 ± 3 degrees F. (23 ± 3 degrees C.) and 50 ± 5% relative humidity for 24 hours prior to testing.

Test Panels. Unless otherwise specified herein, when tests are to be performed using test panels, the specimens of retroreflective material shall be applied to smooth aluminum cut from ASTM B209 alloy 5052-H36, 5052-H38, 5154-H38 or 6061-T6 sheets in 0.020 inch (0.051 cm), 0.040 inch (0.102 cm) or 0.063 inch (0.160 cm) thickness. The aluminum shall be degreased and lightly acid etched before the specimens are applied. The specimens shall be applied to the panels in accordance with the recommendations of the retroreflective sheeting manufacturer.

860.5 PHYSICAL REQUIREMENTS.

Color Requirements.

**TABLE 1
 COLOR SPECIFICATION LIMITS* (DAYTIME)**

COLOR	1		2		3		4		MIN.	MAX.
	x	y	x	Y	x	y	x	y		
White	0.303	0.300	.0368	0.366	0.340	0.393	0.274	0.329	40.0	-
Yellow	0.498	0.412	0.557	0.442	0.479	0.520	0.438	0.472	24.0	45.0
Red	0.648	0.351	0.735	0.265	0.629	0.281	0.565	0.346	3.0	15.0
Blue	0.078	0.171	0.150	0.220	0.210	0.160	0.137	0.038	1.0	10.0
Green	0.026	0.399	0.166	0.364	0.286	0.446	0.207	0.771	3.0	12.0
Orange	0.558	0.352	0.636	0.364	0.570	0.429	0.506	0.404	12.0	30.0
Brown	0.430	0.340	0.430	0.390	0.518	0.434	0.570	0.382	1.0	6.0
Purple	0.302	0.064	0.310	0.210	0.380	0.255	0.468	0.140	2.0	10.0

* The four pairs of chromaticity coordinates determine the acceptable color in terms of the CIE 1931 standard colorimetric system measured with standard illuminant D65.

TABLE 2
COLOR SPECIFICATION LIMITS* (NIGHTTIME)

COLOR	1		2		3		4	
	X	y	x	y	x	y	x	y
White	0.475	0.452	0.360	0.415	0.392	0.370	0.515	0.409
Yellow	0.513	0.487	0.500	0.470	0.545	0.425	0.572	0.425
Red	0.650	0.348	0.620	0.348	0.712	0.255	0.735	0.265
Blue	0.033	0.370	0.180	0.370	0.230	0.240	0.091	0.133
Green	0.007	0.570	0.200	0.500	0.322	0.590	0.193	0.782
Orange	0.595	0.405	0.565	0.405	0.613	0.355	0.643	0.355
Brown	0.595	0.405	0.540	0.405	0.570	0.365	0.643	0.355
Purple	0.355	0.088	0.385	0.288	0.500	0.350	0.635	0.221

* The four pairs of chromaticity coordinates determine the acceptable color in terms of the CIE 1931 standard colorimetric system measured with standard illuminant A.

Color Test. Conformance to color requirements shall be determined by instrumental method in accordance with ASTM E1164 on sheeting applied to test panels and conditioned as in Article 860.4, Section A. The values shall be determined on a HunterLab Labscan II 0/45 spectrophotometer with option CMR 559. Computations shall be done in accordance with ASTM E308.

Coefficient of Retroreflection (R'). The coefficients of retroreflection shall not be less than the minimum values specified in Table 3 and Table 3A. Testing shall be in accordance with ASTM E810 except that the Table 3 values shall be met at 0 degrees and at 90 degrees orientation without averaging and the Table 3A values shall be met using only the 45 degree orientation.

- A. Units.** Coefficients of retroreflection (R') shall be specified in units of candelas per lux per square meter.
- B.** The observation angles shall be 0.1, 0.2, 0.5 and 1 degree.
- C.** The entrance angles shall be -4, 30 and 45 degrees.
- D.** For screen printed transparent colored areas or transparent colored overlay films on white sheeting, the ratio of coefficients of retroreflection (R') of the white to the other color, when measured at 0.2° observation, -4° entrance, and 0° rotation, shall be 5:1 to 15:1 for red, and not less than 5:1 for all other colors.

TABLE 3

**MINIMUM COEFFICIENT OF RETROREFLECTION R'
 (CANDELAS PER LUX PER METER SQUARED)
 (0 AND 90 DEGREE ORIENTATION)**

OBSERVATION ANGLE (DEG.)	ENTRANCE ANGLE (DEG.)	WHITE	YELLOW	RED	GREEN	BLUE
0.1	-4	625	565	165	80	42
0.1	+30	430	315	110	45	22
0.1	+45	120	90	24	12.5	6
0.2	-4	370	300	98	45	22
0.2	+30	225	180	65	28	14
0.2	+45	90	70	26	9.8	4.5
0.5	-4	275	220	70	32	17
0.5	+30	125	100	32	16	8
0.5	+45	35	27	10	3.5	1.5
1.0	-4	75	58	20	9	4.5
1.0	+30	42	35	11	6	3
1.0	+45	10	8.8	3	1.6	.8

80 percent of values listed in Table 3 after 7 years and 70 percent of values listed in Table 3 after ten years must be maintained.

Failure of processing inks or overlay films provided and/or sold for use on recommended sheeting shall constitute a failure of entire sign and shall be replaced under manufacturer's replacement obligation.

TABLE 3A

**MINIMUM COEFFICIENT OF RETROREFLECTION R'
 (CANDELAS PER LUX PER METER SQUARED)
 (45 DEGREE ORIENTATION)**

OBSERVATION ANGLE (DEG.)	ENTRANCE ANGLE (DEG.)	YELLOW
0.2	-4	550
0.2	+30	130
0.5	-4	145

OBSERVATION ANGLE (DEG.)	ENTRANCE ANGLE (DEG.)	YELLOW
0.5	+30	70

Specular Gloss. The retroreflective sheeting shall have an 85 degree specular gloss of not less than 50 when tested in accordance with ASTM D523.

Color Processing. The retroreflective sheeting shall permit cutting and color processing with compatible transparent and opaque process colors in accordance with the sheeting manufacturer's recommendations at temperatures of 60 to 100 degrees F. (16 to 38 degrees C.) and relative humidities of 20 to 80 percent. The sheeting shall be heat resistant and permit force curing without staining of applied or unapplied sheeting at temperatures recommended by the sheeting manufacturer.

Flexibility. The retroreflective sheeting with the liner removed and conditioned as in Article 860.4, Section A, shall be sufficiently flexible to show no cracking when slowly bent, in one seconds' time, around a 1/8 inch mandrel, with the adhesive contacting the mandrel, at test conditions. Talcum powder shall be spread on the adhesive to prevent sticking to the mandrel.

Adhesive. The protective liner attached to the adhesive shall be removed by peeling without soaking in water or other solutions, without breaking, tearing, or removing any adhesive from the backing. The protective liner shall be easily removed following accelerated storage for 4 hours at 160 degrees F. (71 degrees C.) under a weight of 2.5 pounds per square inch (0.176 kg/cm²). The adhesive backing of the retroreflective sheeting shall produce a bond to support a 1.75 pound (0.79 kg) weight for 5 minutes without the bond peeling for a distance of more than 2 inches (5.08 cm) when applied to a test panel prepared as in Article 860.4, Section B. Apply 4 inches (10.16 cm) of a 1 inch x 6 inch (2.54 cm x 15.2 cm) specimen to a test panel. Condition and then position the panel face down horizontally; suspend the weight from the free end of the sample and allow it to hang free at an angle of 90 degrees to the panel surface for 5 minutes.

Impact Resistance. The retroreflective sheeting applied according to the sheeting manufacturer's recommendations to a test panel of alloy 6061-T6, 0.040 inch (0.10 cm) by 3 inch (7.6 cm) by 5 inch (12.7cm) and conditioned as in Article 860.4, Section A, shall show no cracking outside the impact area when the face of the panel is subjected to an impact of a 4 lb. (1.82 kg) weight, with a 5/8 inch (15.8 mm) diameter rounded tip, dropped from a height necessary to generate an impact of 10 in. lb. (1.13 N-m) at test

temperatures of 32 degrees F. (0 degrees C.) and 72 degrees F. (22 degrees C.).

Resistance to Accelerated Outdoor Weathering. The retroreflective surface of the sheeting shall be weather resistant and show no appreciable cracking, blistering, crazing or dimensional change after 3 years unprotected outdoor exposure, facing the equator and inclined 45 degrees from the vertical. Following weather exposure, panels shall be washed in a 5 percent HCL solution for 45 seconds, rinsed thoroughly with clean water, blotted with a soft clean cloth and brought to equilibrium at standard conditions. After cleaning, the coefficient of retroreflection shall not be less than 70 percent of the values in Table 3.

The sample shall:

- A. Show no appreciable evidence of cracking, scaling, pitting, blistering, edge lifting, or curling, or more than 1/32 inch (0.08 cm) shrinkage or expansion;
- B. Be measured only at angles of 0.2 degrees observation, -4 degrees entrance and 90 degrees orientation. Where more than one panel of a color is measured, the coefficient of retroreflection shall be the average of all determinations.

Resistance to Heat. The retroreflective sheeting, applied to a test panel and conditioned as in Article 860.4, Section A, shall be measured in accordance with Article 860.5, Section C at 0.2 degrees observation and -4 degrees entrance angles at both 0 degree and 90 degree orientations and exposed to 170 ± 5 degrees F. (77 ± 3 degrees C.) for 24 hours in an air circulating oven. After heat exposure the sheeting shall retain a minimum of 70 percent of the original coefficient of retroreflection at both orientations when measured at room temperature.

Resistance to Corrosion. The retroreflective sheeting applied to a test panel and conditioned as in Article 860.4, Section A, shall show no loss of adhesion, appreciable discoloration, or corrosion, and after cleaning shall retain a minimum of 80 percent of the original coefficient of retroreflection when measured at 0.2 degrees observation, -4 degrees entrance and 0 degrees and 90 degrees orientation angles only, after 1000 hours exposure to a 5 percent concentration salt spray at 95 degrees F. (35 degrees C.) when tested in accordance with ASTM B117.

General Characteristics and Packaging. The faces/finished signs supplied shall be of good appearance, free from ragged edges, cracks, and extraneous materials, and show careful workmanship with the message and border sharply defined.

When furnished as faces the sheeting shall be packaged flat in accordance with commercially accepted standards. Faces shall be interleaved with slipsheets as called for in this Item. The slip sheet glossy side shall be placed against the face with a maximum of 25 faces per carton.

When furnished as finished signs the signs must be protected with slip sheet and foam padding. The slip sheet glossy side shall be placed against the face and sign face padded with closed cell packaging foam. Finished signs shall be packaged in quantities of 10 or less to facilitate handling.

The packaged faces or signs shall include the appropriate number of washers as called for in this Item.

860.6 PERFORMANCE REQUIREMENTS AND OBLIGATIONS.

Certification. The sheeting manufacturer shall, upon request, submit with each lot or shipment, a certification which states that the material supplied will meet all of the requirements listed herein.

Field Performance Requirements: Retroreflective sheeting processed and applied to sign blank materials in accordance with the sheeting manufacturer's recommendations, shall perform effectively for a minimum of 10 years. The retroreflective sheeting will be considered unsatisfactory if it has deteriorated due to natural causes to the extent that:

- A.** The sign is ineffective for its intended purpose when viewed from a moving vehicle under normal day and night driving conditions; or
- B.** The coefficient of retroreflection is less than the minimums specified in Table 3.

Measurements. All measurements shall be made after sign cleaning according to the sheeting manufacturer's recommendations.

Coefficients of Retroreflection. For screen printed transparent colored areas on white sheeting, the coefficients of retroreflection shall maintain the ratios required by this Item as indicated in Article 860.5, Section C.

Sheeting Manufacturer's Replacement Obligation. Where it can be shown that retroreflective signs with Types A and B sheeting supplied and used according to the sheeting manufacturer's recommendations have not met the performance requirements of Article 860.6, Section B, the sheeting manufacturer shall cover the restoration costs as follows for sheetings shown to be unsatisfactory during:

- A. The entire 10 years: the sheeting manufacturer will replace the sheeting required to restore the sign surface to its original effectiveness.
- B. In addition, during the first 7 years the sheeting manufacturer will cover the cost of restoring the sign surface to its original effectiveness at no cost to Harris County for materials and labor.

Harris County shall require the dating of all signs at the time of application. The date constitutes the start of the field performance obligation period.

860.7 MEASUREMENT AND PAYMENT.

Measurement and payment for Sign face materials shall be incidental to Item 636 "Signs".

There are no item code(s), description(s), or unit(s) for this Item.

NOTE: This Item requires other Standard Specifications.

Item 636 "Signs"

END OF ITEM 860

END OF SECTION 10 14 53

SECTION 10 21 13 – SOLID PLASTIC (HDPE) TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Toilet partitions.
 - 2. Urinal screens.
 - 3. Entrance screens.
 - 4. Accessories necessary for a complete installation.

1.3 SUBMITTALS

- A. Product Data: Technical data for each type of product including construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Submit plans, elevations, sections, details, and attachments to other work.
 - 1. Show locations of cutouts for compartment-mounted toilet accessories.
 - 2. Show locations of reinforcements for compartment-mounted grab bars.
 - 3. Show locations of centerlines of toilet fixtures.
 - 4. Show ceiling grid and overhead support or bracing locations.
- C. Samples: Submit for each type of unit with samples of hardware and accessories involving material and color selection.
- D. Maintenance Data: Submit data to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Accessibility Requirements: Comply with applicable requirements.
 - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
 - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
 - c. Texas Accessibility Standards (TAS) 2012.
 - 2. Surface Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame Spread Index: 26 to 75.
 - b. Smoke Developed Index: 450 or less.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

1.6 MAINTENANCE MATERIAL

- A. Furnish extra materials that match products installed and packaged with protective covering for storage and identified with labels describing contents and source.
 - 1. Door Hinges: One hinge(s) with associated fasteners.
 - 2. Latch and Keeper: One latch and keeper(s) with associated fasteners.
 - 3. Door Bumper: One bumper(s) with associated fasteners.
 - 4. Door Pull: One door pull(s) with associated fasteners.
 - 5. Fasteners: Ten fasteners of each size and type.

1.7 WARRANTY

- A. Furnish twenty-five year limited warranty for panels, doors, and stiles against breakage, corrosion, delamination, and defects in factory workmanship.
- B. Furnish one-year guarantee against defects in material and workmanship for stainless steel door hardware and mounting brackets.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Solid Plastic (HDPE):
 - a. Accurate Partitions Corp.; ASI Group.
 - b. Global Partitions; ASI Group
- B. Aluminum Castings: ASTM B 26/B 26M.
- C. Aluminum Extrusions: ASTM B 221 (ASTM B 221M).
- D. Stainless Steel Sheet: ASTM A 666, Type 304, stretcher leveled standard of flatness.
- E. Stainless Steel Castings: ASTM A 743/A 743M.

2.2 PARTITION COMPONENTS

- A. Solid Plastic Partitions:
 - 1. Style:
 - a. Toilet Partition: Floor anchored and overhead braced.
 - b. Entrance Screen Style: Floor supported and overhead braced.
 - c. Urinal Screen Style: Floor anchored overhead braced.
- B. Door, Panel, Screen, and Pilaster Construction: Solid, high density polyethylene (HDPE) panel material, not less than 1 inch (25 mm) thick, seamless, with eased edges, no sightline system, and with homogenous color and pattern throughout thickness of material.
 - 1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
 - 2. Heat Sink Strip: Continuous, stainless steel strip fastened to exposed bottom edges of solid plastic components to hinder malicious combustion.
 - 3. Color and Pattern: Selected by Architect from manufacturer's full range.
 - 4. Panel and Pilaster Brackets:
 - a. Aluminum stirrup brackets shall be 2" long made of heavy-duty anodized aluminum (6063-T5 Alloy). Stirrup brackets shall be 1/8" thick and mounted with stainless steel, vandal-resistant screws. Panels shall be attached with stainless steel, vandal-resistant

through bolts. The attachment of brackets to the adjacent wall construction shall be accomplished with 2 1/2" stainless steel vandal-resistant screws and plastic anchors.

- C. Urinal Screen Post: Post design of stainless steel matching the thickness and construction of pilasters or 1-3/4 inch (44 mm) square, aluminum tube with satin finish; with shoe and sleeve (cap) matching that on the pilaster. Color to match Toilet Partitions. Ceiling and floor mounted.

2.3 HARDWARE AND ACCESSORIES

- A. Hardware and Accessories: Heavy duty operating hardware and accessories.
 - 1. Hinges: 16-gauge continuous piano, self-closing hinge. Continuous piano hinge shall be attached to door and stile by theft resistant, pin-in-head Torx stainless steel machine screws into factory installed, threaded brass inserts. Fasteners secured directly into the core are not acceptable.
 - 2. Latch and Keeper: Heavy duty surface mounted cast stainless steel latch unit designed to resist damage due to slamming, with combination rubber faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through bolts.
 - 3. Coat Hook: Heavy duty combination cast stainless steel hook and rubber tipped bumper, sized to prevent in swinging door from hitting compartment mounted accessories. Mount with through bolts.
 - 4. Door Bumper: Heavy duty rubber tipped cast stainless steel bumper at out swinging doors and entrance screen doors. Mount with through bolts.
 - 5. Door Pull: Heavy duty cast stainless steel pull at out swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through bolts.
- B. Overhead Bracing: Continuous, extruded aluminum head rail with antigrip profile and in standard finish.
- C. Anchorages and Fasteners: Exposed fasteners of stainless steel, finished to match the being secured, with theft resistant type heads. Provide sex type bolts for through bolt applications. For concealed anchors, use stainless steel, hot dip galvanized steel, or rust resistant, protective coated steel compatible with related materials.

2.4 FABRICATION

- A. Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through partition toilet accessories where required for attachment of toilet accessories.
- B. Overhead Braced Units: Provide corrosion resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- C. Floor Anchored Units: Provide corrosion resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
- D. Urinal Screen Posts: Provide corrosion resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of posts. Provide shoes and sleeves (caps) at posts to conceal anchorage.
- E. Door Size and Swings: Unless otherwise indicated, provide 24 inch (610 mm) wide, in swinging doors for standard toilet compartments and 36 inch (914 mm) wide, out swinging doors with a minimum 32 inch (813 mm) wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the work. Confirm location and adequacy of blocking and supports required for installation. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

- A. Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels: 1/2 inch (13 mm).
 - b. Panels and Walls: 1 inch (25 mm).
 - 2. Full Height (Continuous) Brackets: Secure panels to walls and to pilasters with full height brackets.
 - a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
- B. Overhead Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches (44 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Floor Anchored Units: Set pilasters with anchors penetrating not less than 2 inches (51 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.
- D. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out swinging doors to return doors to fully closed position.

END OF SECTION 10 21 13

SECTION 10 26 13 – CORNER GUARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Corner guards.
 - 2. Accessories necessary for a complete installation.

1.3 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements of each type corner guard specified.
 - 2. Manufacturer's installation requirements.
 - 3. Manufacturer's cleaning and maintenance instructions.
- B. Shop Drawings: Show locations of each item and installation details. Provide elevations of non-standard conditions.
- C. Samples:
 - 1. Color charts consisting of actual product pieces, demonstrating full range of available colors, for Architect's color selection.
 - 2. 12 inch long piece in full size profiles of corner guard in color selected.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Surface Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame Spread Index: 25 or less.
 - b. Smoke Developed Index: 450 or less.
 - 2. Accessibility Requirements: Comply with applicable requirements.
 - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
 - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
 - c. Texas Accessibility Standards (TAS) 2012.
- B. Source Limitations: Obtain corner guards products from single source from single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store corner guards in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
 - 1. Maintain room temperature within storage area at not less than 70 degrees F (21 degrees C) during the period plastic materials are stored.
 - 2. Keep plastic materials out of direct sunlight.

3. Store plastic wall and door protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 degrees F (21 degrees C).
 - a. Store corner guard covers in a vertical position.

1.6 WARRANTY

- A. Warranty: Written warranty in which the manufacturer agrees to repair or replace components of wall and door protection units that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
 - b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.
 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum: Continuous 6063-T6 aluminum retainer behind entire height of corner guard, minimum 0.060 inch thick.
- B. Plastic Materials: Chemical and stain resistant, high impact resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.
- C. Fasteners: Aluminum, nonmagnetic stainless steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security type fasteners where exposed to view.
- D. Adhesive: Recommended by protection product manufacturer.

2.2 WALL PROTECTION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Construction Specialties, Inc.
 2. InPro Corporation (IPC).
 3. JL Industries, Inc.
 4. Korogard Wall Protection Systems.
 5. Nystrom, Inc.
- B. Flush Mounted, Plastic Cover Corner Guards: Assembly consisting of snap on, resilient plastic cover that is flush with adjacent wall surface, installed over retainer; including mounting hardware; fabricated with 90 degree or 135 degree turn to match wall condition; full wall height.
 1. Cover: Extruded rigid plastic, minimum 0.078 inch (2.0 mm) wall thickness.
 - a. Profile: Nominal 2 inch (50 mm) long leg and 1/4 inch (6 mm) corner radius.
 - b. Height: 8 feet (2.4 m).
 - c. Color: Selected by Architect.
 2. Continuous Retainer: Minimum 0.060 inch (1.5 mm) thick, one piece, extruded aluminum.
 3. Retainer Clips: Impact absorbing clips.
 4. Aluminum Cove Base: Nominal 4 inches (100 mm) high.

2.3 FABRICATION

- A. Fabricate corner guards according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.
- B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- C. Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.4 FINISHES

- A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and wall areas for compliance with requirements for installation tolerances, fire rating, and other conditions affecting performance of the work.
- B. Examine walls to which corner guards will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
- C. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing wall and door protection.
- B. Prior to installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

- A. Installation Quality: Install wall protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings.
- C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.
 - 1. Provide anchoring devices and suitable locations to withstand imposed loads.
 - 2. Where splices occur in horizontal runs of more than 20 feet (6.1 m), splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches (305 mm) apart.

3. Adjust end and top caps as required to ensure tight seams.

3.4 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia based household cleaning agent.

END OF SECTION 10 26 13

SECTION 10 28 13 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Public use washroom accessories.
 - 2. Public use shower room accessories.
 - 3. Private use bathroom accessories.
 - 4. Healthcare accessories.
 - 5. Warm air dryers.
 - 6. Childcare accessories.
 - 7. Underlavatory guards.
 - 8. Custodial accessories.
 - 9. Accessories necessary for a complete installation.

1.3 SUBMITTALS

- A. Product Data: Technical Data including construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 1. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 2. Include electrical characteristics.
- B. Samples: Full size, for each exposed product and for each finish specified.
 - 1. Approved full size Samples will be returned and may be used in the Work.
- C. Product Schedule: Show types, quantities, sizes, and installation locations by room of each accessory required. Identify locations using room designations indicated.
- D. Maintenance Data: Submit for inclusion in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Accessibility Requirements: Comply with applicable requirements.
 - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
 - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
 - c. Texas Accessibility Standards (TAS) 2012.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Source Limitations: Obtain products from single source from single manufacturer.

1.5 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6 WARRANTY

- A. Mirrors: Written warranty signed by manufacturer in which manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, visible silver spoilage defects.
 - 2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Manufacturers: Toilet accessories schedule is based on Bobrick Washroom Equipment unless noted otherwise. Subject to compliance with requirements, provide products by one of the following:
 - 1. AJW Architectural Products.
 - 2. American Specialties, Inc.
 - 3. Bobrick Washroom Equipment, Inc.
 - 4. Bradley Corporation.
 - 5. Brey-Krause Manufacturing Co.
 - 6. GAMCO Specialty Accessories; a division of Bobrick.
 - 7. Tubular Specialties Manufacturing, Inc.
- B. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.
- C. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- D. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.
- E. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot dip zinc coating.
- F. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot dip galvanized after fabrication.
- G. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear glass mirrors, nominal 6.0 mm thick.

2.2 COMPONENTS

- A. Underlavatory Guard: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
 - 1. Material and Finish: Antimicrobial, molded plastic, white.

2.3 FABRICATION

- A. Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of [six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items. Remove temporary labels and protective coatings. Clean and polish exposed surfaces according to manufacturer's written recommendations.

PART 4 - SCHEDULE

4.1 ACCESSORY SCHEDULE

- A. TA-1 - Soap Dispensers:
 - 1. Mounting : Directly Over Lavatories
 - 2. Model No.: Buckeye Symmetry Stealth Prestige 1250 mL
 - 3. Locations: Refer to drawings.
 - 4. Finish: Black
- B. TA-2 - Mirrors: Bright Polished Stainless Steel Framed.
 - 1. Mounting: Concealed surface.
 - 2. Model No.: B-165
 - 3. Size: 18 inch by 30 inch.
 - 4. Location: Refer to the Drawings.
- C. TA-3 - Toilet Paper Dispensers:
 - 1. Model No.: Solaris Paper LoCor Top-Down Bath Tissue Dispenser
 - 2. Locations: Refer to drawings.
 - 3. Finish: To be Selected by Architect
- D. TA-4 - Paper Towel Dispensers:
 - 1. Model No.: In-Sights Sanitouch HRT 1.75" HUB.mL
 - 2. Locations: Refer to drawings.
 - 3. Finish: Black
- E. TA-5 - Grab Bars: (At Typical Accessible Toilet Stalls)
 - 1. Size/Finish: 1-1/2 inch diameter satin stainless steel.
 - 2. Clearance: 1-1/2 inch between rail and wall.

3. Model No.: B-6206.99
 4. Mounting: Attach with concealed mounting kit. Mount parallel to floor.
 5. Location: Accessible water closets and toilet stalls.
- F. TA-6 – Sanitary Napkin Dispenser:
1. Basis of Design: Model B-2706 as manufactured by Bobrick Washroom Equipment.
 2. Mounting: Surface.
 3. Operation: Single coin / Double coin - (25/50 cents).
 4. Capacity: 20 Napkins/ 30 Tampons.
 5. Locations: Women's toilet room.
- G. TA-7 - Sanitary Napkin Disposal:
1. Mounting: Surface.
 2. Model No.: B-270.
 3. Locations: Women's toilet rooms.
- H. TA-8 Mop and Broom Holder:
1. Mounting: Surface.
 2. Model No.: B-223 x 34.
 3. Capacity: Four hooks, three mop holders.
 4. Locations: Janitor's closets and at laundry unless otherwise noted.
- I. TA-9 - Grab Bars: (At Accessible Shower)
1. Basis of Design: Model B-6861 modified (24 x 16) as manufactured by Bobrick Washroom Equipment.
 2. Mounting: Surface.
 3. Locations: Accessible shower stalls.
- J. TA-10 – Bariatric Folding Shower Seat with Legs:
1. Basis of Design: Model B-918116 as manufactured by Bobrick Washroom Equipment.
 2. Mounting: Surface.
 3. Hinge Bracket: 11-gauge stainless steel with satin finish.
 4. Swing-Down Legs: Three (3) adjustable, zinc-plated 3/4 inch, 1/10 inch thickness, 1/8 inch white vinyl antibacterial, biocompatible, and warm-to-the-touch coating thickness, 1-5/16 inch outside diameter.
 5. Seat: High pressure laminate with matte-finish, white-colored surfaces and black phenolic-resin core. Integral slots for water drainage.
- K. TA-11 - Clothes Hook:
1. Mounting: Surface.
 2. Attachment: Concealed.
 3. Finish: #4 Satin Finish.
 4. Model No.: B-6717.
 3. Locations: All individual offices and individual toilet rooms. Verify mounting height with architect prior to installation.
 4. Toilet and Shower Partitions: If toilet and shower partitions are utilized, hooks are to be provided by the partition manufacturer(s) as part of their hardware package.
- L. TA-12 - Shower Curtains, Rods and Hooks:
1. Basis of Design: Bobrick Washroom Equipment.
 2. Rods: Model B-047 (36 inches or as indicated).
 3. Curtains: Model B-204-2 (42 inches x 72 inches or as required).
 4. Hooks: Model B-204-1.
 5. Mounting/Locations: Accessible shower stalls.
- M. TA-13 – NOT USED.

- N. TA-14 – NOT USED.
- O. TA-15 – NOT USED.
- P. TA-16 – NOT USED.
- Q. TA-17 – NOT USED.
- R. TA-18 – Electric Hand Dryers:
 - 1. Basis of Design: World Hand Dryers.
 - 2. Mounting: Surface.
 - 3. Voltage: 120/280/240.
 - 4. Current Rating: 20/11/10 Amps.
 - 5. Automatic Activator.
 - 6. Integral Nozzles.
 - 7. 25 Second Run Time.
 - 8. Stainless Steel Finish.
 - 9. ADA Compliant.
 - 10. Location: Refer to drawings.
- S. TA-19- Seat Cover Dispensers:
 - 1. Basis of Design: Model B-221 as manufactured by Bobrick Washroom Equipment.
 - 2. Construction: Stainless steel with concealed fasteners.
 - 3. Location: At each staff or adult toilet.
- T. TA-20 – Specimen Passthrough.
 - 1. Basis of Design: Model B-505 as manufactured by Bobrick.
 - 2. Finish: Stainless Steel, Satin Finish.
 - 3. Location: Refer to Drawings.

END OF SECTION 10 28 13

SECTION 10 44 00 - FIRE EXTINGUISHER AND CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Fire Extinguisher.
 - 2. Extinguisher Cabinet.
 - 3. Bleeding Control Kit Cabinet.
 - 4. Brackets.
 - 5. Accessories necessary for a complete installation.
 - 6. Defibrillator.

1.3 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and technical data to indicate specification compliance.
 - 2. Manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Specifications are based on the products of named manufacturers. Other listed manufacturers who produce products equivalent to those specified are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent to those specified and comply with Division 1 requirements regarding substitutions to be considered.
 - 1. Larsen's Manufacturing Co.
 - 2. The Williams Bros. Corporation of America.
 - 3. J. L. Industries, Inc.
 - 4. Nystrom, Inc.
 - 5. Potter-Roemer.

2.2 MATERIALS

- A. Fire Extinguisher Cabinets (FEC):
 - 1. Size: 24 inches x 9-1/2 inches x 6 inches inside tub dimension.
 - 2. Type: Semi-recessed with 2-1/2 inch return trim rolled edge; ADA compliant.
 - 3. Tub Construction: 22 gauge min. steel with standard baked acrylic enamel interior finish.
 - 4. Door and Frame: 18 gauge min. 304 stainless steel door and frame with vertical decal lettering "FIRE EXTINGUISHER" in red color, unless directed otherwise by Architect.
 - 5. Glazing: Scored plexi glass.
 - 6. Hardware: Continuous concealed piano hinge constructed of material which matches door and trim material. Satin finish pull handle with cam cylinder lock with safety pull designed to release upon firm pull on handle (Larsen's "Larsen-Loc"™, J.L. Industries "Saf-T-Lok"™; or equivalent).
 - 7. Bracket: Hook type; Larsen's #546, or equal.
 - 8. Finish of Exterior: #4 Stainless steel.

9. Fire rating: as occurs, provide fire rated cabinet, for one or two hour rated conditions as indicated or required by specific location. Cabinet shall be tested and approved by Warnock Hersey to ASTM E-814, and shall bear the Warnock Hersey label.
 10. Quantity: As indicated in Drawings. Include a minimum of ten (1) cabinets.
 11. Location: Confirm locations with Architect.
- B. Fire Extinguishers (F.E):
1. Models/Types:
 - a. Multipurpose dry chemical with 10 lbs. capacity and UL 4A-80B:C rating conforming to MP10 Series.
 - b. Wet chemical (Potassium Acetate) with 6 liter, Class A, Type K for kitchen use.
 2. Mounting: Provide eye brackets for direct wall mounting to hook and for mounting in Fire Extinguisher cabinets. Refer to drawings for location and quantity.
 3. Provide initial inspection tag for each extinguisher.
- C. Defibrillator (AED) Cabinet (for Owner-furnished AED):
1. Basis of Design: J. L. Industries, Inc. 1400 Series steel cabinet.
 2. Mounting: Fully or semi-recessed, as indicated on drawings. Surface mounted units are not acceptable.
 3. Door: Fully glazed with acrylic glazing, continuous hinge, "AED" and symbolic heart graphics, roller catch, and plated metal handle.
 4. Alarm: Battery-operated, with on/off key switch on exterior of cabinet.
 5. ADAC-compliant.
 6. Size: Large enough to accommodate most AEDs, but at least 14 inches x 14 inches by 7 inches deep net inside dimensions.
 7. Finish: White powder coat.
- D. Bleeding Control Kit Cabinet with 8-pack Kit: ADA Compliant.
1. Basis of Design: 80-0867 by NARescue or comparable product by Architect.
 2. Mounting: Semi-recessed.
 3. Outside Dimensions: 17.5 inch H x 17.5 inch W x 1 inch D.
 4. Inside Dimensions: 14.13 inch H x 14.13 inch W x 6.88 inch D.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fire extinguishers and cabinets in openings in accordance with manufacturer's printed instructions.
- B. Install fire extinguishers and cabinets where indicated on the drawings and at every exterior door in designated egress path.
- C. Provide five (5) additional of multi purpose dry and two (2) of the wet chemical fire extinguishers to be installed at locations determined by Fire Marshall.

END OF SECTION 10 44 00

SECTION 10 51 13 - METAL LOCKERS AND BENCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Welded corridor lockers.
 - 2. Wooden Locker room benches.
 - 3. Accessories necessary for a complete installation.

1.3 SUBMITTALS

- B. Product Data:
 - 1. Manufacturer's schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.
 - 2. Manufacturer's installation instructions.
- C. Shop Drawings: Indicate size, material, and finish. Show location and installation procedures. Include details of joints, attachments and clearances.
- D. Locker/Lock Schedule: Schedule indicating locker number, serial number of the lock installed, key number, or combinations as applicable, for each locker. Submit schedule in spread sheet format. Submit three hard copies and one electronic file.
- E. Sample: Provide half size locker samples to Architect for approval showing all fasteners and door types for locks.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Accessibility Requirements: Comply with applicable requirements.
 - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
 - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
 - c. Texas Accessibility Standards (TAS) 2012.
- B. Source Limitations: Obtain metal lockers and accessories from single source from single locker manufacturer.
 - 1. Obtain locks from single lock manufacturer.
- C. Preinstallation Conference: Conduct conference at site.

1.5 WARRANTY

- A. Warrant the work specified herein for ten (10) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.

- B. Defects shall include, but not be limited to, the following:
1. Rapid deterioration of finish.
 2. Loose or missing parts.
 3. Non-functioning components and mechanisms.
 4. Rust, delamination, warp, rot or breakage.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ASI Storage Solutions, Inc., Memphis, TN (901) 312-6195
 2. DeBourgh Manufacturing Co., LaJunta, CO; (800) 328-8829
 3. Superior Lockers as manufactured by List Industries, Inc. Deerfield Beach, FL; (800) 776-1342.
 4. Penco Products, Inc., Oaks, PA; (800) 562-1000
 5. Republic Storage Systems Co., Inc., Canton, OH; (800) 477-1255.
 6. WEC Manufacturing, Germantown, TN; (901) 367-3923.
- B. Locker: All welded construction; double tier:
1. Material: Prime, high grade Class I mild annealed, cold-rolled steel.
 2. General Construction: Pre-assembled, welded seams and joints. Bolts, screws or rivets used in the assembly of the locker bodies are not permitted. Welds shall be free of burrs.
 3. Body: 16 gauge, flanged.
 4. Backs: 18 gauge, one-piece
 5. Door Frame: 16 gauge, channels or angles, with continuous door strike. Multiple tiered assemblies shall have intermediate cross frame welded to vertical framing members.
 6. Door: 14 gauge formed door constructed of single piece cold rolled steel with staggered 7/16 inch wide by 15/16 inch diamond perforations. Full channel shaped on lock side, formed channel formation on hinge side, right angle shaped on horizontal sides.
 7. Hinges: Two (2) inches high minimum, five (5) knuckle, full loop, tight pin. Weld to door and frame. Two (2) per door for lockers 42 inches high or less; three (3) per door for lockers over 42 inches high.
 8. Latching: one-piece, pre-lubricated spring steel, completely contained within the lock bar under tension to provide rattle-free operation. Provide three (3) latching points for lockers over 42 inches in height and two (2) latching points on for all tiered lockers 42 inches and under in height.
 9. Pre-Locking Device: Lockers shall be equipped with a positive automatic pre-locking device whereby the locker may be locked while the door is open and then closed without unlocking and without damaging the locking mechanism.
 10. Handles: Recessed, stainless steel with non-protruding lifting trigger.
 11. Number Plates: Aluminum with etched figures at least 3/8 inches high, attached near top of door with two (2) aluminum rivets. Number plates shall be in order as directed by the Architect.
 12. Finish: Baked enamel. Colors shall be as selected by Architect from manufacturer's standard colors. Lockers shall be painted inside and outside with the same color.
 13. Fasteners/Anchors: Provide fasteners and anchors of type, size and finish as recommended by manufacturer for attaching or anchoring lockers to walls and floor.
 14. Free-Standing Lockers: Provide front and end closed bases.
 15. Base: Lockers shall rest on bases as detailed on drawings.
 16. Locks: Master Lock Built-In Combination Locks with five (5) Master / Control keys and metal dial. Furnish locker/lock schedule as specified in Paragraph 1.2, D above.
 17. Top Closures, Closure Strips, and Fillers: Provide where shown, factory fabricated and finished to match lockers, unless noted otherwise.

- C. Accessible Locker: Accessible lockers with recessed handles, single tier or the lower opening of double tier locker. Locker bottom shall be a minimum of 15 inches off the floor, or an extra shelf placed 15 inches off the floor with bottom or shelf turned down to close resultant opening.

2.3 LOCKER TYPES

- A. Athletic Lockers: 1 foot 6 inches by 1 foot inches. Welded Deluxe Collegiate Lockers without doors and with combination lock with and four (4) inch high CMU base. Colors shall be as selected by Architect from manufacturer's standard colors.

2.4 LOCKER ROOM BENCHES

- A. Benches:
 - 1. Bench Material: Shall be laminated hardwood maple.
 - 2. Size: Shall be 9-1/2 inches deep x 1-1/4 inch thick x lengths as shown on drawings.
 - 3. Finish: Manufacturer's two (2) coat clear acrylic finish.
- B. Pedestals:
 - 1. Manufacturer's heavy-duty cast iron pedestal supports not more than 6 feet-0 inches o.c., with provisions for attaching pedestals to bottom of bench and anchoring pedestals to floor.
 - 2. Height: 17-3/4 inches. 17-1/2 inches to meet ADA requirements.
 - 3. Finish: Manufacturer's baked enamel finish in selected color by Architect to match lockers, unless noted otherwise.
- C. Anchorages: Provide screw fasteners for attaching each pedestal to bottom of bench and two (2) suitable anchors per pedestal for anchoring pedestals to floor.

2.5 OTHER MATERIALS:

- A. Provide other materials, not specifically described but required for a complete and proper locker installation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Assemble and install lockers plumb, level, and flush in the locations shown on the drawings in accordance with the manufacturer's instructions. Lockers shall have no sharp metal edges.
- B. Install and anchor lockers to the floor and wall as instructed by the manufacturer.
- C. Install sloping hoods, metal fillers, end panels and trim to close openings, and accessories where shown on drawings or required to complete installation. Install using concealed fasteners. Provide flush hairline joints against adjacent surfaces.
- D. Ensure number plates are installed in order directed by the Architect.

3.2 ADJUST AND CLEAN

- A. Adjust doors and latches to operate without binding and positive latching and automatic locking.
- B. Touch up marred finishes on lockers with manufacturer's supplied paint.

END OF SECTION 10 51 13

SECTION 10 56 16 - METAL STORAGE SHELVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Four post metal storage shelving.
 - 2. Accessories necessary for a complete installation.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design metal storage shelving, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Seismic Performance: Metal storage shelving shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. Seismic Component Importance Factor: 1.0.

1.4 SUBMITTALS

- A. Product Data: Technical data for each type of shelving unit and accessory components including recessed tracks. Include rated capacities, installation and construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Submit plans, elevations, sections, and details, including installation details of connectors, lateral bracing, and special bracing.
- C. Seismic Qualification Certificates: For metal storage shelving, accessories, and components, from manufacturer.

1.5 COORDINATION

- A. Coordinate sizes and locations of blocking and backing required for installation of metal storage shelving attached to wall and ceiling assemblies.
- B. Coordinate locations and installation of metal storage shelving that may interfere with ceiling systems including lighting, HVAC, speakers, sprinklers, access panels, electrical switches or outlets, and floor drains.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install metal storage shelving until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for building occupants during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Hot Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- B. Cold Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- C. Metallic Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with G60 (Z180) zinc (galvanized) or A60 (ZF180) zinc-iron-alloy (galvannealed) coating.
- D. Steel Tubing: ASTM A 513, Type 2.

2.2 STORAGE SHELVING UNITS

- A. Four Post Metal Storage Shelving:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMCO Corporation.
 - b. Dixie Shelving Co,
 - c. Equito.
 - d. InterMetro Industries Corporation.
 - e. Lyon Workspace Products, LLC.
 - f. Montel, Inc.
 - g. Penco Products, Inc.
 - h. Republic Storage Systems Co.
 - i. Safco Products.
 - j. Tenssco.
 - 2. Open Four Post Metal Storage Shelving: Comply with MH 28.1; field assembled from factory formed components. Shelves span between supporting corner posts that allow shelf height adjustment over full height of shelving unit. Provide fixed top and bottom shelves, adjustable intermediate shelves, and accessories indicated.
 - 3. Load Carrying Capacity per Shelf: Minimum 700 lb (318 kg).
 - 4. Posts: Fabricated from hot rolled steel; in standard shape; with perforations at 1-1/2 inches (38 mm) o.c. to receive shelf to post connectors.
 - a. Unit Configuration: Configure shelving units as individual, freestanding] [starter and add on unit assemblies.
 - 1) Add On Shelf Posts: Fabricated from hot rolled steel, standard shape; perforated to match main posts.
 - b. Post Base: Adjustable steel floor plate, drilled for floor anchors.
 - 5. Bracing: Standard, single or double diagonal cross bracing.
 - a. Location: At unit back and ends necessary for stability, load carrying capacity of shelves, and number of shelves indicated.
 - b. Back Panel: One piece fabricated from cold rolled steel sheet; of nominal: 0.024 inch (0.61 mm) steel sheet thickness.
 - 6. Solid Type Shelves:
 - a. Steel Sheet: Nominal thickness minimum 0.048 inch (1.21 mm) or as necessary for load carrying capacity per shelf.
 - b. Metallic Coated Steel Sheet: Nominal thickness minimum 0.052 inch (1.32 mm) or as necessary for load carrying capacity per shelf.

- c. Fabricate fronts and backs of shelves with vertical edges that are flanged and returned, with edges reinforced with steel bars, angles, or channels.
7. Framed Type Wire Shelves: Metallic coated steel] wire; with shelf frame fabricated from same material and with same finish as posts.
8. Shelf Quantity: Four shelves per shelving unit in addition to top and bottom shelf.
9. Shelf to Post Connectors: Mechanical fasteners (nuts and bolts).
10. Base: Closed, with base strips fabricated from same material and with same finish as shelving.
11. Overall Unit Width: 36 inches (914 mm) inclusive of two end posts.
12. Overall Unit Depth: 18 inches (457 mm).
13. Overall Unit Height: 84 inches (2134 mm).
14. Steel Finish: Baked enamel or powder coat.
 - a. Color and Gloss: Selected by Architect.

2.3 ANCHORS

- A. Floor Anchors: Galvanized steel, post installed expansion anchors or power actuated fasteners. Provide number per unit recommended by manufacturer unless additional anchors are indicated in calculations.
- B. Wall Anchors: Galvanized steel anchors designed to secure metal storage shelving to adjacent wall. Provide one per shelving unit for each shelving unit adjacent to a wall unless additional anchors are indicated in calculations.

2.4 FABRICATION

- A. Fabricate metal storage shelving components to provide field assembled units that are square and rigid, with posts plumb and true and shelves flat and free of dents or distortion. Fabricate connections to form a rigid structure, free of buckling and warping.
 1. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.
 2. Build in straps, plates, brackets, and other reinforcements as needed to support shelf loading.
 3. Cut, reinforce, drill, and tap metal fabrications to receive hardware, fasteners, and similar items.
- B. Form metal in maximum lengths to minimize joints. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing the work. Form backs of shelving units of up to 48 inches (1219 mm) wide from one piece.
- C. Form edges and corners free of sharp edges or rough areas. Fold back and crimp exposed edges of unsupported sheet metal to form a hem on the concealed side; ease edges of metal plate to radius of approximately 1/32 inch (0.8 mm). Shear and punch metals cleanly and accurately. Remove burrs.
- D. Weld corners and seams continuously to develop strength, minimize distortion, and maintain the corrosion resistance of base metals. At exposed locations, finish welds and surfaces smooth and blended so surface is smooth after finishing and contour of welded surface matches that of adjacent surface. Weld before finishing components to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces before finishing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas for compliance with requirements for installation tolerances and other conditions affecting performance of the work. Examine floors for suitable conditions where metal storage shelving will be installed.
- B. Examine walls and ceilings to which metal storage shelving will be attached for properly located blocking, grounds, or other solid backing for attachment of support fasteners.
- C. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

- A. Vacuum and clean finished floor over which metal storage shelving is to be installed.

3.3 INSTALLATION

- A. Install metal storage shelving level, plumb, square, rigid, true, and with shelves flat and free of dents or distortion. Make connections to form a rigid structure, free of buckling and warping.
 - 1. Install exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
 - 2. Install braces, straps, plates, brackets, and other reinforcements as needed to support shelf loading and as required for stability.
 - 3. Adjust post base bolt leveler to achieve level and plumb installation.
 - 4. Anchor shelving units to floor with floor anchors through floor plate. Shim floor plate to achieve level and plumb installation.
 - 5. Install seismic restraints.
 - 6. Connect side to side and back to back shelving units together.
 - 7. Install shelves in each shelving unit at spacing indicated on Drawings.
 - a. Case Type Metal Storage Shelving: Install adjustable shelf clips at front and back of each shelf.
 - b. Four Post Metal Storage Shelving: Install four clips, one at each post, for support of each shelf; with clips fully engaged in post perforations.
 - c. Post and Beam Metal Storage Shelving: Install beams with beam to post connectors fully engaged in post perforations.

3.4 ERECTION TOLERANCES

- A. Erect metal storage shelving to a maximum tolerance from vertical of 1/2 inch (13 mm) in up to 10 feet (3 m) of height, not exceeding 1 inch (25 mm) for heights taller than 10 feet (3 m).

3.5 ADJUSTING

- A. Adjust metal storage shelving so that connectors and other components engage accurately and securely.
- B. Adjust and lubricate operable components to operate smoothly and easily, without binding or warping. Check and readjust operating hardware.
- C. Touch up marred finishes or replace metal storage shelving that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by metal storage shelving manufacturer.

- D. Replace metal storage shelving components that have been damaged beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 56 16

SECTION 10 71 13 - EXTERIOR SUN CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes
 - 1. Modular, shop fabricated, metal sun shades to mount on exterior window systems and building walls.
- B. Related Requirements
 - 1. Section 04 20 00 - Unit Masonry: Exterior wall surfaces to receive sun shades.
 - 2. Section 08 41 13 - Aluminum-Framed Storefronts" and Section 08 44 13 - Glazed Aluminum Curtain Walls: Metal window wall to receive sun shades.

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM) Publications:
 - 1. ASTM A 526 – Sheet Steel, G-90 Zinc-Coated (Galvanized) by the Hot Dip Process
 - 2. ASTM A 792 – Steel Sheet, Aluminum-Zinc Alloy-Coated (Galvalume) by the Hot Dip Process.
 - 3. ASTM B 209 – Aluminum and Aluminum-Alloy Sheet and Plate.
 - 4. ASTM B 221 – Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube.
 - 5. ASTM D 3363 – Test Method for Film Hardness by Pencil Test.

1.4 SUBMITTALS

- A. Provide in accordance with Section 01 33 00 – Submittals.
 - 1. Product data for sun shade components and finish.
 - 2. Shop drawings showing layout, dimensions, spacing of components, and anchorage and installation details.
 - 3. Calculations for support system.
 - 4. Sample: 12 x 12 inches minimum size sample of sun shade panel of edge condition illustrating design, fabrication workmanship, connection detailing, and selected color coating.
- B. Shop Drawings: Indicate size, material, and finish. Show location and installation procedures. Include details of joints, attachments and clearances.
- C. Samples or color charts showing specified color.
- D. Copy of warranty for review by Architect.

1.5 QUALITY ASSURANCE

- A. Design structural support framing components for sun shades under direct supervision of professional structural engineer.
- B. Installer qualifications: Approved by manufacturer for installation of sun shade system.

1.6 WARRANTY

- A. Warranty the Work specified herein for ten (10) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to, the following:
 - 1. Noticeable deterioration of finish including cracking, peeling, and blistering.
 - 2. Loose or missing parts.
 - 3. Noisy or difficult operation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 regarding substitutions to be considered.
 - 1. AGS, Inc. Franfort, IL.
 - 2. Airolite Co., Marietta, OH (Bar Blade).
 - 3. All-Lite Architectural Products, Fort Worth, TX.
 - 4. Ametco Manufacturing Corp., Willoughby, OH.
 - 5. ASCA Inc., Portsmouth, NH.
 - 6. Dittmer Architectural Aluminum. Winter Springs, FL.
 - 7. Intertec, Alsip, IL.

2.2 BASIS OF DESIGN

- A. AVAdek Walkway Cover Systems & Canopies; Webster, TX or comparable product approved by Architect.

2.3 MATERIALS

- A. Extruded aluminum: ASTM B 221, Alloy 6063, Temper T5 or T6
- B. Sheet Aluminum: ASTM B 209 6063, Temper as appropriate for forming required shapes.

2.4 SUN SHADE SYSTEM

- A. Type: Aluminum sun shades consisting of modular framed panels with louver tube infill and outriggers for mounting on window framing and exterior wall surfaces.
- B. Sun shade panel: Modular panel with perimeter frame.
 - 1. Panel size: As indicated on drawings.
 - 2. Panel infill: Bar grill type consisting of extruded, shaped louvers connected with cross bars.
 - a. Amount of direct visual screening: 100 percent
 - b. Main bars: as shown in drawings.
- C. Support system: Provide outriggers for support of sun shade panel fabricated from same material as panel. System shall be designed to resist applicable dead, live, wind, and seismic loads.
 - 1. Type: Projecting outriggers shaped as shown in drawings
 - 2. Construction: Welded fabrication consisting of attachment plate, double support angles, and tapered plate extension as detailed and dimensioned on Drawings and approved shop drawings.
 - 3. Size: As required to provide sufficient structural support of panels.

- D. Fasteners: Stainless steel bolts, studs, and other types of size and spacing as recommended by manufacturer for specific condition and detailed on approved shop drawings.

2.5 FACTORY FINISH

- A. Sun shade panels, louvers, outriggers, and other components shall receive electrostatically applied colored polyester powder coating heat cured to chemically bond finish to metal substrate.
 - 1. Minimum hardness measured in accordance with ASTM D 3363: 2H.
 - 2. Direct impact resistance tested in accordance with ASTM D 2794: withstand 160 inch-pounds.
 - 3. Salt spray resistance tested in accordance with ASTM B 117: no undercutting, rusting, or blistering after 500 hours in 5 percent salt spray at 95 degrees F and 95 percent relative humidity and after 1000 hours less than 3/16 inch undercutting.
- B. Finish:
 - 1. Architect to select finish from clear anodized, color anodized, baked enamel, and powder coat. Architect to select color from manufacturer's full range of colors.
 - 2. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
 - 3. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 - 4. Baked Enamel or Powder Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, application, and baking.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prior to fabrication, field verify required dimensions.
- B. Coordinate sun shade installation with provision of exterior wall system and window wall system to ensure proper structural support is provided, attachment of sun shades is compatible with substrate, and weathertightness of exterior envelop is maintained.

3.2 INSTALLATION

- A. Install sun shades in accordance with manufacturer's installation instructions and approved shop drawings.
- B. Insulate dissimilar metals to prevent electrolysis with bituminous paint or non-absorptive gasket to prevent contact.
- C. Allow for thermal expansion and contraction of metal components.
- D. Install shade panels plumb, level, free from distortion, and aligned with building elements and adjacent shade panels.
- E. Do not install bent, bowed, or otherwise damaged panels. Remove damaged components from site and replace.
- F. Attach shade panels to outriggers with appropriate fasteners for secure, permanent installation.
- G. After installation, touch-up damaged finish with paint supplied by manufacturer and matching original coating.

END OF SECTION 10 71 13

SECTION 10 73 13 - ALUMINUM CANOPY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to
 1. Fixed canopy.
 2. Accessories necessary for a complete application.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports, including comprehensive engineering analysis by a qualified professional engineer licensed in the State of Texas, using performance requirements and design criteria indicated.
- B. System Performance: Provide canopy system that has been designed, produced, fabricated and installed to withstand normal temperature changes as well as live loading, dead loading and wind loading in compliance with building code requirements:
 1. Live Load: 20 psf minimum.
 2. Structural Design for Wind Forces: Comply with ANSI A58.1.
 3. Base Mean Wind Velocity: 120 mph, Exposure Classification C.
 4. Importance Factor: 1.0.
 5. Stability Criteria: Comply with applicable building codes.
 6. Design structural members to meet minimum deflection criteria of L/180.
 7. Design footings for maximum bearing pressure of 1,500 psf.
- C. Provide structure capable of sustaining severe icing, hail, hurricane force winds and supporting concentrated load such as being walked upon.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 1. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, specifications, component performance data and installation instructions.
- B. Shop Drawings: Submit detailed drawings, layout of canopy system, bent locations, mechanical joint locations with complete details, connections, jointing and accessories. Include details of tube anchorage.
- C. Samples: Color charts showing full range of colors.
- D. Delegated Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible in the jurisdiction of the project, for their preparation.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Building Code: International Building Code.
 - 2. AWS (American Welding Society) standards for structural aluminum welding.
- B. Installer Qualification: Firm with not less than 5 years experience in installation of aluminum sunshades of type, quantity and installation methods similar to work of this section.
- C. Source Limitations: Obtain aluminum covered walkway system from single source.
- D. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication where possible, to insure proper fitting of work.
- E. Allow for adjustments within specified tolerations wherever taking of field measurements before fabrication might delay work.
- F. Shop Assembly: Preassemble units in shop to greatest extent possible and disassemble as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- G. Coordination: Coordinate work of this section with work of other sections which interface with sunshade system (building structure, building finishes, etc.).

1.6 CONTRACTOR'S RESPONSIBILITIES

- A. As scope and performance documents, the Drawings and Specifications do not necessarily indicate or describe all Work required for the performance and completion of the Work. Contracts will be let on the basis of such documents with the understanding that the Provide the items required for proper completion of the Work without adjustment to price or schedule. Work shall be of sound, quality construction and the Contractor shall be solely responsible for the inclusions of adequate labor and materials to cover the proper and timely fabrication and installation of the aluminum walkway cover indicated, described, or implied.
- B. As a performance specification, the criteria for the solution of structurally sound aluminum walkway cover indicated on the Drawings or specified herein are the sole purpose of defining the design intent and performance requirements. The details shown are intended to emphasize the acceptable profiles and performance requirements for this Project. To avoid any misunderstanding or lack of interpretation, the Contractor is hereby advised that the responsibility for the aluminum walkway cover is totally his and that designs and resolutions proposed in the Contractor's shop drawings, structural calculations, and related documentation shall be demonstrated throughout the Work and warranty period specified or required.
- C. Design proposal submissions which follow exactly the details indicated on the Drawings for the aluminum walkway cover, will not relieve the Contractor of his responsibility for the design, fabrication, erection, or performance of the Work of this Section.
- D. In the event of a controversy over the design, the decision of the Architect will take precedence.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle sunshade system components as recommended by manufacturer. Handle and store in a manner to avoid deforming members and to avoid excessive stresses.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Basis of Design Manufacturer: AVAdek, Inc.: Other manufacturers are subject to compliance with requirements:
 - 1. Canopy-Solutions; (713) 510-3800.
 - 2. East Texas Canopy.
 - 3. Mapes Industries, Inc. Lincoln, NE; (800) 228-2391.
 - 4. Peachtree Protective Covers, Inc.
 - 5. Jones Aluminum Inc.
 - 6. Airvent Remodeling & Design Center, Houston, TX
 - 7. American Walkway Covers, LLC, Pompano Beach, FL
 - 8. Dittmer Architectural Aluminum, Winter Springs, FL
 - 9. Perfection Architectural Systems, Inc., Orlando, FL
 - 10. Superior Metal Products Co., Birmingham, AL
 - 11. Texas Aluminum Industries, Inc., Houston, TX
- B. Aluminum Extrusion: ASTM B221 alloy 6063 heat treated to T-6 temper.
- C. Aluminum Sheet: ASTM B209, minimum 0.032 inch thickness.
- D. Finish: As selected by the architect from manufacturers full line of colors for both campuses.
- E. Structure shall be designed by the manufacturer to withstand walking on top, heavy hail, and winds in the configurations shown on drawings.
- F. Fasteners:
 - 1. Deck Screws: Type 18-8 non-magnetic stainless steel sealed with a neoprene "O" ring beneath 5/8 inch (7 mm) outside dimension, conical washer. Rivets are not permitted.
 - 2. Fascia Rivets: Size 3/16 inch by 1/2 inch (4 mm by 13 mm) grip range aluminum rivets with aluminum mandrel.
 - 3. Bolts, Nuts, and Washers: 18-8 non-magnetic stainless steel.
 - 4. Tek Screws: Not permitted.
- G. Beam/Deck connection flashing (Bird cover): .080" thick metal flashing at all beams.
- H. Provide concealed drainage from deck into columns.
- I. Roof Deck: Shall be of size and depth recommended by the manufacturer to suit application, intended use, requirements of building code authorities having jurisdiction.
- J. Expansion Joints: Expansion joints shall have no metal to metal contact.
- K. Horizontal U-Beams and vertical tube columns shall be sizes recommended by the manufacturer to suit application, intended use, and requirements of building code authorities having jurisdiction, and shall be attached with concealed fasteners.
- L. Horizontal Beams and Column Covers: as shown and called out in the drawings at main entry, library and commons sheets A-311 - A313 & A316.

2.2 FABRICATION

- A. Comply with indicated profiles, dimensioned requirements, and structural requirements. Provide minimum 6 inch by 10 inch (150 mm by 250 mm) structural bents. Provide fascia as indicated.
- B. Use sections true to details with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture, free from defects impairing strength and durability.
- C. Mechanical Joints: Consisting of stainless steel bolts with minimum of 2 bolts per fastening. Install bolts and nuts concealed utilizing 1/2 inch thick by 1-1/2 inch (13 mm by 44 mm) aluminum bolt bars welded to structural members.
- D. Detail mechanical joints on shop drawings showing each location.
- E. Roof Deck: Extruded aluminum shapes, interlocking self flashing sections. Shop fabricate to lengths and panels widths required for field assembly. Depth of sections to comply with structural requirements. Provide shop induced camber in deck units with spans greater than 16 feet to offset dead load deflections. Use welded dams at non-draining ends of deck.
- F. Expansion joints, design structure for thermal expansion and contraction. Provide expansion joints as required.
- G. Provide exposed rivets for fastening bottom of fascia to deck to match fascia finish.
- H. Apply shop applied dip coat of clear acrylic enamel to each column end terminating in concrete to insulate from electrolytic reaction. Pierce column ends to "key" grout to bent for maximum uplift protection.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for supporting members, blocking, inserts, installation tolerances, and other conditions affecting performance of the work.
- B. Confirm locations, dimensions and elevations shown on shop drawings prior to fabrication.
- C. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

- A. Erection: Set walkway support tube frames onto steel channels projecting from bidding structure; set to required elevations, align, plumb and level; secure tube frame to structural channels. Comply with manufacturer's instructions.
- B. Erection: Set roof support frames (bents) into pockets provided in top of footings; set to required elevations, align, plumb and level; and grout in place with 2,000 psi. portland cement grout. Ensure grout fills voids and keys to columns. Fill downspout units with grout to bottom of discharge level. Install aluminum deflectors after grouting. Match to finish and elevation of adjacent sidewalks.
- C. Install roof deck sections, accessories, and related flashing in accordance with manufacturer's instructions. Provide roof slope for rain drainage without ponding water. Align and anchor roof deck units to structural support frames.

3.3 FLASHING

- A. Flashings: Flashings required between covered walkway system and adjoining structures are not work of this section. Refer to 07 62 00.

3.4 CLEANING AND PROTECTION

- A. Damaged Units: Replace roof deck panels and other components of the work that have been damaged or have deteriorated beyond successful minor repair.
- B. Cleaning: Remove protective coverings at time in project construction sequence that provide greatest protection of work. Clean finished surfaces to comply with recommendations of manufacturer.
- C. Protection: Protect completed work ensuring walkway cover will be without damage or deterioration at time of Substantial Completion.

END OF SECTION 10 73 13

SECTION 11 66 00 - GYMNASIUM EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 1. Basketball equipment.
 2. Volleyball equipment.
 3. Safety pads.
 4. Accessories necessary for a complete installation.

1.3 DEFINITIONS

- A. NFHS: National Federation of State High School Associations.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Basketball backstops and anchors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.5 SUBMITTALS

- A. Product Data: Technical data for each type of product, including assembly, disassembly, and storage instructions for removable equipment and to indicate the performance, fabrication procedures, product variations, and accessories
 1. If applicable, include assembly, disassembly, and storage instructions for removable equipment.
 2. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.
- B. Shop Drawings: Submit plans, elevations, sections, details, and attachments to other work.
 1. Include details of field assembly for removable equipment, connections, installation, mountings, floor inserts, attachments to other work, and operational clearances.
 2. Include transport and storage accessories for removable equipment.
- C. Samples: For the following products:
 1. Pad Fabric: Wall padding not less than 3 inches (76 mm) square, and corner and column samples not less than 3 inches (76 mm) long, with specified treatments applied. Mark face of material.
- D. Coordination Drawings: Court layout plans, drawn to scale, and coordinated with floor inserts, game lines, and markers applied to finished flooring.
- E. Product Certificates: For each type of gymnasium equipment.
- F. Operation and Maintenance Data: For gymnasium equipment to include in emergency, operation, and maintenance manuals.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not install gymnasium equipment until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Verify position and elevation of floor inserts and layout for gymnasium equipment.

1.7 COORDINATION

- A. Coordinate installation of floor inserts with structural floors and finish flooring installation and with court layout and game lines and markers on finish flooring.
- B. Coordinate layout and installation of overhead supported gymnasium equipment and suspension system components with other construction including light fixtures, HVAC equipment, fire suppression system components, and partition assemblies.

1.8 WARRANTY

- A. Written warranty in which manufacturer agrees to repair or replace components of gymnasium equipment that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Basketball backboard failures including glass breakage.
 - b. Faulty operation of basketball backstops.
 - 2. Warranty Period: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for use and finish type indicated.
 - 1. Extruded Bars, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
 - 2. Cast Aluminum: ASTM B 179.
 - 3. Flat Sheet: ASTM B 209 (ASTM B 209M).
- B. Steel: Comply with the following:
 - 1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
 - 2. Steel Tubing: ASTM A 500/A 500M or ASTM A 513, cold formed.
 - 3. Steel Sheet: ASTM A 1011/A 1011M.
- C. Support Cable: 1/4 inch (6 mm) diameter, 7x19 galvanized stranded steel wire rope with breaking strength of 7000 lb (3175 kg). Provide fittings complying with wire rope manufacturer's written instructions for size, number, and installation method.
- D. Support Chain and Fittings: For chains used for overhead lifting, provide Grade 80 heat treated alloy steel chains, complying with ASTM A 391/A 391M, with commercial quality, hot dip galvanized or zinc plated steel connectors and hangars.
- E. General Purpose Chain: For chains not used for overhead lifting, provide carbon steel chain, complying with ASTM A 413/A 413M, Grade 30 proof coil chain or other grade recommended by gymnasium equipment manufacturer. Provide coating type, chain size, number, and installation method complying with manufacturer's written instructions.

- F. Castings and Hangers: Malleable iron, complying with ASTM A 47/A 47M; grade required for structural loading.
- G. Softwood Plywood: DOC PS 1, exterior.
- H. Anchors, Fasteners, Fittings, and Hardware: Corrosion resistant or noncorrodible units; concealed; tamperproof, vandal and theft resistant design.
- I. Grout: Nonshrink, nonmetallic, premixed, factory packaged, nonstaining, noncorrosive, nongaseous grout, complying with ASTM C 1107/C 1107 with minimum strength recommended in writing by gymnasium equipment manufacturer.

2.2 BASKETBALL EQUIPMENT

- A. Basis of Design: Performance Sports Systems (PSS). Other manufacturers are subject to compliance with requirements.
 - 1. AALCO Manufacturing.
 - 2. ADP Lemco.
 - 3. Arizona Courtlines, Inc.
 - 4. Basketball Products International.
 - 5. Bison, Inc.
 - 6. Douglas Industries, Inc.
 - 7. Draper Inc.
 - 8. IPI by Bison.
 - 9. Jaypro Sports, LLC.
 - 10. L. A. Steelcraft Products, Inc.
 - 11. P. W. Athletic Mfg. Co.
 - 12. Porter Athletic Equipment Company.
 - 13. Schelde North America.
 - 14. Spalding Equipment.
- B. Protruding fasteners or exposed bolt heads on front face of backboards are not permitted.
- C. Provide manufacturer's recommended connections complying with Section 05 50 00 of size and type required to transfer loads to building structure.
- D. Overhead Supported Backstops:
 - 1. Folding Type: Provide manufacturer's standard assembly for backward folding backstop, with hardware and fittings to permit folding.
 - 2. Framing: Steel pipe, tubing, and shapes. Design framing to minimize vibration during play.
 - a. Dual Mast Frame: Welded and bolted or clamped with cross bracing.
 - b. Finish: Polyester powder coat finish.
 - 3. Goal Height Adjuster: Adjustable from 8 to 10 feet (2.4 to 3 m) with gear drive mechanism, locking in any position within adjustment range, with visible height scale attached to side of framing.
 - a. Operation: Electric with integral gear-drive motor, with limit switches preset to goal heights and the following:
 - 1) Key switch control.
 - 2) One detachable electric control device(s).
 - 3) Wireless remote controls.
- E. Backstop Safety Device: Designed to limit free fall if support cable, chains, pulleys, fittings, winch, or related components fail; with mechanical automatic reset; 6000 lb (2722-kg) load capacity; one per folding backstop.

- F. Winch: Hoist, consisting of heavy duty, fully enclosed worm gear; brake; cable drum; cable; and fittings, for mounting on wall with equipment mounting board; designed to move and hold backboard in any raised or lowered position.
1. Operation: Manual winch with detachable hand crank.
 2. Portable Winch Operator: One portable electric motor-drive device(s) including adaptor to fit crank mechanism.
- G. Backstop Electric Operator: Provide operating machine of size and capacity recommended by manufacturer for equipment specified, with electric motor and factory prewired motor controls, starter, gear reduction unit, and remote controls. Coordinate wiring requirements and electrical characteristics with building electrical system.
1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Operator Type: Cable drum with grooved drum and cable tension device to automatically take up cable slack and retain cable in grooves.
 3. Operator Mounting: Wall mounted board.
 4. Motor Electrical Characteristics:
 - a. Voltage: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
 - b. Horsepower: 1 hp.
 - c. Phase: Single.
 5. Remote Control Station(s): NEMA ICS 6, Type 1 enclosure for recessed or flush mounting and momentary contact, three position, switch operated control with up, down, and off functions.
 - a. Group Key Switch Control Stations: One switch per two backstops.
 - b. Keys: Provide dual keys, one key for up and one for down per station.
 - c. Switches, Ganged: Single faceplate with multiple switch cut outs for six switches operating 12 backstops.
 - d. Control Station Enclosure: Provide prime-painted metal enclosure with key access with two sets of keys per enclosure.
 - e. Radio Controls: Digital system consisting of code compatible universal coaxial receiver, one per backstop winch, and two portable multiple channel transmitters for operating up to nine backstops individually with up and down functions.
 - f. Provide a total of three (3) remotes in addition to the local control switches.
 6. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop basketball equipment at fully retracted and fully lowered positions.
- H. Basketball Backboards:
1. Shape and Size:
 - a. Rectangular, 72 inches by 48 inches (1800 mm by 1200 mm) width by height.
 2. Backboard Material: With predrilled holes or preset inserts for mounting goals, and as follows:
 - a. Glass: Not less than 1/2 inch (13 mm) thick, transparent tempered glass complying with ASTM C 1048 Kind FT (fully tempered) and with impact testing requirements in 16 CFR 1201 Category II or ANSI Z97.1 Class A for safety glazing.
 - 1) Provide glass with impact absorbing resilient rubber or PVC gasket around perimeter in a fully welded, brushed natural finish, extruded aluminum frame, with steel subframe, reinforcement, bracing, and mounting slots for mounting backboard frame to backboard support framing.
 - 2) Standard Mount: Provide steel corner reinforcement with mounting slots for mounting backboard frame to backstop at standard mounting centers. Provide center strut frame reinforcement.

- 3) Direct Mount: Designed for mounting backboard frame to center mast of backstop to maximize relief of stresses on backboard frame and glass.
 - 4) Rim Restraining Device: Complying with NCAA and NFHS rules and designed to ensure that basket remains attached if glass backboard breaks.
3. Target Area and Border Markings: Permanently etched in white color, marked in pattern and stripe width according to referenced rules.
- I. Goal Mounting Assembly: Compatible with goal, backboard, and support framing; with hole pattern 5 inches (127 mm) o.c. horizontally and vertically for goal attachment.
1. Glass Backboard Goal Mounting Assembly: Goal support framing and reinforcement designed to transmit load from goal to backboard frame and to minimize stresses on glass backboard.
- J. Basketball Goals: Complete with flanges, braces, attachment plate, and evenly spaced loops welded around underside of ring.
1. Single Rim Basket Ring Competition Goal: Materials, dimensions, and fabrication complying with referenced rules.
 2. Type: Movable, breakaway design with breakaway mechanism and rebound characteristics identical to those of fixed, nonmovable ring.
 3. Breakaway Characteristics: Positive lock movable breakaway design, with breakaway mechanism including preset pressure release, set to release at 230 lb (105 kg) load, and automatic reset. Provide movable ring with rebound characteristics identical to those of fixed, nonmovable ring.
- K. Basketball Nets: 12 loop mesh net, between 15 inches and 18 inches (380 mm to 460 mm) long, sized to fit rim diameter:
1. Cord: Made from white nylon.
 2. Competition Cord: Antiwhip, made from white nylon cord not less than 120 gm thread and not more than 144 gm thread.
- L. Backboard Safety Pads: Designed for backboard thickness indicated and extending continuously along bottom and up sides of backboard and over goal mounting and backboard supports required by referenced rules.
1. Attachment: Peel and stick tape.
 2. Color: Match Existing.

2.3 VOLLEYBALL EQUIPMENT

- A. Basis of Design: Performance Sports Systems (PSS). Other manufacturers are subject to compliance with requirements.
1. AALCO Manufacturing.
 2. ADP Lemco.
 3. American Athletic, Inc.
 4. Arizona Courtlines, Inc.
 5. Bison, Inc.
 6. Douglas Industries, Inc.
 7. Draper Inc.
 8. IPI by Bison.
 9. Jaypro Sports, LLC.
 10. L. A. Steelcraft Products, Inc.
 11. P. W. Athletic Mfg. Co.
 12. Porter Athletic Equipment Company.
 13. Schelde North America.
 14. Spalding Equipment.

15. Sports Imports.

- B. Floor Plates and Sleeves: Model KA25; Provide and install as located on the drawings
1. Approved Products/Manufacturer: "Senoh" equipment manufactured by Sports Imports, Inc. (No substitutions)

2.4 SAFETY PADS

- A. Basis of Design: Performance Sports Systems (PSS). Other manufacturers are subject to compliance with requirements.
1. AALCO Manufacturing.
 2. ADP Lemco.
 3. American Athletic, Inc.
 4. Bison, Inc.
 5. Draper Inc.
 6. IPI by Bison.
 7. Jaypro Sports, LLC.
 8. Porter Athletic Equipment Company.
 9. Spalding Equipment.
- B. Safety Pad Surface Burning Characteristics: ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. Flame Spread Index: 25 or less.
 2. Smoke Developed Index: 450 or less.
- C. Pad Coverings: Provide safety pad fabric covering that is fabricated from puncture and tear resistant, PVC coated polyester or nylon reinforced PVC fabric, not less than 14 oz./sq. yd (475 g/sq. m) and treated with fungicide for mildew resistance; with surface burning characteristics indicated, and lined with fire retardant liner.
- D. Wall Safety Pads: Padded wall wainscot panels designed to be attached in a continuous row; each panel section consisting of fill laminated to backer board with visible surfaces fully covered by seamless fabric covering, free of sag and wrinkles and firmly attached to back of backer board.
1. Backer Board: Not less than 3/8 inch (9.5 mm) thick fire retardant treated plywood according to AWPA U1, UCFA Fire Retardant Interior.
 2. Fire Resistive Fill: Multiple impact resistant foam not less than 1-1/2 inch (38 mm) thick, fire resistive neoprene; 6.0 lb/cu. ft. (96 kg/cu. m) density.
 3. Size: Each panel section, 24 inches (600 mm) wide by not less than 72 inches (1800 mm) long.
 4. Number of Modular Panel Sections: As indicated.
 5. Installation Method: Concealed mounting Z clips.
 6. Fabric Covering Color(s): Selected by Architect for two color(s).
 7. Graphics: Custom graphics as indicated.
- E. Cut out Trim: Provide flanged cut out trim kits for fitting pads around switches, receptacles, and other obstructions.
1. Color: Match Existing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for play court layout, alignment of mounting substrates, installation tolerances, operational clearances, accurate

locations of connections to building electrical system, and other conditions affecting performance of the Work.

1. Verify critical dimensions.
2. Examine supporting structure, subgrades, subfloors, and footings below finished floor.
3. Examine wall assemblies, where reinforced to receive anchors and fasteners, to verify that locations of concealed reinforcements are clearly marked. Locate reinforcements and mark locations.

B. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

A. Comply with manufacturer's written installation instructions and competition rules indicated for each type of gymnasium equipment. Complete equipment field assembly where required.

B. Unless otherwise indicated, install gymnasium equipment after other finishing operations, including painting, are completed.

C. Permanently Placed Gymnasium Equipment and Components: Install rigid, level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated; in proper relation to adjacent construction; and aligned with court layout.

1. Floor Insert Location: Coordinate location with application of game lines and markers , and core drill floor for inserts after game lines are applied.
2. Floor Insert Elevation: Coordinate installed heights of floor insert with installation and field finishing of finish flooring and floor-plate type.
3. Operating Gymnasium Equipment: Verify clearances for movable components of gymnasium equipment throughout entire range of operation and for access to operating components.

D. Floor Insert Setting: Position sleeve in oversized, recessed voids in concrete slabs and Footings. Clean voids of debris. Fill void around sleeves with grout, mixed and placed to comply with grout manufacturer's written instructions. Protect portion of sleeve above subfloor and footing from splatter. Verify that sleeves are set plumb, aligned, and at correct height and spacing; hold in position during placement and finishing operations until grout is sufficiently cured. Set insert so top surface of completed unit is flush with finished flooring surface.

E. Safety Pads: Mount with bottom edge at 4 inches (102 mm) dimension indicated on Drawings above finished floor.

F. Cut out Trim: Limit cuts in face of padding from trim unit's corner to corner outside dimensions. Install with ends of cuts concealed behind trim flange.

G. Anchoring to In Place Construction: Use anchors and fasteners where necessary to secure built in and permanently placed gymnasium equipment to structural support and to properly transfer load to in place construction.

H. Connections: Connect electric operators to building electrical system.

I. Removable Gymnasium Equipment and Components: Assemble in place to verify that equipment and components are complete and in proper working order. Instruct Owner's designated personnel in properly handling, assembling, adjusting, disassembling, transporting, storing, and maintaining units. Disassemble removable gymnasium equipment after assembled configuration is approved by Architect and Owner, and store units in location indicated on Drawings.

3.3 ADJUSTING

- A. Adjust movable components of gymnasium equipment to operate safely, smoothly, easily, and quietly, free from binding, warp, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and moving parts.

3.4 CLEANING

- A. After completing gymnasium equipment installation, inspect components. Remove spots, dirt, and debris and touch up damaged shop applied finishes according to manufacturer's written instructions.
- B. Replace gymnasium equipment and finishes that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

- A. Engage a factory authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain gymnasium equipment.

END OF SECTION 11 66 00

SECTION 11 66 43 - INDOOR SCOREBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Indoor single-sided LED Basketball, Volleyball and Wrestling scoreboard with control center.
- B. Responsibility of Coordination: Coordinate the work specified herein with the work specified in other sections including electrical requirements in Division 26.
- C. Related Work
 - 1. Section 05 50 00 – Misc. Metal Fabrications: Steel shapes required for those scoreboards requiring framing, posts, or other steel support either from ground, attachment to structures.
 - 2. Division 26 - Electrical: Electrical requirements.
 - 3. All Sections regarding work to which scoreboards are attached.

1.3 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.
 - 2. Manufacturer's installation instructions.
- B. Shop Drawings: Indicate size, material, and finish. Show locations and install procedures. Include details of joints, attachments, and clearances.
- C. Samples: Submit full range of colors, lettering styles, and finishes available for Architect's selection.

1.4 WARRANTY

- A. Warrant the work specified herein as follows:
 - 1. Scoreboards shall be guaranteed for five (5) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
 - 2. LED digits shall be guaranteed for ten (10) years against defects in materials.
- B. Defects shall include, but not be limited to, the following:
 - 1. Loose or missing parts
 - 2. Severe deterioration of finish
 - 3. Faulty operation, including, but not limited to burned out LED lamps.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- A. Basis of Design: Model 5242-C3 with MSX control scoring console as manufactured by The Spectrum Corporation, Houston, Texas. Other manufacturer's listed below who produce equivalent products to those specified are approved for use on the Project with Architect's approval. Manufacturers other than those listed must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
1. Daktronics, Inc., Brookings, South Dakota
 2. Nevco Scoreboard Co., Greenville, Illinois;
 3. Sportable Scoreboards, Murray, Kentucky.
 4. Trans-Lux Fair-Play, DesMoines, Iowa.

2.2 BASKETBALL & VOLLEYBALL & WRESTLING SCOREBOARDS

- A. General Information:
1. Dimensions: 5' H x 10' W x 5" D
(1.5 m x 25 cm x 13 cm)
 2. Weight: 189 lbs. (86 kg)
 3. Power requirements: 408 VA, 120 VAC
 4. Shall have a Premium Polyurethane Finish
 5. Color: As selected by Architect from Manufacturer's full range of colors.
 6. Shall have a deluxe game horn rated at 100 dB @ 10'0"
 7. Shall have Border Trim and Clock Striping
 8. Scoreboards functionality shall include:
 - a) 99:59 Minute Clock counts down
 - b) Segment Timer capable
 - c) Home and Visitor scores 0-199
 - d) Period 1-4
 - e) Preprogrammable Double Bonus indicators
 - f) Possession indicators
 - g) Team fouls 0-99
 - h) Time-Out Timer displays time remaining
 - i) User selectable 1/10 or 1/100 second displays in last minute of a period
 - j) Automatic clock reset and period advance
 - k) Automatic Quarter reset

- l) Automatic Substitution feature
 - m) Programmable Celebration Flash Feature
 - n) Instant reset and posting for all digits
- B. Construction:
- 1. Scoreboard Face: 22g galvanized steel with premium polyurethane finish.
 - 2. Scoreboard back: 24g galvanized steel.
 - 3. Digit face plate: 0.125 acrylic lexan clear sheet.
- C. Digits:
- 1. All LEDs shall be covered with 1/8 inch lexan SpectraShields to protect and absorb impacts.
 - 2. Shall be a combination of red and amber LED digits.
 - 3. Shall be rated 100,000 hours of use.
 - 4. Shall be 8-segment solid stroke design.
 - 5. All LED digits shall be individually serviceable from the front of the scoreboard cabinet.
 - 6. Scoreboard assembly shall be include Twenty (20) numeric LED digits, four (4) B's for bonus and double bonus, two (2) arrows for possession.
 - 7. Digits sets shall have:
 - a. Ultra-Bold LED Digit Technology:
 - 1) 14 inch (36 cm) Clock and team scores.
 - 2) Shall include 320 LEDs per digit.
 - b. SpectraBrite LED digit technology.
 - 1) 9 inch (23 cm) high- Team fouls (won), Player Number (Game), Player Fouls and Period.
 - 2) Shall include 108 LEDs per digit.
- D. Captions:
- 1. Home and Visitor shall be 6 inches high (15 cm).
 - 2. Team Fouls, player number and player fouls shall be 4 inches high (10 cm).
 - 3. Games wone, game number and period shall be 3 inches high (8 cm).
 - 4. Captions shall be 3m brand 220 high performance vinyl applied directly to scoreboard face.

2.4 CONTROL SCORING CONSOLE

- A. Control shall be an MSX Controller.
- B. Controller functionality shall include:
- 1. Easy set up for 15 different sports.
 - 2. Changeable key pad inserts for other sports.
 - 3. Memory backup to retain configurations and eliminate date loss.
 - 4. Durable, lockable rugged waterproof carry case.
 - 5. A ten (1) foot (3 m) low voltage data cable cord that connects to control receptable junction box and shall unplug and store inside the carrying case.
- C. Components: All electronic components shall be solid state. Component module shall be accessible from the front of the scoreboard.
- D. Console: Operator's control console requires 120 VAC electrical power. The low voltage control console shall be housed in a protective, weather resistant carry case. A single ten (10) feet

long, three (3) wire, low voltage control cable shall unplug and store inside the carrying case. Furnish two (2) control consoles with carrying cases.

- E. Switches: Switching shall be accomplished by solid state membrane switching technology; each switch having a life of at least five (5) million operations. All switches shall be "splash proof" and environmentally sealed by a combination of layers of a velvetgrain, highly durable, polycarbonate and glossy polyester. All switches are defined by the 0.020 inch thick black velvetgrain polycarbonate "switch locator" overlay. The numeric keypad, clock on-off, and score switches shall give "tactile feedback" to recognition. Sound shall be emitted by all switches to let the operator know a switch has occurred. The clock on-off switch shall be environmentally sealed "bat type" toggle switch. Visual feedback shall be accomplished by LED indicators (green) for the clock and other selected switches (red.) This gives three (3) methods of feedback to the operator: Tactile (feel), Audio (sound), LED/Coding (sight).
- F. Multi-Sport: The control panel switch functions shall be changed (depending on the type of scoreboard being used; i.e., basketball, volleyball, football, soccer, wrestling, etc.) by removing a single switch label insert from under the overlay and re-inserting the appropriate switch label insert. The insert shall slide in and out and is locked in place. (This allows a single control to operate multiple scoreboards of different sports). Each sport has a single switch label insert.
- G. Electrical: Scoreboard shall require not more than 2.5 amperes at 120 VAC, 60 Hz.
- H. Number/Location: Provide two (2) basketball scoreboards in the Auxiliary Gymnasium in location shown on drawings.

2.3 OTHER MATERIALS

- A. Provide other materials, not specifically described but required for a complete and proper scoreboard installation include, but not limited to, the following:
 - 1. 2.4 GHz spread spectrum radio system with frequency hopping technology and 64 non-interfering channels; system includes a transmitter installed inside the console and a receiver installed inside the scoreboards.
 - 2. Hard carrying case.
 - 3. Battery pack.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install specified units in accordance with manufacturer's printed instructions. Erect units plumb and level, with power supply coordinated with the electrical Division.
- B. Install each scoreboard on framing and supports as indicated on drawings. Refer to Section 03 30 00, Cast-In-Place Concrete for concrete footings of scoreboard posts as shown or required. Refer to Section 05 50 00, Miscellaneous Metals for steel items incidental to framing and support of scoreboards as shown or required.
- C. Adjust each scoreboard for proper function. Replace broken lamps, faulty control elements, and damaged parts.
- D. Provide remote locations for additional controller hook-ups as indicated.

END OF SECTION 11 66 43

SECTION 12 11 00 - DIGITALLY-PRINTED VINYL WALL GRAPHICS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Very large scale vinyl wall graphics (murals) digitally printed on self-adhesive vinyl graphics film from electronic graphic image files furnished by the Architect, adhered to gypsum board surfaces with a Level 5 skim coated, smooth painted finish.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. Installation drawings: Indicate configuration and dimensions of substrate(s) including (if applicable) penetrating and protruding elements; vinyl mural panels; seam locations; details of installation; and related and adjacent work. Note field-measured dimensions.
- B. Product Data:
 - 1. Manufacturers' specifications for vinyl film medium, inks and laminating film, and other data sufficient to demonstrate compliance with specified requirements
 - 2. Manufacturer's written preparation, installation, and cleaning and maintenance instructions and recommendations
- C. Samples:
 - 1. Color Approval Proof:
 - a. Full color laminated print produced with the same equipment that will be used for the actual vinyl wall graphics panels, using the specified resolution, ink sets, vinyl film printing medium and clear protective laminating film, in a size proportional to the finished mural, with the lesser dimension approximately equal to the width of the vinyl film medium.
 - b. Make adjustments, reprint and resubmit as necessary to obtain Architect's approval.
- D. Certificates: Submit written certification, on graphics provider firm's letterhead, that products and installation comply with specified requirements.

1.4 ENVIRONMENTAL CONDITIONS

- A. Maintain room and substrate temperature and humidity within the ranges recommended by the graphic film manufacturer at least 48 hours prior to, during, and after installation, until Substantial Completion.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver, handle and store products as recommended by the manufacturer(s), in graphics provider's labeled protective packaging. Protect from damage and deterioration.

1.6 WARRANTY

- A. Graphics provider shall provide a 10-year material and labor warranty against fading, edge lifting, peeling, discoloration, delamination of the overlamine from the vinyl graphics film, and delamination of the vinyl film from the painted Level 5 skim-coated smooth-painted gypsum board substrate.

PART 2 - PRODUCTS

2.1 ACCEPTABLE PRODUCTS, MANUFACTURERS AND GRAPHICS PROVIDERS

- A. Specifications are based on products, manufacturers and graphics providers named herein or listed as the Basis of Design. Products of manufacturers listed which meet or exceed specifications are approved for use on the Project. Other manufacturers and graphics providers must have a minimum of five years experience supplying (and for graphics providers, installing) products meeting or exceeding the specifications, and comply with requirements of Section 01 25 13 Product Substitution Procedures to be considered.

2.2 GRAPHICS PROVIDER

- A. Basis of Design: Riot Creative Imaging division of ARC (Dana LaPointe), 6300 Gulfton, Houston, TX 77081; 713-830-3933; dana.lapointe@riotcolor.com; www.riotcolor.com
- B. Single-source Responsibility: Graphics Provider shall be solely responsible for processing, production and installation, whether installation is performed by its own personnel or by its approved installation contractor.

2.3 EQUIPMENT

- A. Basis of Design Printer: HP 3000 grand format inkjet printer with HP 881 Latex Printheads; 54 inch wide media capacity; 600 dpi minimum resolution, or equivalent equipment acceptable to the Architect and compatible with the specified (or approved substitution) inks and media.
- B. Laminator: Compatible with the specified (or approved substitution) vinyl film media, inks and overlamine.

2.4 MATERIALS

- A. Basis of Design for VWC-Drywall Application:
 - 1. Protective Laminated Film: ClearShield Wall Armor film. Category V Type II.
 - a. Colorfastness: Greater than or equal to 200h.
 - b. Washability: Greater than or equal to 100 cycles.
 - c. Scrubbability: Greater than or equal to 300 cycles.
 - d. Abrasion Resistance: Greater than or equal to 300 cycles.
 - e. Cracking, Drying: Good.
 - f. Stain Resistance to Reagents: 4.
 - g. Flame Spread: Less than or equal to 25.
 - 2. Inks: HP™ 881 Latex Inks; low-VOC, UV-resistant, water-soluble, latex-based, odorless pigmented inks.
 - a. Curing: Heat and infrared cured
 - b. VOCs: Less than 294 g/L
 - c. Hazardous Air Pollutants (HAPs): None.
 - d. Hazard Warning Labels: None (cautionary only; no "R" phrases).
 - e. Flammability/ combustibility: Nonflammable; noncombustible; FP > 93.3C

3. Vinyl Wall Covering: Dreamscape Suede.
 - a. Description: Commercial grade vinyl printable vinyl wallcovering media for modern wide format inkjet printers.
 - b. Construction: Embossed vinyl face with laminated fabric backing.
 - c. Backing: Poly-cotton woven or polyester/pulp non-woven.
 - d. Type Properties: Passes all criterion for WA 101, Type II.
 - e. Thickness: 0.017 in.
4. Accessory products, tools, and equipment: Recommended by, or acceptable to, the manufacturers of the materials with which they are used.

2.4 PROCESSING AND PRODUCTION

- A. Lay out each mural image in full-height vertical panels without horizontal seams. Allow overlap at vertical seams for accurate alignment and trimming. Unless otherwise specifically authorized by the Architect, lay out so panels are equal in width and arranged symmetrically. In no case shall a panel be less than one-half the vinyl media width.
- B. For uniform appearance, produce all panels using vinyl film media, inks, and laminating film that are each sourced from a single manufacturing lot or production run.
- C. Each panel shall be free from skipped print head scan lines, ink deposition irregularities, physical defects and other noticeable flaws. If flaws are found, reprint as many panels as necessary for flawless appearance and consistent color match between all panels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. With the installer, examine the conditions affecting work of this section, including but not necessarily limited to substrate surface smoothness, cleanliness, and uniformity; adjacent materials; and temperature and humidity.
 1. Confirm that substrate surfaces are properly finished, smooth, and clean, and are free of contaminants, texture, roughness, voids, protrusions and other surface irregularities that could impair adhesion or telegraph through the applied film.
 2. Report unsatisfactory conditions to the Architect in writing.
 3. Do not proceed with installation until unsatisfactory conditions have been corrected. Commencement of installation shall be deemed to be acceptance of conditions as satisfactory.

3.2 PREPARATION

- A. Acclimatize printed vinyl film and other materials to the environment where they will be installed for at least 24 hours prior to commencement of installation, or for a longer period if recommended by the manufacturer.
- B. Prior to installation, re-inspect mural panels closely for skipped print head scan lines, ink deposition irregularities, physical defects and other noticeable flaws. If flaws are found, reprint and replace as many panels as necessary for flawless appearance and consistent color match between all panels.

3.3 INSTALLATION

- A. Digitally-Printed Vinyl Murals:
 1. Installation shall be performed only by trained, experienced personnel approved by the graphics provider.

2. Install in accordance with manufacturer's instructions and reviewed submittals.
3. Install in location(s) shown on drawings
4. Seams: Hairline, with overlapped, razor-cut butt joints. Visually align adjacent panels for accurate registration with no visible gaps, offsets or misalignments.
5. Install without bubbles, wrinkles, gaps, fish mouths and other surface and seam irregularities for a smooth, uniform appearance.

3.4 CLEANING AND PROTECTION

- A. Protect installed work from deterioration and other damage as recommended by the manufacturer until date of Substantial Completion.
- B. If necessary and possible, clean or repair murals to restore to like-new condition following manufacturer's written instructions and recommendations.
- C. Replace materials found to be defective or damaged, if it is not possible to clean or restore them to like-new condition.
- D. Clean and repair damaged adjacent surfaces and other work damaged by the work of this section. If damage cannot be cleaned or repaired to the equivalent of new condition (or for existing materials, their condition prior to damage from construction), replace damaged materials with new undamaged materials.

END OF SECTION 12 11 00

SECTION 12 21 13 - HORIZONTAL LOUVER BLINDS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Horizontal slat louver blinds.
 - 2. Operating hardware.
- B. Related Sections:
 - 1. Section 06 10 00 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.
 - 2. Section 10 71 13 - Exterior Sun Control Devices: Exterior horizontal louver blinds.

1.3 REFERENCE STANDARDS

- A. NFPA 1 - Fire Code; 2024.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. WCMA A100.1 - Standard for Safety of Window Covering Products; 2022.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the placement of concealed blocking to support blinds. Refer to Section 06 10 00 - Rough Carpentry.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide data indicating [physical and dimensional characteristics; operating features;
- C. Shop Drawings: Indicate opening sizes, tolerances required, method of attachment, clearances, and operation.
 - 1. Motorized Blinds: Include schematic system riser diagram indicating component interconnections, detailed sequence of operations describing system functions, and requirements for interface with other systems.
- D. Samples: Submit two samples, 6-inch long illustrating slat materials and finish, wand type and color.
- E. Manufacturer's Installation Instructions: Indicate [special procedures; perimeter conditions requiring special attention.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Refer to Section 01 60 00 - Product Requirements for additional provisions.
 - 2. Extra Blind Assemblies: One of each size.
 - 3. Extra Slats: 20 of each type and size.
 - 4. Extra Lift Cords, Control Cords, and Wands: One of each type.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Horizontal Louver Blinds:
 - a. Draper, Inc; www.draperinc.com.
 - b. Hunter Douglas Architectural: www.hunterdouglasarchitectural.com.
 - c. Levolor: www.levolor.com/commercial.
 - d. Springs Window Fashions (SWF) contract, a division of Springs Window Fashions, LLC: www.swfcontract.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
- C. Source Limitations: Furnish blinds and associated controls produced by a single manufacturer and obtained from a single supplier.

2.2 BLINDS WITHOUT SIDE GUIDES

- A. Basis of Design:
 - 1. Classics 1" Cordless Aluminum Blinds manufactured by SWFcontract.
- B. Description: Horizontal slat louvers hung from full-width headrail with full-width bottom rail complying with WCMA A100.1.
- C. Manual Operation: Control of raising and lowering by cordless mechanism; blade angle adjustable by control wand.
- D. Metal Slats: Spring tempered pre-finished aluminum square; radiused; slat corners, with manufacturing burrs removed.
 - 1. Width: 1 inch.
 - 2. Minimum Thickness: 0.006 inch.
 - 3. Color: As selected by the Architect.
- E. Slat Support: Polymer cord ladder configuration.
- F. Head Rail: Pre-finished, formed aluminum box, with end caps; internally fitted with hardware, pulleys, and bearings for operation; same depth as width of slats.
 - 1. Height: As required.
 - 2. Color: As selected by the Architect.
- G. Bottom Rail: Pre-finished, formed steel; with top side shaped to match slat curvature; with end caps.
 - 1. Color: As selected by the Architect.
- H. Lift Cord: Braided polypropylene continuous loop; complying with WCMA A100.1.
 - 1. Free end looped through wall-mounted spring-tensioned.
 - 2. Color: As selected by the Architect.
- I. Control Wand: Extruded hollow plastic square shape.
 - 1. Non-removable type.
 - 2. Length of window opening height.
 - 3. Color: As selected by the Architect.
- J. Accessory Hardware: Type recommended by blind manufacturer.

2.3 FABRICATION

- A. Determine sizes by field measurement.
- B. Fabricate blinds to fit within openings with uniform edge clearance of 1/8 inch.

- C. Fabricate blinds to cover window frames completely.
- D. At openings requiring multiple blind units, provide separate blind assemblies with space of 1/4 inch between blinds located at window mullion centers.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that openings are ready to receive the work.
- B. Ensure structural blocking and supports are correctly placed. Refer to Section 06 10 00 - Rough Carpentry.

3.2 INSTALLATION

- A. Install blinds in accordance with manufacturer's instructions.
- B. Secure in place with flush countersunk; concealed; fasteners.
- C. Place intermediate head supports at spacing recommended by the manufacturer.

3.3 TOLERANCES

- A. Maximum Variation of Gap at Window Opening Perimeter: 1/4 inch.
- B. Maximum Offset from Level: 1/8 inch.

3.4 ADJUSTING

- A. Adjust blinds for smooth operation.
- B. Motorized Blinds:
 - 1. Set limit switches for uniform range of motion according to project requirements.
 - 2. Program control system parameters according to requirements of the Owner.

3.5 CLEANING

- A. Clean blind surfaces just prior to occupancy.
- B. Refer to Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

END OF SECTION 12 21 13

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SECTION 12 24 00 - WINDOW SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Window shades and accessories for room darkening.

1.3 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Shop Drawings:
 - 1. Indicate field verified dimensions of openings scheduled to receive shades.
 - 2. Indicate fabric selection, operator, hardware style, and finish.
 - 3. Show location and installation procedures.
 - 4. Include details, attachments and clearances for Architect's approval.
- C. Samples or color charts showing manufacturer's full range of material colors for Architect's selection.

1.4 PRODUCT DELIVERY

- A. Deliver to job site in manufacturer's original cartons.
- B. Label shades with room and opening location in accordance with Room Finish Schedule.
- C. Carefully handle and store shades to prevent damage to materials, finishes, and operating mechanisms.

1.5 PROJECT CONDITIONS

- A. Install roller shades after finish work and ambient temperature, humidity and ventilation conditions are maintained at levels recommended for project upon completion.

1.6 PRODUCT DELIVERY

- A. Hardware and Shade Fabric: Draper's standard twenty-five (25) years limited warranty.
- B. Motors and Controls: Manufacturer's standard five year (5) limited warranty.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specifications are based on MechoSystems as manufactured by Mechoshades; (Other manufacturers are not precluded from making a proposal on this Project, but to do so, they must

have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.

2.2 METHOD OF OPERATION

- A. Bead Chain Clutch: Bead chain and clutch operated, vertical roll-up, fabric, opaque window shade system, complete with headbox, side and sill channels for total opacity.

2.3 HARDWARE

- A. Rollers (except shades with spring rollers): Sizes 1-1/2 inch diameter with 0.065 inch wall or two (2) inch diameter with 0.080 inch wall of 6063-T5 aluminum extruded tube. Roller assembly easily removable.
- B. Roller Idler Assembly: Type 6/6 injected molded nylon and a zinc-plated cold rolled steel pin. Sliding pin for easy installation and removal of the roller.
- C. Endcaps: 1028 steel stamping, 3-1/4 inch x 3-3/4 inch, complete with roller adapter bracket. Installs to face, ceiling, or jamb as shown or required. Accepts snap-lock roller box cover and fabric guide. Clear anodized, black, white, ivory, or dark bronze baked enamel finish as selected by Architect.
- D. Head Box, Channels & Slat Bar: 6063-T5 aluminum custom extruded shapes, 0.060 inch wall. Clear anodized finish or black, white, ivory, or dark bronze baked enamel finish as selected by Architect. All contain grooves to accept light seal elements.
 - 1. Head Box: (Configuration shown or required)
 - a. For Surface or Jamb Installation (standard): Shall consist of an L-shaped back/top and an L-shaped front/bottom.
 - b. For Pocket Installation: Shall include a U-shaped back/top/front with removable bottom. Some exposed fasteners required.
 - 2. Side Channels: Shall be of one-piece construction. Channel consists of two (2) chambers. One (1) accepts the fabric and contains groove for fabric retainer. The second accepts the fabric guide and channel locator. Face-mounted units require plastic cover buttons.
 - 3. Sill Channel: Accepts the slat bar, prevents light leakage. Bottom of channel provides for use of flat head screws.
 - 4. Slat Bar: Shall be furnished with sill channel and is attached to the bottom of shade fabric. Includes a chamber for additional weight if needed for smooth operation. Does not retract into operator enclosure (headbox).
- E. Channel Locator: Type 6/6 injected molded nylon. Aligns enclosure and channels.
- F. Fabric Guides: Plated steel. Forms a transition for the fabric as it rolls into the channels, reducing friction.
- G. Patented Fabric Retention: Horizontal steel stays are installed at regular intervals and covered. At each end of stays, a grommet is installed through the stay and shade fabric. The grommets are then held within the side channels by fabric retainers. This system enables the shade to withstand reasonable air pressure differentials. Note-Extreme air currents or physical interference may cause product failure.
- H. Opacity Plates: 1018 steel with a rubber "O" ring. Installed on the endcaps of the roller box to eliminate light leakage.

2.4 OPAQUE WINDOW SHADE SYSTEM

- A. Operation Type: Motorized, vertical roll-up, fabric, opaque window shade system, complete with headbox, side and sill channels for total opacity; MechoSystems_as manufactured by MechoShades.
- B. Shade Motor and Control System:
 - 1. Standard Motor: 110 VAC, single phase, 60 HZ, instantly reversible, lifetime lubricated, and equipped with internal thermal overload protector, electric brake, and pre-set accessible limit switches. Tubular motor concealed inside each shade roller tube.
 - a. Group Control:
 - 1) ISO relay - UL listed component. One ISO relay per motor. Allows 110-120V group switching via toggle switch. Allows for up to 12 motors on one switch.
- C. Roller Tube: Fabricated from extruded aluminum, galvanized steel, or enameled steel. Diameter, wall thickness, and material selected by manufacturer to accommodate shade type and size. Fabric connected to the roller tube with LSE (low surface energy) double sided adhesive specifically developed to attach coated textiles to metal. Adhesive attachment to eliminate horizontal impressions in fabric.
- D. Headbox: Consists of extruded aluminum sections with endcaps and opacity plates.
 - 1. Size: 5 inches high by 5 inches wide by length required for shade being provided.
 - 2. U-shaped front, back, and top and removable bottom.
- E. Endcaps: Stamped steel with universal design suitable for mounting to ceiling, wall, and jamb. Provide size compatible with roller size.
- F. Side Channels: Double chamber fabricated from 0.06 inch (1.5 mm) thick extruded aluminum sections. One chamber accepts fabric and contains groove for fabric retainer. Other chamber accepts fabric guide and channel locator.
- G. Sill channel: L bracket to prevent light leakage.
- H. Slat bar: Extruded aluminum bar attached to bottom of shade. Bar does not retract into headbox.
- I. Channel locator: Injected molded nylon insert to align side and sill channels with headbox.
- J. Fabric guide: Plated steel transition for fabric rolling into side channel.
- K. Fabric retainer: System designed to prevent disengagement of fabric from side channels due to normal variations of air pressure caused by doors opening, HVAC systems, and temperature differences between room and window well. System consists of horizontal steel stays installed in shade, covered with fabric, and spaced at regular intervals. Grommets installed through stays are held within groove of side channel chamber.
- L. Exposed aluminum finish:
 - 1. Finish: Black.

2.4 FABRICS

- A. Light-Filtering Fabrics
 - 1. SheerWeave Series SW2400 by Phifer: VOC Emissions: GREENGUARD Children & Schools -certified as a low emitting fabric. Manufacturer to supply GREENGUARD Children & Schools certificate. 500 denier fiberglass, vinyl coated and woven into a 2 x 2 basket weave. Fire rating: NFPA 701. Bacteria and Fungal Resistance: ASTM G 21 and ASTM G 22. Series SW2400, 3 percent open, .019 inches thick.

2. Color and pattern: Architect to select from manufacturer's full range of colors.
- B. Room Darkening Fabrics
1. SunBloc Series SB9000: Close woven fiberglass base textile with sun-resistant vinyl film bonded to each side, opaque with minimum tensile strength of 190 pounds for warp and 180 pounds for fill. Fire rating: NFPA 701 1006-Test 1. Washable and stain resistant. Wt. 12 oz/sq yd. Same color both sides, .015 inches thick.
 2. Color and pattern: Architect to select from manufacturer's full range of colors.
- C. Color and pattern: As indicated in Color Schedule on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Coordinate requirements for blocking, construction of shade pockets, and structural supports to ensure adequate means for installation of window shades.
- B. Coordinate installation of recessed shade pockets with construction of suspended acoustical panel ceilings specified in Division 9.
- C. Coordinate installation of recessed shade pockets with construction of suspended gypsum board ceilings specified in Division 9.
- D. Coordinate requirements for power supply conduit, and wiring required for window shade motors and controls.

3.3 INSTALLATION

- A. Install shades at locations scheduled, noted on the drawings, or as directed by the Architect in accordance with manufacturer's installation procedures, except as otherwise specified herein.
- B. Install intermediate support and extension brackets as needed to prevent deflection in headrail.
- C. Install shades with adequate clearance to permit smooth operation of shades and any sash operators. Hold shades 1/4 inch clear from each side of window opening on inside mount, unless other clearance is indicated.
- D. Provide 20 gauge, galvanized steel strap for anchoring.

3.4 CLEANING AND DEMONSTRATION

- A. Clean shades in accordance with manufacturer's instructions.
- B. Demonstrate shades to be in smooth uniform working order.

END OF SECTION 12 24 00

SECTION 12 35 50 - EDUCATIONAL CASEWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Manufactured plastic laminated casework, hardware and related accessories.

1.3 RELATED WORK

- A. Section 06 10 00 - Rough Carpentry: Wood blocking in walls for support of wall cabinets.
- B. Section 06 20 00 - Finish Carpentry and Millwork: General millwork and custom cabinetry unless specified herein or so noted on plans as included within this section.
- C. Section 09 65 13 - Resilient base.
- D. Division 22 - Mechanical: Sinks, service fixtures, and their installation and final connections.
- E. Division 26 - Electrical: Electrical connections.

1.4 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI A156.9 - Cabinet Hardware.
 - 2. ANSI A161.1 - Woodwork Testing Standards
 - 3. ANSI A208.1 - Mat-Formed Wood Particleboard.
- B. Architectural Woodwork Institute:
 - 1. AWI - Quality Standards Illustrated.
- C. National Electrical Manufacturers Association:
 - 1. NEMA LD 3 - High Pressure Decorative Laminates.
- D. Composite Panel Association
 - 1. Technical Bulletin - Particleboard and MDF for Shelving

1.5 DEFINITIONS

- A. Identification of casework components and related products by surface visibility.
 - 1. Balanced construction: High pressure laminate or cabinet liner shall be installed on both sides of core to restrict warpage in accordance with AWI Quality Standards Illustrated Section 400B-T-2.
 - 2. Open Interiors: Open unit without solid door and drawer fronts, and units with full glass insert or acrylic doors.
 - 3. Closed Interiors: Closed unit behind solid door, drawer fronts, and sliding solid doors.
 - 4. Exposed Ends: Exterior side surface that is visible after installation.
 - 5. Other Exposed Surfaces: Faces of doors and drawers when closed and tops of cabinets less than 72 inches above finished floor.
 - 6. Semi-Exposed Surfaces: Interior surfaces which are visible, bottoms of wall cabinets and tops of cabinets 72 inches or more above finished floor.

7. Concealed Surfaces: Any surface not visible after installation.

- B. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

1.6 PERFORMANCE REQUIREMENTS

- A. Unless otherwise indicated, perform work in accordance with AWI "Quality Standards Illustrated", Custom Grade, except where specification exceeds those standards, the more stringent shall govern.
- B. Submit certified product test data in accordance with ANSI A161.1, NEMA LD3, and general static load testing performed and certified by an independent testing agency, covering the following areas of product performance, with these minimum results:
1. Base cabinet construction/racking test: 800 lbs.
 2. Cabinet front joint loading test: 425 lbs.
 3. Wall cabinet static load test: 2,000 lbs.
 4. Drawer front joint loading test: 600 lbs.
 5. Drawer construction/static load test: 750 lbs.
 6. Cabinet adjustable shelf support device/static load test: 300 lbs.
- C. Shelf Loading: Comply with loading/deflection standards of the Composite Panel Association.

1.7 SUBMITTALS

- A. Product Data:
1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 2. Manufacturer's preprinted product information for all hardware proposed on the project.
 3. Manufacturer's preprinted maintenance instructions for the casework hardware.
- B. Shop Drawings:
1. Indicate size, material and finish.
 2. Show locations and installation procedures, including hardware, sinks, service fixtures, trim and other pertinent data for each unit.
- C. Certification: Provide AWI Quality Certification Program certification for casework fabrication indicating manufacturer's registration with AWI Quality Certification Program.
- E. Samples: Two (2) each, 6 inch by 6 inch by 3/4 inch sample of specified particleboard core with grade stamp for use as verification of installed product.
- F. Provide one (1) upper and one (1) lower unit for approval prior to fabrication.

1.8 QUALITY ASSURANCE

- A. Manufacturer: Minimum of five (5) years experience in providing manufactured casework systems for similar types of projects, produce evidence of financial stability, bonding capacity, and adequate facilities and personnel required to perform on this project.
- B. Manufacturer: Products certified as meeting or exceeding ANSI-A 161.1 testing standards.

- C. Comply with Architectural Woodwork Institute's (AWI) "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork, construction, finishes and other requirements.
 - 1. Provide AWI Quality Certification Program labels indicating that the woodwork complies with the requirements of grades specified; and
 - 2. Upon award of work of this section, register the work with the AWI Quality Certification Program.
- D. Delivery conference: 48 hours prior to delivery, notify Architect of delivery date and time. At the Architect's discretion, a representative of the Architect may be present at the time of delivery. Casework not conforming to the specified requirements, as reasonably determined by the Architect's representative, shall be removed and returned to manufacturer for repair or replacement at no additional cost to the Owner or increase in time.

1.9 PRE-INSTALLATION CONFERENCE

- A. Section 01 31 00 – Project Management and Coordination.

1.10 PRODUCT HANDLING

- A. Deliver completed laminate clad casework, countertops and related products only after wet operations in building are completed. Store in ventilated place, protected from the weather, with relative humidity range of 20 to 50 percent.
- B. Protect finished surfaces from soiling and damage during handling and installation with a protective covering.

1.11 JOB CONDITIONS

- A. Environmental Requirements: Do not install casework until permanent HVAC systems are operating and temperature and humidity have been stabilized for at least one (1) week.
 - 1. Manufacturer/Supplier shall advise Contractor of temperature and humidity requirements for architectural casework installation areas.
 - 2. After installation, control temperature and humidity to maintain relative humidity between 25 and 55 percent.
- B. Conditions: Do not store or install casework in building until concrete, masonry, and drywall/plaster work is dry.

1.12 COORDINATION

- A. Coordinate the Work of this Section with plumbing work specified in Division 22. Coordinate sink opening construction with sinks specified in Division 22.
- B. Coordinate location of blocking in walls for installation and support of wall cabinets.

1.13 WARRANTY

- A. Warranty the work specified herein for five (5) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to the following:
 - 1. Rough or difficult operation, or loose or missing parts.
 - 2. Delamination of surfaces.
 - 3. Noticeable deterioration of finish.

4. Warped or misaligned surfaces or telegraphing of subsurface imperfections.

PART 2 - PRODUCTS

2.1 CASEWORK MANUFACTURERS

- A. Catalog numbers shown on drawings are based on Architectural Woodwork Standards. They are shown for reference only to indicated component requirements only. Fabrication of units shall be in accordance with these designations.
- B. Manufacturers listed below are certified by AWI Quality Certification Program and are listed for the Contractor's convenience only and shall not preclude the Contractor from using other manufacturers, provided they produce equivalent products of the type specified for the scope and size of the Project.
 1. Casework:
 - a. Jericho Woodworks; (281) 969-7947. (Basis of Design).
 - b. Calmar Manufacturing Co., Inc., a subsidiary of Imperial Woodworking Company; (563)562-3261.
 - c. Case Systems, Inc., (989) 496-9510.
 - d. Global Casework Manufacturing, Inc.; (281) 494-6181.
 - e. MGC Millwork, LP; (713) 772-0294.
 - f. Robert Shaw Mfg. Co., Inc.; (817) 927-2557.
 - g. Stevens Industries, Inc.; (217) 540-3100.
 - h. Terrill Manufacturing Co.; (915) 655-7133.
 - i. TMI Systems Design Corp., Dickenson, ND; (701) 456-6716.
 2. Other basis of design products/manufacturers are listed within 2.4 Specialty Items.

2.2 MATERIALS

- A. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD3, and the following requirements:
 1. Exterior Color Selection Available:
 - a. Architect to select from minimum of 250 selections available, including wood grain patterns and solid colors.
 - b. Provide 5 different colors available per project.
 - c. If laminate has wood grain, direction of grain shall be vertical on door, end panels, fascia panels, and exposed backs; horizontal on drawer faces, aprons, and top rails.
 2. Laminate grades:
 - a. Exposed doors, finished end panels, and other vertical surfaces: GP28 (0.028 inch thick nominal)
 - b. Horizontal surfaces other than top: GP28 (0.028 inch thick nominal)
 - c. Cabinet Liner: CL20 (0.020 inch nominal), white.
 - d. Work Surfaces and Countertops: GP50 (0.050 inch thick nominal) with BK20 (0.20 inch thick) backer sheet.
 - e. Backsplash: PH42 (0.042 inch nominal) with nominally balanced backer sheet.
 3. Adhesive: PVA water resistant adhesive. Contact adhesives not permitted.
 4. Chemical Resistant Cabinet Surfacing: (all locations of Science Labs and Prep Rooms) Provide WilsonArt Chemsurf or comparable product at all exterior cabinet faces and exposed end panels and shall be used at all Science Labs and Prep Rooms.
 5. Pressure Fused Laminate:

- a. NEMA LD3 VGL, and NEMA LD3 CLS, Melamine resin impregnated, 120 gram PSM minimum, thermofused to core under pressure.
 - b. Color:
 - 1) Closed interiors, underside of wall cabinets: White.
 - 2) Exposed and Semi-exposed open cabinets: Match exterior.
 - c. Provide balanced construction with same thermofused melamine. Unsurfaced coreboard or simple backers not allowed.
- B. Core Material:
1. Particleboard: ANSI 208.1, minimum 45 pcf density, Grade M-3.
 2. Plywood: Exterior grade, hardwood faced, any species, with no defects affecting strength or utility. Overlay plywood not permitted.
 3. Water resistant treated plywood: shall have 24 hour thickness swell factor of five percent or less and 24 hour water absorption factor of ten percent or less; P.S. 51, Type II or better.
 4. Cabinet components shall be of the following minimum core thicknesses:
 - a. Cabinet backs, drawer body, and drawer bottoms: 1/2 inch particleboard
 - b. Door and drawer face, base, wall, and tall cabinet tops and bottoms, cabinet sides, drawer spreaders, cabinet back rear hangstrips, structural dividers, and exposed cabinet backs: 3/4 inch particleboard.
 - c. Work surfaces and countertops: 1 inch particleboard, except use plywood core at counters with sinks.
 - d. Shelves: 3/4 inch particleboard core for 30 inches long or less, 1 inch thick particleboard core for more than 30 inches long; 14" deep, unless otherwise noted. Provide vertical dividers for shelves over 36 inches long.
 - e. Cabinet Toe-Base: Preservative treated 2x solid lumber. No particleboard within four (4) inches of floor.
- C. Countertops and Backsplashes:
1. Countertops: Provide countertops with PVC edge in as long as practical continuous lengths. Provide field glued splines at joints. No joints closer than 24 inches either side of sink cutout.
 2. Backsplash: 4 inch high unless otherwise shown. No joint shall occur at sink openings. Provide backsplash set in full bead of sealant.
 3. At exposed countertop end corners, provide 1 inch radius, or similar safety treatment.
 4. No joints shall be permitted above knee spaces.
- D. Sinks: Refer to Division 22. Sizes as shown on drawings. Provide sealant at sink cut-outs.
- E. Service Fixtures: Refer to Division 22.
- F. Toe Spaces: Leave toe spaces unfinished for installation of resilient base, unless otherwise shown.
- G. End Panels and Filler Strips: Match adjacent case-piece.
- H. Edging:
1. Provide the following in accordance with "Edging Locations":
 - a. Flat Edge PVC: 0.020 inch. Solid, high-impact, purified, color-thru, acid resistant, machine-applied with hot melt adhesives.
 - b. 3 mm PVC: Solid, high-impact, purified, color-thru, acid resistant, pre-lamination primed edging, machine-applied with hot melt adhesives, and machine profiled to 1/8 inch radius.
 2. Edging Locations:

- a. Cabinet body edge, including door/drawer front spacer rail: Flat Edge PVC, color matched to door/drawer face or as selected.
- b. Forward edge of interior body components, interior dividers, shelf, and top edges of drawer body: Flat Edge PVC to match cabinet interior surface color.
- c. Door/Drawer-Front edging: 3mm PVC, color matched to standard laminates.

2.3 CABINET HARDWARE

- A. All hardware shall meet ANSI A156.9 and shall be subject to approval by the Architect. All keying shall match existing master key system and be approved by the Owner.
 1. Acceptable Manufacturers:
 - a. Accuride; (562) 372-6793.
 - b. Ives, an Allegion company; (877) 671-7011.
 - c. Knappe & Vogt; (800) 253-1561.
 - d. National Hardware; (800) 346-9445.
 - e. As specified herein, provide specified product, or Architect approved equal.
- B. Hinges:
 1. Basis of Design Product/Manufacturer: Institutional Hinge No. 100742.
 2. Heavy duty, five-knuckle 2 3/4 inch institutional type hinge shall meet ANSI/BHMA A156.9 Grade 1 requirements. Mill ground, hospital tip, Teflon coated tight pin feature with all edges eased. Hinge shall be full wrap around type of tempered steel 0.095 inch thick. Each hinge shall have minimum of 9 screws, #7, 5/8 inch FHMS to assure positive door attachment.
 3. One pair per door to 48 inch height. One and one-half pair over 48 inches in height. Hinge shall accommodate 13/16 thick laminated door and allow 270 degree swing.
 4. Finish: US26D.
 5. No European stone hinges.
- C. Pulls:
 1. Wire design, 4 inches, Chrome, US26D finish.
- D. Sliding Door Hardware:
 1. Frameless 1/4 inch glass sliding doors: double track rolling door assembly.
 2. Framed 13/16 inch thick stile and rail sliding doors: top mounted track with dual roller hangers. Vertical adjustment for accurate alignment.
- E. Drawer Slides:
 1. Standard Drawers: 3/4 extension, self-closing, white epoxy-coated, lever disconnect, positive in-stop/out-stop, nylon rollers, minimum 100 pound dynamic load rating at full extension.
 2. File Drawers: Full extension, 3-part progressive opening slide, precision steel ball bearing, minimum 100 pound dynamic load rating at full extension, zinc plated or epoxy coated at manufacturer's option.
 3. Provide body mounted molded rails for hanging file system for legal or letter size as indicated by manufacturer's model number. Cutting or machining of drawer body/face not permitted.
 4. Paper Storage Drawers: Full extension, self-closing, white epoxy-coated, lever disconnect, positive in-stop/out-stop, nylon rollers, minimum 150 pound dynamic load rating at full extension.
- G. Catches: Provide opening resistance in compliance with the Americans with Disabilities Act.
 1. Provide top-mounted magnetic catch for base and wall cabinet door.
 2. Provide two at each tall cabinet door. Catch housing shall be molded in White.
- G. Adjustable Shelf Supports:

1. Dual-pin design with anti tip-up shelf restraints for both 3/4 inch and 1 inch shelves.
 2. Include keel to retard shelf slide-off, and slot for mechanical attachment of shelf to clip.
 3. Load rating shall be minimum 300 pounds each support without failure.
- H. Wardrobe Rod: 1 inch diameter plated steel rod, with captive sockets.
- I. Coat Hooks: Single and double prong, wall mount - Satin Aluminum.
- J. Locks: Five-disk tumbler cam-style with strike. Locks on cabinets in same room keyed alike. Provide two (2) keys per room where doors and drawers are scheduled to receive locks. Cylinder face and keys to be engraved with matching numbers. Dull chrome finish. Lock core shall be removable with a control key, permitting Owner to change lock arrangements without tools.

2.4 SPECIALTY ITEMS

- A. Grommets:
1. Size: 2-1/2 inches diameter with "Flip-Top"™ tab in cap.
 2. Colors: As selected by Architect from manufacturer's available colors.
 3. Number/Location: Where electrical, telephone, and computer data wiring need to pass through tops whether shown or not.
 4. Approved Product/Manufacturer: Model No. EDP3 manufactured by Doug Mockett & Company, Inc.; (800) 523-1269, or comparable product.
- B. Keyboard Drawers (At all knee spaces):
1. Approved Product/Manufacturer: No. SD-1 as manufactured by Knappe & Vogt; or comparable product.
- C. Molded Personal Pencil Drawer: High-impact 100 Polystyrene with in-stop, out-stop, and self-closing features. Provide under top mounted 100 lb self-closing slides. Twelve compartment drawer body, and slides, Black. Provide where indicated on plans.
- D. Hanging File Rails to be provided at all File Drawers.
- E. LF Cart with countertop: Stainless steel top with stainless rails that double as handles, top mounted tool holders, one storage drawer, one storage door mounted on institutional hinges, industrial grade, non-marring casters.
1. Basis of Design: Model 2108-18 as manufactured by Collins or comparable product approved by Architect.
 2. Dimensions: 18 inch W x 18 inch Depth x 41 inch Height.
 3. Warranty: Three (3) warranty to becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
 - a. Defects shall include, but not be limited to the following:
 - 1) Rough or difficult operation, or loose or missing parts.
 - 2) Delamination of surfaces.
 - 3) Noticeable deterioration of finish.
 - 4) Warped or misaligned surfaces or telegraphing of subsurface imperfections.
- F. Wig Dryer Cabinet:
1. Basis of Design: Model 2230-30 as manufactured by Collins or comparable product approved by Architect.
 2. Dimension: 30 inch Width x 15 inch Depth x 72 inch Height.
 3. Mounting blocks for twelve (12) mannequin heads.
 4. 500 CFM air flow @ 145 degrees.
 5. 1750 watts, 110 volts, and 17.5 amps.

6. Dedicated 20 amp circuit required.
 4. Warranty for Cabinet Hinges: Three (3) warranty to becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship. All remaining parts to be one (1) warranty.
- G. Organizer 48 inch Color Cubbies:
1. Basis of Design: Model 2165 as manufactured by Collins or comparable product approved by Architect.
 2. Dimension: 48 inch Width x 10 inch Depth x 30 inch Height.
 3. Cubbies with dividers for color organization and storage.
 4. Lower shelf for partially used tubes or bottle.
 5. 3376-48, 48 inch.
 6. Cubbies measure 4-7/8 inch Width x 3-3/8 inch Height.
 7. Lower opening: 46-3/8 inch Width x 5-15/16 inch Height.
 8. Warranty for Ball-Bearing Drawer Slides & Cabinet Hingers: Three (3) warranty to becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship. All remaining parts to be one (1) warranty.
- H. Magazine Rack:
1. Basis of Design: Model 2070-24 as manufactured by Collins or comparable product approved by the Architect.
 2. Dimension: 24 inch Width x 6-1/2 inch Depth x 36 inch Height.
 3. Mounted: Wall-mounted.
 4. Angled slots for magazine storage.
 5. Display.

2.5 FABRICATION

- A. Fabricate casework, countertops and related products to dimensions, profiles and details shown on drawings. Fabricate casework square, plumb, and true.
- B. Detailed Requirements For Cabinet Construction:
1. Toe-Base:
 - a. Continuous, ladder type platform with concealed fastening to cabinet bottom, level and secured to floor
 - b. Toe-base at exposed cabinet end panels shall be recessed 1/4 inch from face of finished end, for flush installation of finished base material.
 - c. No cabinet sides-to-floor will be allowed.
 2. Cabinet Top and Bottom:
 - a. Solid sub-top shall be furnished for all base and tall cabinets.
 - b. At cabinets over 36 inches bottoms and tops shall be mechanically joined by a fixed divider.
 - c. Assembly devices shall be concealed on bottom side of wall cabinets.
 3. Cabinet Sides:
 - a. Doweled, and glued under pressure, or attached with fully concealed interlocking mechanical fasteners to sub-top and bottom.
 - b. Drill holes for adjustable shelves 1-1/4 inches on center.
 4. Cabinet Backs:
 - a. Side bound, captured in grooves, recessed from cabinet rear, and securely fastened at top and bottom.

- b. Hang rails shall be located at rear of cabinet back and fastened to cabinet sides. Provide minimum of two (2) at base, two (2) at wall, and three (3) at tall cabinets as instructed by casework manufacturer.
 - c. Provide removable back panels and closure panels for plumbing access at all sink cabinets, and where shown on drawings.
5. Exposed end corner and face frame attachment:
- a. Butt joint, glued and finish nailed; or attached with fully concealed interlocked mechanical fasteners.
6. Door and Drawer Fronts:
- a. Drawer fronts and hinged doors shall overlay the cabinet body. Maintain a maximum 1/8 inch reveal between pairs of doors, between door and drawer front, or between multiple drawer fronts within the cabinet.
 - b. Where indicated, provide Stile and Rail doors with full 1/4 inch plate glass, hinged or sliding. Exposed lite-opening edges shall be trimmed and glazed with extruded glazing bead.
 - c. Where indicated, frameless sliding glass doors shall be 1/4 inch thick plate glass with ground and polished edges. Fit with anodized aluminum shoes and nylon rollers.
- C. Drawers:
- 1. Drawer fronts: apply to separate drawer body component sub-front.
 - 2. Drawer sides: doweled to receive front and back, glued under pressure, machine squared.
 - 3. Drawer bottom: set into front and sides, 1/4 inch deep groove with minimum 3/8 inch standing shoulder, continuously glued. Reinforce drawer bottoms with 1/2 inch by 4 inch front-to-back intermediate underbody stiffeners, mechanically fastened. One at 24 inches, two at 36 inches, and over.
 - 4. Paper storage drawers: fitted with full width hood at back.
 - 5. File Drawers: inside drawer dimensions to accommodate letter and/or legal size hanging file rails.
- D. Vertical and Horizontal Dividers: As required by manufacturer for type and style of component.
- E. Door/Drawer Front Rail: As required by manufacturer for type and style of component, and hardware placement.
- F. ADA, Americans with Disabilities Act Requirements: The following special requirements shall be met, where specifically indicated on architectural plans as "ADA", or by General Note. Shall be in compliance with Federal Register Volume 56, No. 144, Rules and Regulations:
- 1. Countertop height: With or without cabinet below, not to exceed a height of 34 inches Above Finished Floor (A.F.F.), at a surface depth of 24 inches
 - 2. Kneespace clearance: minimum 29 inches A.F.F. at apron, and 30 inches clear span width.
 - 3. 14 inch deep shelving, adjustable or fixed: Not to exceed a range from 9 inches A.F.F. to 54 inches A.F.F.
 - 4. Wardrobe cabinets: Provide with rod/shelf adjustable to 48 inches A.F.F. at a maximum 21 inch shelf depth.

5. Sink cabinet clearances: In addition to above, upper kneespace frontal depth shall be no less than 8 inches, and lower toe frontal depth shall be no less than 11 inches, at a point 9 inches A.F.F., and as further described in Volume 56, Section 4.19.

- G. Typical Desk or Counter Height at Kneespace Locations:
1. 30" above finished floor.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.
- B. Verify that casework and equipment may be installed in accordance with the original design, pertinent codes, and regulations, and approved shop drawings.
- C. Verify casework and equipment requiring power or other utilities, have power and other utilities ready for their installation.
- D. In the event of discrepancy, immediately notify the Architect. Do not proceed with installation in areas of discrepancy until such discrepancies have been resolved.

3.2 INSTALLATION

- A. Items of casework shall be uncrated, placed in proper location, assembled, leveled, and secured to wall, base or floor, when required, at locations indicated on the Architect's drawings. Apply and adjust hardware.
- B. Plumbing and electrical items not specified in this Section shall be furnished under Division 22 and 26. The casework supplier shall be responsible for all cutouts necessary to receive plumbing items. Provide 'J' clamps to secure sinks to countertops.
- C. Installation of work furnished by the various trades shall be coordinated to assure properly functioning equipment at the completion of the job.
- D. Verify lengths of countertops, splashes, and bases. All units with exposed backs, interiors, ends and/or bases shall be plastic clad with colors as selected by Architect.
- E. Provide backsplashes and end splashes wherever a back or end is next to a wall, where shown or not.
- F. Provide matching fillers and scribes to fit cabinets to partitions, equipment, and columns.
- G. Provide closure panels at top and bottom of wall hung cabinets at corner intersections.
- H. Repair or remove and replace defective work as directed on completion of installation.
- I. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.
- J. Provide necessary protective measures of finished work to prevent damage of casework and equipment from exposure to other construction activity.

END OF SECTION 12 35 50

SECTION 12 35 53 - LABORATORY CASEWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Wood casework.
- B. Epoxy resin work surfaces.
- C. Epoxy resin sinks, drain outlets.
- D. Laboratory Equipment.
- E. Service fittings.
- F. Accessory items as specified herein.
- G. Fume hoods.
- H. Four Student Laboratory Tables.

1.3 RELATED SECTIONS

- A. Section 06 10 00 - Rough Carpentry: Blocking within walls to adequately support casework.
- B. Section 08 71 00 – Door Hardware: Refer for Owner’s keying system for locks.
- C. Section 09 65 19 - Resilient Tile Flooring and Base: Furnishing and installing rubber base.
- D. Section 12 35 50 - Educational Casework.
- E. Division 22 - Mechanical:
 - 1. Furnishing and installation of piping, drainline, traps, final connections and setting of sinks and fixtures.
- F. Division 26 - Electrical: Furnishing and installation of electrical wiring, conduit and/or electrical items and final connections.

1.3 REFERENCES

- A. American Disabilities Act (ADA)
 - 1. American Disabilities Act Design Guidelines (ADADG).
 - 2. 2012 Texas Accessibility Standards (TAS).

- B. American National Standards Institute (ANSI)
 - 1. American National Standards Publications.

- C. American Woodwork Institute
 - 1. Architectural Woodwork Quality Standards.

- D. SEFA (Scientific Equipment and Furniture Association) standards.
 - 1. SEFA 2.3 – Installation of Scientific Laboratory Furniture and Equipment.
 - 2. SEFA 3 – Work Surface.
 - 3. SEFA 7 – Laboratory and Hospital Fixtures.
 - 4. SEFA 8 – Laboratory Furniture.

1.4 DEFINITIONS

- A. Definitions of cabinet components by surface visibility:
 - 1. Exposed Surfaces:
 - a. Surfaces visible when drawers and solid doors are closed.
 - b. Surfaces visible behind clear glass doors.
 - c. Interior surfaces of open units.
 - d. Bottoms of cabinets 42 inches or more above finished floor.
 - e. Tops of cabinets less than 78 inches above finished floor, or are visible from an upper floor or staircase after installation.
 - f. Front edges of cabinet body members visible though a gap greater than 1/8 inch with doors and drawers closed.
 - g. Surfaces visible when fixed appliances are installed.
 - 2. Semi-exposed Surfaces:
 - a. Surfaces visible when doors are open.
 - b. Bottoms of cabinets 30 inches - 42 inches above finished floor.
 - c. All front edges of shelving behind doors.
 - 3. Concealed Surfaces:
 - a. Surfaces not normally visible after installation.
 - b. Bottoms of cabinets less than 30 inches above finished floor.
 - c. Tops of cabinets over 78 inches above finished floor which are not visible from an upper level.
 - d. Stretchers, blocking, components concealed by drawers.

1.5 SUBMITTALS

- A. Manufacturer's Compliance Statement:
 - 1. Pre-qualified manufacturers whose name appears below under acceptable Manufacturers shall provide statement of compliance as scheduled by General Contractor; or
 - 2. Manufacturers requesting substitution of products shall submit statement of compliance at proposal time in accordance with Division 1 requirements for substitutions.

- B. Shop Drawings: Provide large scale plans and elevations of casework, cross sections, rough-in and anchor placements, tolerances and clearances. Indicate relationship of units to windows, doors, surrounding walls and other building components.

- C. Product Data: Submit manufacturer's catalog for reference. Include cabinet dimensions,

configurations, construction details, joint details, attachment details, and rough-in details as required.

- D. Product Samples to be submitted for approval (One (1) each):
1. Worktop: Four (4) inch x four (4) inch sample of each material.
 2. Finish: Three (3) inch x five (5) inch sample of each available standard stain color with finish for Architect's selection.
 3. Provide an actual sample of a cabinet in the color and finish selected for Architect's approval. Approved cabinet color and finish will be basis for which all work will be judged. Approved sample cabinet may be used in the work. All cabinets shall match in color and finish to that of the approved sample and if found to vary in color, i.e., too light or too dark shall be refinished to match approved sample at no expense to Owner.
 4. Hardware: Pulls, locks and hinges. Locks shall be keyed alike and masterkeyed to Owner's keying system as specified in Section 08 71 00.

1.6 QUALITY ASSURANCE

- A. Single source: Casework to be manufactured and furnished by a single laboratory furniture company.
- B. Manufacturer's qualifications: Modern plant with proper tools, dies, fixtures and skilled production staff to produce high quality laboratory casework and shall meet the following minimum requirements:
1. Minimum of ten (10) years experience in manufacture of wood laboratory casework.
 2. Ten (10) installations of equal or larger size.
- C. Installer qualifications: Certified by the manufacturer.
- D. Manufacturer to provide load test results certified by an independent testing laboratory for drawers, doors, suspension slides and unit shelving.
- E. Casework construction and performance characteristics shall be in full compliance with SEFA 8 standards. At the Owner's request, independent, third part testing must be submitted validating compliance and adheres to the architectural specifications.

1.7 PROJECT CONDITIONS

- A. Do not deliver or install wood product until the following conditions are met:
1. Windows and doors are installed and the building is secure and weathertight.
 2. Ceiling, overhead ductwork and lighting are installed.
 3. All painting is completed and floor tile is installed.
 4. Interior building temperature to be between 65 degrees F and 80 degrees F, and ambient relative humidity maintained between 25 percent and 55 percent prior to delivery, and during and after installation. Frequent and/or excessive changes in temperature and/or humidity levels during casework installation, or once casework is installed, shall be avoided to prevent damage to materials.
- B. Field measurements shall be taken to verify that the equipment will fit into the designated space. Entryways, corridors and door openings shall be verified to ensure that the equipment be manufactured in a manner to permit it to be moved through properly into place.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Delivery: Schedule delivery so rooms are sufficiently complete that material can be installed immediately following delivery.
- B. Casework: Protect finished surfaces from soiling or damage during handling and installation.
- C. Work surfaces: Protect throughout the construction period.

1.9 WARRANTY

- A. Warrant casework against becoming unserviceable or causing an objectionable appearance resulting from defects in materials and workmanship, including workmanship of installation. Materials provided by Casework Manufacturer shall carry a warranty for five (5) years from date of Substantial Completion. Other materials and equipment shall carry warranty by the product manufacturer.
- B. Defects shall include, but not limited to:
 - 1. Discoloration of finish.
 - 2. Missing or loose parts.
 - 3. Noisy or hard operation of moving parts.
 - 4. Failure to meet specifications.

PART 2 - PRODUCTS

2.1 APPROVED PRODUCT/MANUFACTURERS

- A. Design, materials, construction and finish of casework as specified represents the minimum acceptable standard of quality for wood laboratory casework.
- B. Basis of Design Manufacturer: Diversified Casework, Suring, WI (877) 348-9663. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
 - 1. Campbell Rhea Caseworks.
 - 2. Collegedale Casework LLC.
 - 3. Diversified Woodcrafts, Inc.
 - 4. Hamilton Laboratory Solutions, LLC.
 - 5. Kewaunee Scientific Corp.
 - 6. Leonard Peterson & Co.
 - 7. MGC Millwork, LP.
 - 8. South Texas Woodmill, Inc.
 - 9. TMI Systems Corporation.

2.2 CASEWORK DESIGN

- A. Door and Drawer Design:
 - 1. Lipped Overlay: Partial overlay design with 3/8 inch reveals between door or drawer and frame, door to door, door to drawer, drawer to drawer; 7/16 inch vertical reveal between doors/drawers and cabinet ends.
- B. Standard grain pattern on end panels is vertical.

- C. Grain pattern on cabinet fronts:
 - 1. Combination Grain: Horizontal grain on drawer fronts, vertical grain on door fronts.
- D. Cabinet end panels exposed to view after installation shall be specified as a "finished end" panel. All end panels not exposed to view after installation shall be as listed under "unexposed" plywood.
- E. Cabinets to be rigid, self-supporting design for use in assembly or as single, interchangeable stand-alone units.
- F. Flush Interiors: Surface mounted bottoms and offsets caused by front face frames which interfere with ease of cleaning are not acceptable.
- G. Joinery: 32mm doweled joinery system glued, clamped and screwed. Dowels are to be hardwood, laterally fluted with chamfered ends and a minimum diameter of 8mm.
- H. Where shown or required, provide products conforming to ADADG for barrier-free design.

2.3 CASEWORK MATERIALS

- A. Hardwood:
 - 1. Lumber core shall conform to ANSI/HPVA HP-1 product standards.
 - 2. Hardwood lumber, clean and free of defects. All lumber kiln-dried to uniform moisture content of six (6) percent.
 - a. Exposed material: Red Oak, Grade I minimum.
 - b. Semi-exposed material: Select hardwood.
 - c. Unexposed material: Sound hardwood of species suitable for the intended purpose.
- B. Plywood:
 - 1. Hardwood plywoods shall conform to ANSI/HPVA HP-1 product standards.
 - 2. Core: 7-ply (3/4 inch thick) and 9-ply (one (1) inch thick) veneer core plywood with cross and face plies bonded with Type II water-resistant glue; drawers are 9-ply, 1/2 inch thick.
 - 3. Face veneer:
 - a. Exposed surfaces: Plain-sliced red oak veneer, grade A, selected for golden wheat color and narrow hearts.
 - b. Semi-exposed: Same species as specified for exposed face veneer, grade 2 for oak.
 - c. Unexposed: Same species as specified for exposed and semi-exposed veneer, grade at option of manufacturer.
- C. Welded fiberboard: Tempered welded fiber shall be wood fibers and natural resin binding agent compressed into dense homogeneous sheets. Sheets are impregnated with a special tempering compound polymerized by baking to give exceptional strength, and shall conform to ANSI/AHA A135.4 Basic Hardboard for Class 1 tempered grade.
- D. Glass: 7/32 inch for tall cases and unframed wall and upper case doors, 1/8 inch for framed wall and upper case doors, without imperfections or marred surfaces of clear float glass.

- E. Glue: Laminating - Type II water-resistant; assembly - Type III water-resistant.
- F. Edgebanding: 3mm hardwood of same species as exposed face veneers.
- G. Finish: Highly chemical-resistant modified acrylic urethane finish with built in U.V. blocker or equal finish applied over stain of selected color. Finish shall meet performance characteristics of TR-5, Section 1500, AWI Architectural Woodwork Quality Standards (latest edition).

2.4 CASEWORK FABRICATION

- A. Base Units:
 - 1. Cabinet ends: 3/4 inch thick plywood with 3mm hardwood banding on front edges. Bore interior faces, as appropriate, for security panels, rails, and four rows of shelf support holes:
 - 2. Levelers: Provide four (4) metal corner gusset levelers with threaded adjustment screws and floor pad on all base cabinets.
 - 3. Top rails:
 - a. Full Top Frame:
 - 1) Horizontal front top rail: One (1) inch x three (3) inch solid hardwood. Attach to cabinet ends with glued 8mm dowel joinery and screws.
 - 2) Vertical back top rail: 3/4 inch x 3-3/4 inch hardwood. Attach to cabinet ends with glued 8mm dowel joinery and screws.
 - 3) Top side rails: 3/4 inch x 1-1/2 inch hardwood between front horizontal and back vertical rails, glued and screwed in place.
 - 4. Intermediate rails: Front horizontal intermediate rail: 3/4 inch x 1-1/2 inch exposed hardwood rail to be provided between doors and drawers. Secure to cabinet end panels with glued 8mm dowel joinery.
 - 5. Toe space rail: 3-3/4 inch x 3/4 inch hardwood or 7-ply veneer core plywood, mounted between end panels with glued 8mm dowel joinery and metal fasteners, forming a 4 inch high x 2-1/2 inch deep toe space, closed to cupboard bottom.
 - 6. Bottoms: 3/4 inch thick plywood, set flush and joined to cabinet end panels with glued 8mm dowels on 96mm spacing and metal fasteners. Front edge to be banded with 3mm hardwood banding.
 - 7. Backs:
 - a. Cupboard units: One-piece 3/16 inch thick hardboard, rabbetted into rear top rail for easy removal from inside of cabinet.
 - b. Drawer units: Open back.
 - c. Sink units: Half-height, one piece 3/16 inch thick hardboard, rabbetted into rear rail for easy removal from inside of cabinet.
 - 8. Vertical dividers in combination cabinets: 1-1/2 inch thick plywood panel (frames not permitted) glued and screwed in place, top and bottom, with 3mm hardwood banding on front edge.
 - 9. Security panels: None required.
 - 10. Shelves (for base units): Veneer core plywood, 3mm hardwood banded on front edge, adjustable on 32mm centers:
 - a. Full-depth shelf, 17-3/4 inches deep.
 - b. Thickness: 3/4 inch thick for all shelves up to and including 30 inches wide, one (1) inch thick for all shelves over 30 inches wide.
 - c. 1/2 inch wide x 1/2 inch high raised lip on all four (4) sides of shelves for spill containment.

11. Drawer construction:
 - a. Box: Four-sided drawer box with back, front and sides of 12mm (1/2 inch nominal) 9-ply Birch plywood with chemical-resistant finish and finished top edges. (Three-sided drawer box attached to outer drawer front is not acceptable.) Sides shall be joined by Lock joint, glued and pinned.
 - b. Bottom: Nominal 1/4 inch, inset into all four (4) sides of drawer box and sealed with hot melt glue process around entire drawer bottom perimeter. Material to be white melamine-clad tempered hardboard.
 12. Door and removable drawer front construction: 3 ply 3/4 inch thick (door) and 1/2 inch thick (drawer), particleboard core, hardwood framed all four (4) sides, face veneer on both surfaces, radiused edges all four (4) sides; doors to be routed on inside perimeter to allow 1/4 inch inset into door opening.
- B. Hardware:
1. Drawer suspension: 3/4 extension, open roller, 75 lb. dynamic load, self-closing epoxy-coated Blum 230 series or equal on all drawers except file drawers. All file drawers to have full extension with overtravel, ball-bearing roller, 150 lb. dynamic load, zinc-plated Accuride 4034 series, or Architect approved equal.
 2. Drawer and hinged door pulls: Satin chrome wire pulls.
 3. Hinges: Provide two (2) hinges for doors up to 48 inches high; three (3) hinges or doors over 48 inches high. Notch for proper fit. 5-knuckle, institutional stainless steel hinges.
 4. Unit shelf supports: Metal pin and socket.
 5. Door catches: Adjustable, spring-actuated nylon roller.
 6. Elbow catches: Spring type with strike.
 7. Locks, where indicated on drawings: 5-pin tumbler keyed alike and master keyed to Owner's keying system specified in Section 08 71 00.

2.5 EPOXY END SINKS

- A. Model: 952C0730 End Sink Assembly. Center type, consisting of the following:
1. 52L48100 Epoxy Sink
 2. 520C0180 Leg Assembly, End 17.810
 3. 952C073A Frame Assembly

2.6 MECHANICAL SERVICE FITTINGS

- A. Manufacturer: Chicago Faucet Co., vandal resistant.
- B. Laboratory Service Fittings:
1. Service fittings shall be laboratory grade, and water faucets and valve bodies shall be cast red brass alloy or bronze forgings, with a minimum content of 85%. All fittings shall be chromium plated unless specified otherwise.
- C. Water Fittings:
1. Water fittings shall be provided with a renewable unit containing all operating parts which are subject to wear. The renewable unit shall contain an integral volume control device and all faucets shall be capable of being readily converted from compression to self-closing, without disturbing the faucet body proper. Four

(4) arm forge brass handles shall contain plastic screw-on type colored service index buttons.

- D. Ground Key Valve Hose Cocks:
 - 1. Ground key type valves shall have forged body with 10 serration hose end. Handle plug shall be forged brass, long, tapered type with screw-on colored service index button. Valves shall be individually ground, lapped and sealed.

- E. Needle Valve Hose Cocks:
 - 1. Needle type valves shall have a stainless steel replaceable floating cone, precision finished and self-centering. Cone locates against a stainless steel seat, easily removable and replaced with a socket wrench. Valve shall have "Teflon" impregnated packing and designed so unit can be repacked while under pressure.

- F. Gooseneck Type Outlets: Gooseneck outlets shall have a separate brazed coupling to provide a full thread attachment of anti-splash, serrated tip or filter pump fittings.

- G. Remote Control Valves: All valves for remote control use shall be as previously specified, but shall be complete with brass extension rods, escutcheon plates, brass forged handles and screw-on type colored service index button.

- H. Tank Nipples: Tank nipples shall be provided with locking nut and washer for all fixtures where fittings are anchored to equipment.

- I. Service Indexes: Fittings shall be identified with service indexes in the following color coding:
 - Hot Water Red
 - Cold Water Dark Green
 - Gas..... Dark Blue
 - Air Orange
 - Vacuum Yellow
 - Distilled Water White
 - Steam..... Black
 - Nitrogen..... Gray
 - Oxygen..... Light Green
 - Hydrogen..... Pink
 - Special Gases Light Blue

- J. Electrical Fittings: Electrical fittings shall contain 20 Amp., 125 Volt AC, 3-wire polarized grounded receptacles, unless otherwise specified. Pedestal and line-type boxes shall be of aluminum, metallic finish with stainless steel flush plates. Receptacle boxes shall be of plated steel. All electrical or conduit fittings called for or to be furnished under these specifications shall meet the requirements of the National Electrical Code.

- K. Sink Outlets: Unless otherwise specified, sink outlets for other than stainless steel sinks shall be Molded Epoxy Resin, with integral cross bars, tapered for overflow and be complete with gasket and lock nut with 1-1/2 inch I.P.S. male straight thread outlet. Overflows shall not be furnished for sink outlets unless specifically called for.

- L. Crumb Cup Strainers: Crumb cup strainers shall be stainless steel or chromium plated brass, as specified and shall be furnished for stainless steel sinks, and be complete with gasket, lock nut and 4 inch long unthreaded tailpiece outlet in 1-1/2 inch size.

- M. Vacuum Breakers: Vacuum breakers when specified to be required, shall be the 'Nidel or Watts' type unless specified to be an integral part of gooseneck fixture with a renewable seat and fine flow control.
- N. Aerator Outlets: Aerator type outlets shall be furnished for all gooseneck water faucets nor furnished with serrated hose connectors.

2.7 WORKSURFACES

- A. Epoxy Resin Tops: Factory molded tops of modified epoxy resin formulation, uniform mixture throughout full one (1) inch thickness. Color shall be non-glare black. Cast surfaces shall be very smooth, with factory cutouts for sinks and drip grooves. Plain butt type joints assembled with epoxy adhesive.

2.8 PHYSICS TABLES

- A. Dimensions: Modified to 48 inches wide by 42 inches deep by 30 inches high.
- B. Top Surface: Black epoxy resin work surface with two (2) inch overhang to accommodate clamping of accessory apparatus.
- C. Accessories:
 - 1. Three (3) upright rods with crossbars and clamps.
 - 2. Two (2) variable voltage units.
- D. Approved Product/Manufacturer: Model 942C2020 Modified as manufactured by Fisher Hamilton L.L.C., Two Rivers, WI; (920) 793-1121, or Architect approved equal.

2.9 FOUR-STUDENT LAB TABLES

- A. Basis of Design: TE II Four-Student Work Station, Model #14001 as manufactured by Sheldon Laboratory Systems or comparable product approved by Architect.
- B. Construction: Epoxy Resin Top and Trough with Unicast Fixtures.
- C. Work Station: Configuration of the TE II four-student lab table prevents students from unsafely working back-to-back in the lab area. This feature allows convenient aisles and easy access while the instructor monitors student lab activities. Services are located on the outer perimeter of the table allowing access to all students. Standard color is Black.
 - 1. The Work surface height is changeable at time of installation and can be set at 33-3/4", 34-3/4", 35-3/4", or 36-3/4" as shown on the Drawings.
- D. Support Understructure: Formed to accept on four (4) sides, suspended storage cubicles in a variety of configurations, free-standing mobile units. The understructure shall fully enclose and protect the service piping and electrical wiring.
 - 1. Understructure is molded one-piece fiberglass reinforced polyester with Gelcoat surface, 3/4" radius on all exterior corners, and has internal reinforcing braces and webs. Two (2) removable access panels are provided in the understructure immediately below the combination water/gas fixtures for the service connections.

- E. Work Surface: Shelresin top is 1" thick molded epoxy resin with integral raised marine edge. The top is 56" square and 67-1/2" across corners with a minimum of 3,020 square inches of total work area.
- F. Full Length Trough: One-piece molded epoxy resin trough is provided with integral, raised service turrets on each end, a ribbed bottom, and with a center drain. Trough I.D. is 56-1/2" x 9" x 5-1/4" deep at the center and 4-3/4" deep at the ends. The raised service turrets are 10" long x 5-1/2" wide. Trough O.D. is 67-1/2" long and designed to accept removable flush trough covers when used in a Physics Lab. Provide a minimum height of 13" from turret-mounted water fixture outlets to bottom of trough.
- G. Pedestal Base: 10 gauge formed steel, 14-3/4" square, with 3/4" radius on outside corners. Holes at vertical intervals shall accept bolted fasteners for understructure adjustment of desired work heights at the time of installation. The pedestal base is attached to bottom of understructure with four (4) heavy-duty steel angle brackets and bolts that provide both support and height adjustment. Pedestal base is attached to the floor with four (4) 3/16" welded corner gussets. Two (2) removable steel panels secured with sheet metal screws that cover the 10" x 14" opening on opposite sides of the pedestal base are provided for access to service piping. Internal service piping and wiring included.
 - 1. When properly bolted to the floor, unit shall support 250 lb. load at the perimeter, and not allow undue movement of work surface.
- H. Standard services and accessories included with each table:
 - 1. Two (2) 80020-CV Unicast cold water/gas fixtures with check valves. Two (2) 85101 GFI duplex electrical receptacles. Four (4) 86320 upright rod bases. One (1) sink outlet and stopper. Upright rod assemblies provided.

2.10 EMERGENCY DRENCH SHOWER AND EYE WASH COMBINATIONS

- A. Kewaunee Model No. W-0926-00 (Chicago No. 82LC92186).
- B. Provide at locations as indicated on the drawings.

2.11 EMERGENCY DRENCH SHOWER AND EYE WASH COMBINATIONS - LABORATORY

- A. Bradley Model No. S19-310FW
- B. Provide at locations as indicated on the drawings.

2.12 EMERGENCY DRENCH SHOWER AND EYE WASH COMBINATIONS

- A. Number/Location: Provide one (1) at Science Lab, unless indicated otherwise on drawings.
- B. Fisher-Hamilton Watersaver Colortech No. 28L19200 ADA Accessible Free Standing Eye Wash/Body Shower or equivalent by Chicago Faucet, or Architect approved equal.

2.13 MICROSCOPE STORAGE CABINETS

- A. Basis of Design: Model 408 as per AWMA standards. Cabinet shall hold at least 20 microscopes. Refer to the Drawings.

2.14 ACID STORAGE UNIT

- A. Description: Cabinet shall be constructed of one (1) inch thick high-density 9-ply plywood with interior completely lined with polypropylene (floor, interior walls, interior top and top tray).
- B. Dimensions: 35 inch W x 35 inch H x 22 inch D.
- C. Bottle Capacity: (30) 5 pint or (90) 1 pint.
- D. Features:
 - 1. Recessed wooden door handle.
 - 2. Word "ACID" printed on cabinet with six (6) inch red letters.
 - 3. All wooden hinges.
 - 4. Four (4) leveling feet.
- E. Location: As shown on drawings.
- F. Approved Product/Manufacturer: Cabinet SC8051, with Nitric Acid Compartment Model SC8071 as manufactured by Flinn/SciMatCo, Batavia, IL; (888) 879-7620, or Architect approved equal.

2.15 SAFETY GOGGLE COMPARTMENT CASES

- A. Type/Construction: Provide 15 minute Timer
- B. Dimensions: 28-1/2 inches H x 26-1/4 inches W x 10-1/4 inches D
- C. Number/Location: As shown on drawings.
- D. Fasteners: Of type, size, and finish recommended by manufacturer to suit application.
- E. Approved Product/Manufacturer: Model # ~~SE-1000~~ furnished with ~~36~~ 40 pairs of SE1049 non-ventilated goggles with fog-free lens as manufactured by Flinn Scientific, Inc., or Architect approved equal.

2.16 FIRE BLANKETS

- A. Type: Fire blanket in a metal container that easily mounts to wall.
- B. Door: Drop hinge door allows for quick and easy access.
- C. Blanket Size/Type: 66 inches wide x 72 inches long fire retardant-treated woolen blanket for smothering fires.
- D. Number/Location: One (1) wall mounted in each Lab as shown on drawings.
- E. Approved Product/Manufacturer: Model # SE3006 as manufactured by Flinn Scientific, Inc., Batavia, IL; (800) 452-1261, or Architect approved equal.

2.17 FLAMMABLE STORAGE CABINET

- A. Description: Wooden Floor cabinet
 - 1. Dimensions:
 - a. Exterior: 23-7/8 inches wide x 23-7/8 inches deep x 36-5/6 inches high.
 - b. Interior: 21-7/8 inches wide x 21 inches deep x 34 inches high.

2. Bottle Capacity: 18 gallons.
- B. Features:
1. Two (2) doors.
 2. Two (2) inch floor spill retention trough.
 3. One (1) adjustable shelf.
 4. Meets NFPA and OSHA standards.
- C. Location: As shown on drawings.
- D. Approved Product/Manufacturer: Floor Cabinet Model SC7021, with Nitric Acid Compartment Model SC8071 as manufactured by Flinn/SciMatCo, Batavia, IL; (888) 879-7620, or Architect approved equal.

2.18 INSTRUCTOR AND DEMONSTRATION DESK

- A. Approved Product/Manufacturer: Sheldon Laboratory Systems Model No. 16500 Focal Point Demonstration Desk, or Architect approved equal.
1. 10' length x 66" wide x 34" height.
 2. 1" black molded epoxy resin top.
 3. Sink assembly with unimix HW, CW, gas fixture.
 - a. Cantilevered half round black Shelresin sink (22" L x 14-1/2" W x 5-1/2" D) I.D. with sink outlet
 - b. Unimix #80030 combination hot water, cold water and gas fixture with wrist blade handles and soft flow aerator.
 - c. 110V #85101-gfi duplex electric outlet
 - d. One (1) upright rod assembly set consisting of two upright rods with integral C-clamp and one horizontal rod with two connectors.
 - e. Trap not included.
 4. Recessed rotating monitor well with hood and remote wireless keyboard.
 5. Three storage cabinets.
 6. Two tambour door storage cabinets with pullouts for printer.
 7. All units with locks.

2.19 LABORATORY PEGBOARD

- A. Approved Product/Manufacturer: Fisher-Hamilton Model No. 52L77900 Laboratory Pegboard consisting of 1 inch thick black resin pegboard (36 inches by 36 inches) with (38) 5 inch long polypropylene pegs.

2.20 J-FRAME SUPPORT SYSTEMS

- A. General: The 'J'-frame support structure shall consist of vertical (inverted 'J') support members and horizontal tubular frames.
- B. Vertical 'J' Support Members:
1. Vertical 'J' support members shall be 16 gauge, 1-1/4 inch square Type 304 stainless steel seamless tubing, heliarc welded where required, ground smooth at all joints and given a satin finish.
 2. The vertical support members shall be formed into an inverted 'J' maintaining a smooth contour without warp or twist in the metal. Each vertical support shall have a 1 inch height adjustment for handling various floor conditions and be so designed as to maintain a fixed position on the floor. A concealed 'hold-down'

angle or other means will be acceptable. Molded vinyl tapered leg shoes shall be furnished at each support leg to conceal the adjustment device and/or 'hold-down' angle. Each support shall have two 5/16 inch - 18 stud bolts supplied for each side for securing the horizontal frames. Cap nuts shall be furnished for all exposed studs.

- C. Horizontal Frames: All horizontal frames shall have a 1-1/4 inch square tubing front and rear members. Horizontal frames shall be 16 gauge, Type 304 stainless steel, heliarc welded throughout ground smooth at all joints and given a satin finish.
- D. "J"-Frame Performance Requirements: The support structure shall be designed for heavy-duty laboratory usage, and when a wall table is completely assembled with work top and cabinets in place, it shall support the following loads:
 - 1. A 7 foot long wall table assembly with 4 foot and 3 foot modular spacing shall support a load of 1,500 lbs. uniformly distributed over the work top area.

2.21 FUME HOODS

- A. Basis of Design: Model #92204-ADA Air Foil Fume Hood as manufactured by Sheldon Laboratory Systems or comparable product approved by Architect.
- B. Width: 4 feet.
- C. Air foil type fume hood: Features shall include a 45-degree angle around the fascia opening, flush-mount radiused air foil across the bottom, upper front panel with louvered air bypass grille for constant volume with vertical sliding sash, and rear upper and lower fixed exhaust baffle, all resulting in minimized turbulence and increased performance for removal of exhaust fumes, vapors, and particulate matter within the enclosure.
- D. Superstructure: Provide full frame construction, 16" and 18" gauge steel, rigid, self-supporting assembly with 5" wide, double walls and front posts. Walls consist of a sheet steel outer shell and a corrosion resistant full inner liner, and houses electrical services and remote operating service fixtures. Access to fixture valves is provided by two removable panels with a PVC gasket. Top of the hood contains a 10" round, 20-gauge stainless steel exhaust duct collar. Hood shall be UL 1805 Classified.
- E. Sash frame: Steel frame includes a 16-gauge, 1-1/2" bottom sash rail with a full width pull closing on rubber bumper stops, and 7/32" thick laminated safety glass housed into sash frame and set into PVC glazing channels.
 - 1. Powder-coated sash frame is raised and lowered with a counter balance system consisting of a single weight, 2" pulleys, and cable that prevents sash tilting by means of a shaft driven mechanism. This permits one finger operation at any point along full width of pull. Sash cable is 7 x 7 steel, 1/8" diameter, coated to 5/32" dia.
 - 2. The powder-coated, flush-mount, bottom horizontal air foil shall provide a 1" bypass to ensure a clean sweep of air to minimize eddies along the work surface when sash is in the closed position.
- F. Standard features of the hood shall include:
 - 1. Black powder coat finish, white 3/16" Poly Resin liner and baffles, T-8 rapid start fluorescent light fixture with two (2) lamps, 1-1/4" thick, black Shelresin, molded, dished, epoxy resin work surface, base cabinet, kneespace frame, and removable access panel.

2. Superstructure shall be pre-wired and pre-piped by manufacturer. Service rough-ins and trap.
 3. Provide a metal enclosure panel from top of hood to ceiling.
 4. SEFA 1-2010 hood design shall be ADA Compliant with work surface height, kneespace clearance, and access to services.
- G. Hood Exhaust Ratings:
1. 100 FPM recommended face velocity. 833 CFM exhaust and .25-inch static pressure. Exhaust duct and blower.
- H. Source Quality Control Testing of Fume Hoods:
1. Evaluation of a manufacturer's proposed product shall take place in their own test facility with no cost to the Owner. Provide third party, independent test reports to Architect for approval.
 2. Fume Hood shall be tested as described in SEFA 1-2010 in accordance with latest edition of ASHRAE 110 method of testing performance of laboratory fume hoods, As Manufactured (AM). Hoods shall achieve a rating of 4.0 AM 0.05 ppm or less.
- I. Standard services and accessories included:
1. Remote control CW downspout, ADA handle, and powder coat finish.
 2. Remote control Gas outlet, ADA handle, and powder coat finish.
 3. 85101 GFI duplex electrical outlets.
 4. 85106 Light switch.
 5. 85106 Exhaust blower switch.
 6. TS04 Epoxy resin cup sink.
 7. AFA 500 Air Monitor Alarm.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Casework installation:
1. Set casework components plumb, square, and straight with no distortion and securely anchored to building structure. Shim as required using concealed shims.
 2. Fasten continuous cabinets together with joints flush, tight and uniform, with alignment of adjacent units within 1/16 inch tolerance.
 3. Secure wall cabinets to solid supporting material, not to plaster, lath or gypsum board. Blocking in wall by rough carpentry as specified in Section 06 10 00.
 4. Abut top edge surfaces in one true plane. Provide flush joints not to exceed 1/8 inch between top units.
- B. Work surface installation:
1. Where required due to field conditions, scribe or caulk to abutting surfaces.
 2. Secure joints in the field, where practicable, in the same manner as in factory, with dowels, adhesive or fasteners recommended by manufacturer.
 3. Secure work surfaces to casework and equipment components with material and procedures recommended by the manufacturer.
- C. Sink installation: Sinks shall be set in chemical-resistant sealing compound, secured and supported per manufacturer's recommendations.
- D. Accessory installation: Install accessories and fittings in accordance with manufacturer's

recommendations. Turn screws to seat flat; do not drive.

3.2 ADJUSTING

- A. Repair or remove and replace defective work, as directed by Architect upon completion of installation.
- B. Adjust doors, drawers, hardware, fixtures and other moving or operating parts to function smoothly.

3.3 CLEANING

- A. Broom clean finished casework, touch up as required.
- B. Clean materials as recommended by manufacturer.

3.4 PROTECTION OF FINISHED WORK

- A. Provide necessary protective measures to prevent damage of casework and equipment from exposure to other construction activity.
- B. Advise contractor of procedures and precautions for protection of material, installed laboratory casework and fixtures from damage by work of other trades.

END OF SECTION 12 35 53

SECTION 12 36 62 - SIMULATED STONE COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Conditions of the Contract and Division 01, as applicable, apply to this section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Solid-surface-material countertops
- B. Related Sections
 - 1. Section 06 10 00 - Rough Carpentry.
 - 2. Section 06 20 00 - Finish Carpentry and Millwork.
 - 3. Division 22 Sections – Plumbing.

1.3 SUBMITTALS

- A. Product Data:
 - 1. Indicate product description, fabrication information, and compliance with specified performance requirements.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
- C. Samples:
 - 1. Submit minimum 2 inches by 2 inches samples. Indicate full range of color and pattern variation for Architect's selection.
 - 2. Submit 12 inch long by 4 inches wide sample in color and pattern selected and approved by Architect. Approved sample will be retained as standards for work.
- D. Maintenance Data: Submit manufacturer's care and maintenance data, including repair and cleaning instructions. Include in project close-out documents.

1.4 QUALITY ASSURANCE

- A. Allowable Tolerances:
 - 1. Variation in Component Size: Plus or minus 1/8 inch.
- B. Fabricator/Installer Qualifications: Approved by manufacturer of solid polymer manufacturer.
- C. Mock-Up(s):
 - 1. Prior to final approval of shop drawings, erect one full-size mock-up of each component at project site for Architect review.
 - 2. Rework or remake mock-up until accepted; remove rejected units from project site. Acceptable mock-ups shall remain as part of finished work.
- D. Provide all solid polymer fabrications from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components to project site when areas are ready for installation. Store components indoors prior to installation.
- B. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

1.6 WARRANTY

- A. Warrant the work specified herein for 15 years against becoming unserviceable or causing an objectionable appearance resulting from both defective or nonconforming materials or workmanship.
- B. Defects shall include, but not be limited to the following:
 - 1. Shrinking, warping, cracking, chipping, splitting, or deteriorating excessively.
 - 2. Becoming loose from substrate.
 - 3. Inadequate color depth

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specifications are based on Wilsonart or Architect approved equal. Listed manufacturers whose products meet or exceed those specified are approved for use on this Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
 - 1. LG HiMacs 100% Acrylic Solid Surface manufactured by LG Chem; Peoria, AZ

2.2 SOLID SURFACE COUNTERTOPS (SS-1)

- A. Material, General: Homogeneous solid sheets of filled plastic resin complying with ANSI SS1.
 - 1. Superficial damage to a depth of 0.010 inch shall be repairable by sanding and polishing.
- B. Performance Characteristics:
 - 1. Tensile Strength: 5,500 psi, minimum, ASTM D638
 - 2. Flexural Strength: 11,424 psi, minimum, ASTM D790
 - 3. Color Stability: No change, 100 hours minimum, NEMA LD3.1
 - 4. Abrasion Resistance: No loss of pattern, NEMA LD3.1
 - 5. Flame Spread / Smoke Development: Class I/Class A, ASTM E-84
- C. Countertops with Sinks:
 - 1. Material: 1/2 inch thick countertop of solid polymer material.
 - 2. Edge Details: As indicated on the drawings.
 - 3. Sink: Drop-in sink shown on drawings and specified in Division 15.
 - 4. Fabrication: Provide counter complete with backsplash of size shown on the drawings.

5. Color/Finish: Shall be as selected by Architect from manufacturer's full line of colors.

2.3 ACCESSORY PRODUCTS

- A. Joint Adhesive: Manufacturer's standard two-part adhesive kit to create inconspicuous, nonporous joints, with chemical bond.
- B. Sealant: Manufacturer's standard mildew-resistant, FDA/UL recognized silicone sealant in color-matching or clear formulations.
- C. Sink/bowl Hardware: Manufacturer's approved bowl clips, inserts and fasteners.

2.4 FABRICATION

- A. Fabricate components in shop to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings and solid polymer manufacturer requirements.
- B. Form joints between components using manufacturer's standard joint adhesive, joints inconspicuous in appearance and without voids. Attach 2 inch wide reinforcing strip of solid polymer material under each joint.
- C. Rout and finish component edges to a smooth, uniform finish. Rout all cutouts, then sand all edges smooth. Repair or reject defective or inaccurate work.
- D. Finish all surfaces uniformly, matte: Gloss rating of 5-20.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install components plumb and level, in accordance with approved shop drawings and product installation details.
- B. Form field joints using manufacturer's recommended adhesive, with joints inconspicuous in finished work. Keep components and hands clean when making joints.

3.2 CLEANING AND PROTECTION

- A. Keep components and hands clean during installation. Remove adhesives, sealants, and other stains. Components shall be clean on Date of Substantial Completion.
- B. Protect surfaces from damage until Date of Substantial Completion. Repair or replace damaged work that cannot be repaired to architect's satisfaction and invoice for the cost of repairs; before repairs are made, cost estimates are subject to architect's approval.

3.3 MAINTENANCE INFORMATION

- A. Provide Care and Maintenance information to Owner upon completion of Project.
- B. Review maintenance procedures and warranty details with the Owner upon completion of project.

END OF SECTION 12 36 62

SECTION 12 66 13 - TELESCOPING BLEACHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Electrically operated, wall attached with rear wall column cutouts where applicable, telescoping gym seating systems of multiple-tiered seating rows comprising of seat, deck components, understructure that permits closing without requiring dismantling, into a nested configuration for storing or for moving purposes.

1.3 RELATED SECTIONS

- A. Division 3, Cast-In-Place Concrete and Division 9, Finishes: Floor and wall finishes sections for adequate floor and wall construction for operation of telescoping gym seats. Flooring shall be level and rear wall plumb within 1/8 inch in 8 feet-0 inches. Maximum bleacher force on the floor, of 25 feet-6 inch section, shall be a static point load of less than 300 psi.
- B. Section 11 66 43 - Scoreboards: Scoreboard controller connections and microphone jacks mounted in first step of bleacher riser boards.
- C. Division 26 - Electrical: Electrical wiring and connections for electrically operated motor system.

1.4 MINIMUM COMPLIANCE STANDARDS

- A. American with Disabilities Act (ADA)
- B. NFPA Standard 102, Section 4, "Folding and Telescoping Seating", current edition, governs the work except where more restrictive items are specified.
- C. Texas Accessibility Standards (TAS)

1.4 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.
 - 2. Manufacturer's installation instructions.
 - 3. Manufacturer's maintenance instructions for instructing and demonstrating the proper maintenance to the Owner.
- B. Shop Drawings: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.
- C. Samples: Manufacturer's standard color chart or actual samples for selection by Architect.
 - 1. Submit two (2) 18 inch long samples of seat boards

1.5 SPECIAL WARRANTY

- A. Warrant the work specified for ten (10) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
- B. Defects shall include, but not be limited to, the following:
 - 1. Rough or difficult operation
 - 2. Noisy operation
 - 3. Loose or missing parts

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Basis of Design: Products to match existing as manufactured by Irwin Seating Company. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
 - 1. Hussey Seating Co., North Berwick, ME; (207) 676-2271.
 - 2. Folding Bleacher Co., Subsidiary of Irwin Seating Company, Altamont, IL; (618) 483-6157
 - 3. Interkal, Inc., Kalamazoo, MI; (616) 349-1521

2.2 BLEACHERS, GENERAL

- A. Primary Bleachers (**SB-1**):
 - 1. Row Spacing: Refer to the Drawings.
 - 2. Seat Height: Refer to the Drawings.
 - 3. Rise: Refer to the Drawings.
 - 4. Seat Width: Ten (10) inches minimum.
 - 5. Foot Boards: Full width.
 - 6. Number of Rows: As shown on drawings.
 - 7. Length of each unit: As shown on drawings.
 - 8. Provide aisles with intermediate steps and aisle rails as shown on drawings and required by code.

2.3 MATERIALS

- A. Riser, Deck, and Seatboard Material:
 - 1. Seat Board/riser: Molded plastic with contour surfaces. Architect to select color.
 - 2. Aisles and Decks: CD grade 5/8 inches plywood, urethane finished.
- B. Design Features:
 - 1. Liveload: (Of whole bleacher) 100 psf of horizontal projection.
 - 2. Liveload: (Seatboards and platforms) 120 psf
 - 3. Sway Load: Parallel, 24 pounds, per linear foot; perpendicular, ten (10) pounds per linear foot.
 - 4. End Panels: Provide end panels where exposed to view.
 - 5. Rails: Self-storing rail, removable end rails, front railings, rear rails, aisle hand rails, where applicable.
 - a. Hand railings, posts and supports shall be engineered to withstand a concentrated load of 200 lbs. applied at any point and in any direction and a uniform load of 50 lbs. per foot applied in any direction, applied separately.

- b. Guard railings, post and supports shall be engineered to withstand a concentrated load of 200 lbs. applied at any point and in any direction along top rail and a uniform load of 50 lbs. per foot applied horizontally at top rail and a simultaneous uniform load of 100 lbs. per foot applied vertically downward, applied separately.
6. Wheels: Non-marking, extra wide, heavy duty rubber, self lubricating wheels of size and number to suit the wooden floor surfacing.
 7. Wheel Chair Accessible Area: Provide recoverable spaces and end panels complying with ADA and TAS.
 8. Scorers Table:
 - a. High pressure laminate over plywood core.
 - b. Size: 8 ft. x 15 inch.
 9. Coordinate location of scoreboard controller connections and microphone jacks mounted in first step of bleacher riser boards with contractor performing work of Section 11482, Scoreboards.
 10. Delete key locks on front of first step risers.
 11. Finish: Classic wood seats and fascia shall be triple sanded and receive a sealer coat with use surfaces to receive high gloss clear urethane finish.
- C. Operation:
1. Method: Telescope into a stack
 2. Operator: Hussey Roll-R-Eze or Architect approved equal by approved bleacher manufacture, standard non-friction-type electric motor operated; 120/208V, 3-phase, 20 amp. Motorized bleachers shall have 3 - position toggle switches which shall be provided with the bleachers and installed by Division 26. The Toggle Switches shall be installed in a lockable access panel at the location designated on the plans.
 3. Partial Opening: Permit one (1) or more rows to open; lock into any position.
 4. Even Spacing: Mechanism designed to hold all spaces evenly. Provide automatic alignment of units when in operational stages.
 5. Allow varying numbers of rows to be telescoped out and used at any given time.
 6. Provide a total of three (3) remotes for powered seating in addition to local controls.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which Work of this Section will be performed.
- B. Verify flooring is level and rear wall is plumb within 1/8 inch in 8 feet-0 inches.
- C. Bring discrepancies and unsatisfactory conditions to the attention of the Architect and do not proceed until such discrepancies and unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Use only experienced factory authorized installers.
- B. Install in accordance with manufacturer's printed instructions.
- C. Adjust for smooth, quiet operation.

END OF SECTION 12 66 13

SECTION 12 93 00 - SITE FURNISHINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUBMITTALS

- A. Product Data: Include full range of standard color selections.
- B. Shop Drawings: Indicate materials, dimensions, tolerances, welding, fasteners, hardware, mounting, finish, and accessories.
- C. Quality Assurance Submittals:
 - 1. Qualifications: Proof of manufacturer qualifications.
 - 2. Manufacturer's Installation Instructions.
- D. Samples: Provide actual samples of finish materials indicating complete range of colors and textures available for Architect's selection, minimum 2 inch by 2 inch.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum five years experience in producing products of the type specified.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Handling: Protect materials and finish from damage during handling and installation.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURER

- A. Specifications are based on products of listed manufacturer. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

2.2 SITE SEATING

- A. Provide site benches as manufactured by Landscape Forms, Inc.; 7800 E. Michigan Ave, Kalamazoo, Michigan 49048. Phone: (800) 521-2546. Fax (269) 381-3455. Website www.landscapiforms.com or Architect approved substitution.
- B. Benches (EXB-1-3):
 - 1. " Milenio" Benches as manufactured by Landscape Forms, Inc.
 - 2. Material:
 - a. Reinforced cast stone (concrete): Blend of Portland cement, sand, aggregate, and color admixture.
 - b. Water: Clean and Potable.

- c. Integral colored concrete with lightfast (UV and fade resistant) color pigments.
 - d. 100 percent recyclable material.
 - 3. Sizes and angles:
 - a. EXB -1: Straight 18 inches by 99 inches by 18 inches.
 - b. EXB -2: Angled Right 67 inches by 105 inches by 18 inches.
 - c. EXB -3: Angled Left 67 inches by 105 inches by 18 inches.
 - 4. Color: Architect to select from Manufacturer's full range of colors including custom options.
- C. Color: as selected by Architect from manufacturers available colors.
- E. Accessories: Provide fasteners, anchors, and miscellaneous materials required for complete installation.

2.3 FABRICATION

- A. Formwork: Fabricate forms sufficiently rigid to meet casting tolerances. Coat formwork with form release agent.
- B. Casting: Fabricate units to required profiles and sizes. Execute work accurately to specified tolerances and free of broken edges.
- C. Curing: Protect units from exposure to weather until concrete strength is adequate for form removal. Cure under identical conditions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates upon which site furnishings will be installed.
 - 1. Verify that surfaces are clean, flat and level.
- B. Coordinate with responsible entity to perform corrective work on unsatisfactory substrates.
- C. Commencement of work by installer is acceptance of substrate.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's installation instructions.
- B. Install products level and plumb.

3.3 CLEANING

- A. Follow manufacturer's instructions.

3.4 PROTECTION

- A. Protect site furnishings from damage due to other construction operations.

END OF SECTION 12 93 00

SECTION 14 24 00 - HYDRAULIC ELEVATOR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes: Requirements including but not limited to:
 - 1. Hydraulic passenger elevators.
 - 2. Equipment, machines, controls, systems and devices necessary for operation.
 - 3. Materials and accessories necessary to complete the elevator installation.

1.3 DEFINITIONS

- A. Defective Elevator Work: Operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
- B. Definitions in ASME A17.1/CSA B44 apply to work.
- C. Service Elevator: A passenger elevator that is also used to carry freight.

1.4 SUBMITTALS

- A. Product Data: Technical data including capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures; hoistway entrances; and operation, control, and signal systems.
- B. Shop Drawings: Submit plans, elevations, sections, and large scale details indicating service at each landing; machine room layout; coordination with building structure; relationships with other construction; and locations of equipment.
 - 1. Include large scale layout of car control station.
 - 2. Indicate maximum dynamic and static loads imposed on building structure at points of support as well as maximum and average power demands.
- C. Manufacturer Certificates: Signed by elevator manufacturer, certifying that hoistway, pit, and machine room layout and dimensions, shown on Drawings, and electrical service, shown and specified, are adequate for elevator system being provided.
- D. Submittals:
 - 1. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
 - 2. Set of service tools.
 - 3. Provide one electronic copy and two hard copies of manuals and inspection reports. Provide two complete printed sets of service, parts, schematic diagrams and adjustment manuals. Prints required by state code for each elevator.
 - 4. Provide four copies of independent service keys. Provide 4 factory cut keys for every lock on each elevator and label use. Provide two extra copies of the independent service key for a total of 6 keys.

5. Final inspection by the state inspector shall have a School District representative present to observe. Complete the final documentation for the State Inspection and return to the School District Maintenance Department.
 - a. The Owner shall apply for the operation/inspection certificate provided by the State Inspector. Cost of the state inspection shall be paid by the elevator subcontractor/manufacturer.
- E. Operation and Maintenance Data: Submit for elevators to include in emergency, operation, and maintenance manuals and parts list, with recommended parts inventory.
- F. Inspection and Acceptance Certificates and Operating Permits: Required by authorities having jurisdiction for normal, unrestricted elevator use.
- G. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a two year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options. Maintenance agreement includes but is not limited to:
 1. Systematic examination, adjustment, and lubrication of all elevator equipment.
 2. Repair or replacement of electrical and mechanical parts of the elevator installation as required, using only the genuine standard parts approved for the original installation.
 3. Maintenance work as required during regular working hours and regular working days, but with emergency callback service available at all times during this maintenance period.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 1. Building Code: Comply with applicable provisions of the IBC and the Elevator Code.
 2. Elevator Standard: Comply with ASME A17.1/CSA B44.
 3. Fire Rated Hoistway Entrance Assemblies: Door and frame assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 and IBC.
 4. Accessibility Requirements: Comply with applicable requirements.
 - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
 - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
 - c. Texas Accessibility Standards (TAS) 2012.
- B. Manufacturer/Installer Qualifications: Elevator manufacturer having minimum 10 years documented experience who is trained and approved by manufacturer, including but not limited to:
 1. Manufacturer of the power unit, controller, signal fixtures, door operators cab, entrances, and other major parts of the elevator operating equipment.
 2. Primary and major equipment components are manufactured in the United States and are not be an assembled system.
 3. Documented, ongoing quality assurance program.
- C. Source Limitations: Obtain elevators through one source from a single manufacturer.
 1. Provide major elevator components, including pump and tank units, plunger-cylinder assemblies, controllers, signal fixtures, door operators, car frames, cabs, and entrances, manufactured by a single manufacturer.
- D. Inspection and Testing: Elevator Installer shall obtain and pay for required inspections, tests, permits and fees for elevator installation.
 1. Arrange for inspections and make required tests.
 2. Deliver documentation to the Owner upon completion and acceptance of elevator work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components and equipment in manufacturer protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.7 COORDINATION

- A. Coordinate dimensions with structure, walls, and adjacent features.
- B. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
- C. Furnish well casing and coordinate delivery with related excavation work.
- D. Coordinate locations and dimensions of other work specified that relates to hydraulic elevators, including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

1.8 WARRANTY

- A. Written warranty signed by manufacturer in which manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
 - 2. Warranty Period: 2 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Manufacturer: Hydrofit by Otis Elevator.
- B. Elevator System: Machine roomless, holeless hydraulic elevator system with standard components included in elevator systems necessary for complete system.
- C. Elevator Description:
 - 1. Rated Load: 2500 lb.
 - 2. Rated Speed: 125 fpm.
 - 3. Operation System: Single automatic operation.
 - 4. Stops: 2.
 - 5. Openings: Front and Rear.
 - 6. Travel: 9'-3" inches.
 - 7. Clear Inside Dimensions: 6' 5 9/16" x 4' 4 1/8".
 - 8. Cab Height: 93 inches.
 - 9. Clear Cab Height: 7'-4 5/16" (2243 mm)
 - 10. Entrance Type and Width: Single Slide - 3'6" .
 - 11. Entrance Height: 84 inches.
 - 12. Main Power Supply: 480 volts \pm 5% of normal, three-phase, with a separate equipment grounding conductor.

13. Operation: Simplex Collective Operation: Using a microprocessor-based controller, operation shall be automatic by means of the car and hall buttons. If all calls in the system have been answered, the car shall park at the last landing served.
14. Car Lighting Power Supply: 120 volts, single-phase, 15 amps, 60 Hz.
15. Car Enclosures:
 - a. Front Walls (Return Panels): Satin stainless steel, No. 4 finish with integral car door frames.
 - b. Car Fixtures: Satin stainless steel, No. 4 finish.
 - c. Side and Rear Wall Panels: Satin stainless steel, No. 4 finish.
 - d. Reveals: Black.
 - e. Door Faces (Interior): Satin stainless steel, No. 4 finish.
 - f. Door Sills: Nickel silver.
 - g. Ceiling: Luminous ceiling.
 - h. Handrails: 1/2 inch by 2 inches (13 by 50 mm) rectangular, at rear of car.
 - i. Floor prepared to receive resilient flooring.
16. Hoistway Entrances:
 - a. Type: Single speed center opening.
 - b. Frames: Satin stainless steel, No. 4 finish.
 - c. Doors: Satin stainless steel, No. 4 finish.
 - d. Sills: Nickel silver.
17. Hall Fixtures: Satin stainless steel, No. 4 finish.
18. Additional Requirements:
 - a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, No. 4 finish.
 - b. Provide hooks for protective pads and one complete set of full height protective pads.

2.2 SYSTEMS AND COMPONENTS

- A. Pump Units: Positive displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations.
 1. Pump shall be submersible type with submersible squirrel cage induction motor, and shall be suspended inside oil tank from vibration isolation mounts.
 2. Motor shall have solid state starting.
 3. Motor shall have variable voltage, variable frequency control.
- B. Hydraulic Silencers: System shall have hydraulic silencer containing pulsation absorbing material in blowout proof housing at pump unit.
- C. Piping: Size, type, and weight of piping as recommended by elevator manufacturer, with flexible connectors to minimize sound and vibration transmissions from power unit.
 1. Cylinder units shall be connected with dielectric couplings.
 2. Casing for Underground Piping: Schedule 40 PVC pipe complying with ASTM D 1785, joined with PVC fittings complying with ASTM D 2466 and solvent cement complying with ASTM D 2564.
- D. Hydraulic Fluid: Nontoxic, biodegradable, fire resistant fluid, made from vegetable oil with antioxidant, anticorrosive, antifoaming, and metal passivating additives, that is approved by elevator manufacturer for use with elevator equipment.
- E. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified Section 055000.
- F. Protective Cylinder Casing: PVC or HDPE pipe casing complying with ASME A17.1/CSA B44, of sufficient size to provide not less than 1 inch (25 mm) clearance from cylinder and extending

above pit floor. Casing shall have means of monitoring effectiveness to comply with ASME A17.1/CSA B44.

- G. Corrosion Protective Filler: A nontoxic, petroleum based gel formulated for filling the space between hydraulic cylinder and protective casing. Filler shall be electrically nonconductive, displace or absorb water, and gel or solidify at temperatures below 60 degrees F (16 degrees C).
- H. Car Frame and Platform: Welded steel units.
- I. Guides: Roller guides; provide guides at top and bottom of car frame.

2.3 OPERATION SYSTEMS

- A. Provide standard microprocessor operation system required to provide type of operation indicated.
- B. Auxiliary Operations:
 - 1. Single Car Standby Powered Lowering: On activation of standby power, car is lowered to the lowest floor, opens its doors, and shuts down.
 - 2. Automatic Operation of Lights and Fan: When elevator is stopped and unoccupied with doors closed, lighting, ventilation fan, and cab displays are de-energized after 5 minutes and are re-energized before car doors open.

2.4 DOOR REOPENING DEVICES

- A. Infrared Array: Provide door-reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.
- B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door-reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

2.5 CAR ENCLOSURES

- A. Provide steel framed car enclosures with nonremovable wall panels, with removable car roof, access doors, power door operators, and ventilation.
 - 1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.
- B. Materials and Finishes: Standards, but not less than the following:
 - 1. Subfloor: Exterior, underlayment grade plywood, not less than 5/8 inch (15.9 mm) nominal thickness.
 - 2. Floor Finish: Refer to Section 096500.
 - 3. Stainless Steel Wall Panels: Flush, formed metal construction; fabricated from stainless steel sheet.
 - 4. Fabricate car with recesses and cutouts for signal equipment.
 - 5. Fabricate car door frame integrally with front wall of car.
 - 6. Stainless Steel Doors: Flush, hollow metal construction; fabricated from stainless steel sheet or by laminating stainless steel sheet to exposed faces and edges of enameled or powder coated steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
 - 7. Sight Guards: Provide sight guards on car doors.
 - 8. Sills: Extruded or machined metal, with grooved surface, 1/4 inch (6.4 mm) thick.

9. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.
10. Light Fixture Efficiency: Not less than 35 lumens/W.
11. Ventilation Fan Efficiency: Not less than 3.0 cfm/W (1.4 L/s per W).

2.6 HOISTWAY ENTRANCES

- A. Hoistway Entrance Assemblies: Horizontal sliding, door and frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile shall accommodate hoistway wall construction.
 1. Where gypsum board wall construction is indicated, frames shall be self supporting with reinforced head sections.
- B. Fire Rated Hoistway Entrance Assemblies: Door and frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible according to NFPA 252 or UL 10B.
 1. Fire Protection Rating: 1 hour with 30 minute temperature rise of 450 degrees F (250 degrees C).
- C. Materials and Fabrication: Standard, but not less than the following:
 1. Steel Subframes: Formed from cold or hot rolled steel sheet, with factory applied enamel or powder coat finish or rust resistant primer. Fabricate to receive applied finish as indicated.
 2. Stainless Steel Frames: Formed from stainless steel sheet.
 3. Stainless Steel Doors: Flush, hollow metal construction; fabricated from stainless steel sheet or by laminating stainless steel sheet to exposed faces and edges of enameled or powder coated steel doors using adhesive that fully bonds metal to metal without telegraphing or oil canning.
 4. Sight Guards: Provide sight guards on doors matching door edges.
 5. Sills: Extruded or machined metal, with grooved surface, 1/4 inch (6.4 mm) thick.
 6. Nonshrink, Nonmetallic Grout: Factory packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M.

2.7 SIGNAL EQUIPMENT

- A. Provide hall call and car call buttons that light when activated and remain lit until call has been fulfilled. Provide vandal resistant buttons and lighted elements illuminated with LEDs.
- B. Car Control Stations: Provide recessed or semirecessed car control stations. Mount in return panel adjacent to car door unless otherwise indicated.
 1. Mark buttons and switches for required use or function. Use both tactile symbols and Braille.
 2. Provide "No Smoking" sign matching car control station, either integral with car control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
- C. Emergency Communication System: Two way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush mounted cabinet, with identification, instructions for use, and battery backup power supply.
- D. Firefighters' Two Way Telephone Communication Service: Provide flush mounted cabinet and required conductors in traveling cable for firefighters' two way telephone communication service.

- E. Car Position Indicator: Provide digital type car position indicator, located above car door or above car control station. Provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.
- F. Hall Push Button Stations: Provide one hall push button station at each landing.
 - 1. Provide units with flat faceplate for mounting with body of unit recessed in wall.
 - 2. Equip units with buttons for calling elevator and for indicating applicable direction of travel.
- G. Hall Lanterns: Units with illuminated arrows; however, provide single arrow at terminal landings. Provide the following:
 - 1. Wall mounted units, for mounting above entrance frames.
- H. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
 - 1. At manufacturer's option, audible signals may be placed on cars.
- I. Hall Position Indicators: Provide digital display type position indicators, located above hoistway entrance at ground floor.
 - 1. Provide units with flat faceplate for mounting and with body of unit recessed in wall.
 - 2. Integrate ground floor hall lanterns with hall position indicators.
- J. Standby Power Elevator Selector Switches: Provide switches, required by ASME A17.1/CSA B44, where indicated. Adjacent to switches, provide illuminated signal that indicates when normal power supply has failed.
- K. Fire Command Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby power elevator selector switch(es), required by ASME A17.1/CSA B44, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.
- L. Emergency Pictorial Signs: Fabricate from materials matching hall push button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

2.8 FINISH MATERIALS

- A. Cold Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
- B. Hot Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.
- C. Stainless Steel Sheet: ASTM A 240/A 240M, Type 304.
- D. Textured Stainless Steel Sheet: ASTM A 240/A 240M, Type 304, with embossed texture rolled into exposed surface.
- E. Stainless Steel Bars: ASTM A 276, Type 304.
- F. Stainless Steel Tubing: ASTM A 554, Grade MT 304.
- G. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063.

- H. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500 or No. C77600.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elevator areas for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.
- B. Prepare written report listing conditions detrimental to performance of the work.
- C. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

- A. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.
- B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS workmanship and welding operator qualification standards.
- C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.
- D. Install piping above the floor, where possible. Install underground piping in casing.
 - 1. Excavate for piping and backfill encased piping according to applicable requirements.
- E. Lubricate operating parts of systems recommended by manufacturers.
- F. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
- G. Leveling Tolerance: 1/4 inch (6 mm), up or down, regardless of load and travel direction.
- H. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
- I. Locate hall signal equipment for elevators as follows unless otherwise indicated:
 - 1. Place hall lanterns either above or beside hoistway entrance.
 - 2. Mount hall lanterns at a minimum of 72 inches (1829 mm) above finished floor.

3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.

- B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

3.4 PROTECTION

- A. Temporary Use: Do not use elevator for construction purposes:

3.5 DEMONSTRATION

- A. Engage a factory authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevator.
- B. Check operation of elevator with Owner's personnel present before date of Substantial Completion and again not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

3.6 MAINTENANCE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 24 months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 1. Perform maintenance during normal working hours.
 - 2. Perform emergency callback service during normal working hours with response time of two hours or less.

END OF SECTION 14 24 00



Project Manual

for

Humble High School Additions and Renovations Phase Two

PBK Project No.: 220537

Owner Project No.: CSP# 2025-09

for the

HUMBLE INDEPENDENT SCHOOL DISTRICT

18 December 2024

Issue for Proposal

Volume 2 of 2



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18 December 2024

Issue for Proposal

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MEPT



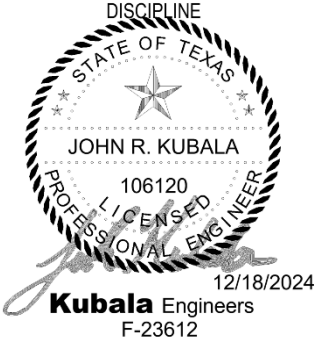
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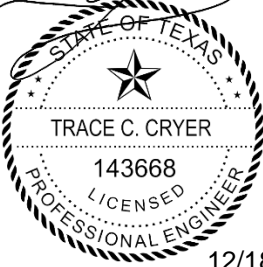


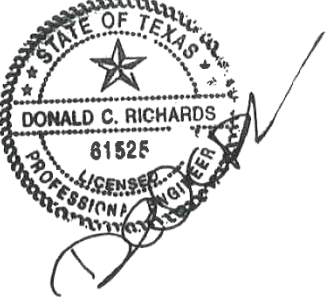

Building Envelope

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Issue for Proposal

Each specification section included herein is listed in the Project Manual Table of Contents with a letter code, indicated below, designating the Designer of Record responsible for its preparation, under whose seal and/or authority it is issued for the purpose(s) stated above. Seals and signatures do not apply to documents not included herein, nor (except as otherwise indicated) to documents prepared by the Owner or others ("O"), including but not necessarily limited to documents in Division 00, geotechnical and other reports, etc.

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DOCUMENT 00 00 10 TABLE OF CONTENTS

<i>Section No.</i>	<i>Title</i>
00 00 00	Project Manual Cover Sheet
00 00 01	Seals Page
00 00 10	Table of Contents
00 11 00	Request for Competitive Sealed Proposals
00 20 01	Humble ISD Selection Criteria
00 21 16	Instructions to Offerors
00 31 00	Affidavit of Non-Asbestos, Lead and PCB Use Affidavit
00 31 32	Geotechnical Data
00 31 32.1	Geotechnical Report
00 40 00	Competitive Sealed Proposal Form
00 40 01	Proposal Bond
00 40 12	List of Subcontractors
00 50 00	Texas Statutory Performance Bond
00 50 01	Texas Statutory Payment Bond
00 71 00	AIA Document A101 – Standard Form of Agreement Between Owner and Contract
00 71 00A	AIA Document A201 – General Conditions of the Contract for Construction
00 72 00	Supplementary Conditions to the AIA Document A201
00 73 00	Exhibit A to A101 – Owner’s Construction Bond and Insurance Requirements
00 73 50	Prevailing Wage Rate Determination Information

DIVISION 1 GENERAL REQUIREMENTS

01 10 00	Summary
01 21 00	Allowances
01 22 00	Unit Prices
01 23 00	Alternates
01 25 13	Product Substitution Procedures
01 25 13.01	Request for Substitution Form
01 26 00	Contract Modification Procedures
01 29 00	Payment Procedures
01 29 73	Schedule of Values
01 29 73.1	Schedule of Values – Sample
01 31 00	Project Management and Coordination
01 32 00	Construction Progress Documentation
01 32 33	Photographic Documentation
01 33 00	Submittal Procedures
01 40 00	Quality Requirements
01 42 00	References
01 45 23	Structural Testing and Inspection Services
01 45 23	Testing and Inspecting Services
01 50 00	Temporary Facilities and Controls
01 50 00	Temporary Facilities (Civil)
01 55 26	Traffic Control
01 56 00	Temporary Jobsite Protection
01 56 23	Traffic Barricades
01 57 13	General Source Controls
01 57 13.13	Filter Fabric Fence
01 57 13.14	Reinforced Filter Fabric Barrier
01 57 13.15	Stabilized Construction Exit
01 57 26	Texas Pollution Discharge Elimination System
01 60 00	Product Requirements
01 73 00	Execution
01 73 29	Cutting and Patching
01 77 00	Closeout Procedures

01 77 01	Closeout Forms A-D
01 77 13	PBK Exterior Punch List Form
01 77 16	PBK Interior Punch List Form
01 78 39	Project Record Documents
01 79 00	Demonstration and Training

DIVISION 2 EXISTING CONDITIONS

02 41 00	Demolition
02 41 13	Selective Demolition
02 41 13.23	Abandonment of Existing Utilities
02 41 19	Selective Structural Demolition

DIVISION 3 CONCRETE

03 05 80	Under Slab Vapor Retarder
03 10 00	Concrete Forming and Accessories
03 10 01	Spread Footings
03 11 00	Concrete Formwork
03 11 31	Void Forms
03 15 00	Concrete Accessories (Civil)
03 15 00	Concrete Accessories (Arch)
03 15 13	Waterstops
03 20 00	Concrete Reinforcement (Civil)
03 20 00	Concrete Reinforcing (Structural)
03 30 00	Cast-in-Place Concrete
03 31 00	Structural Concrete
03 35 19	Concrete Floor Staining
03 52 16	Lightweight Insulating Concrete Deck System

DIVISION 4 MASONRY

04 20 00	Unit Masonry
04 22 00	Concrete Unit Masonry

DIVISION 5 METALS

05 12 00	Structural Steel Framing
05 12 13	Architecturally Exposed Structural Steel Framing
05 21 00	Steel Joist Framing
05 31 13	Steel Floor Decking
05 31 23	Steel Roof Decking
05 40 00	Cold Formed Metal Framing
05 50 00	Metal Fabrications
05 51 00	Steel Stairs, Handrails and Railings
05 58 13	Column Covers
05 70 00	Decorative Metal
05 73 00	Decorative Railing System

DIVISION 6 WOOD, PLASTICS, AND COMPOSITES

06 10 00	Rough Carpentry
06 20 00	Finish Carpentry and Millwork
06 40 23	Interior Architectural Woodwork
06 82 00	Fiberglass Reinforced Plastic Panels

DIVISION 7 THERMAL AND MOISTURE PROTECTION

07 05 43	Thermal Clips
07 13 00	Shower Stall Waterproofing
07 14 00	Cold-Fluid Applied Waterproofing
07 16 00	Below Grade Waterproofing

07 21 00	Thermal Insulation
07 27 26	Fluid Applied Air Barrier System
07 42 11	Formed Metal Wall Panels
07 42 13	Metal Composite Material Wall Panels
07 42 23	External Cladding
07 52 19	Modified Bitumen "Cool Roof" Membrane Roofing System
07 62 00	Roof Related Sheet Metal
07 65 00	Flexible Flashing
07 72 00	Roof Accessories
07 72 33	Roof Scuttle (Hatches) and Heat/Smoke Vents
07 81 00	Applied Fireproofing
07 84 00	Firestopping
07 92 00	Joint Sealants
07 95 00	Expansion Control

DIVISION 8 OPENINGS

08 11 13	Hollow Metal Doors and Frames
08 14 23	Plastic Laminate Faces Wood Doors
08 31 13	Access Doors and Frames
08 35 16	Folding Grilles
08 41 13	Aluminum Framed Entrances and Storefronts
08 44 13	Glazed Aluminum Curtain Walls
08 71 00	Door Hardware
08 71 00	Door Hardware - Alternate
08 80 00	Glazing
08 83 00	Mirrors
08 87 23	Safety and Security Film
08 91 00	Fixed Louvers

DIVISION 9 FINISHES

09 21 16	Gypsum Board Assemblies
09 24 00	Cement Plastering
09 30 13	Ceramic Tiling
09 30 19	Porcelain Tile
09 51 00	Acoustical Ceiling Panels
09 62 33	Rubber Sports Flooring
09 64 66	Wood Gymnasium Flooring
09 65 13	Resilient Base
09 65 16	Vinyl Sheet Flooring
09 65 19	Resilient Tile Flooring
09 68 00	Carpeting
09 84 13	Fixed Sound Absorptive Panels
09 90 00	Paintings and Coatings
09 93 00	Hardwood Floor Adhesives, Finishing, and Maintenance
09 96 46	Intumescent Painting
09 97 23	Concrete Floor Sealer

DIVISION 10 SPECIALTIES

10 01 00	Miscellaneous Specialties
10 11 00	Markerboards and Tackboards
10 14 00	Graphics
10 14 33	Electronic Signage
10 14 53	Traffic Signage
10 21 13	Solid Plastic (HDPE) Toilet Partitions
10 26 13	Corner Guards
10 28 13	Toilet Accessories

10 44 00	Fire Extinguisher and Cabinets
10 51 13	Metal Lockers and Benches
10 56 16	Metal Storage Shelving
10 71 13	Exterior Sun Control Devices
10 73 13	Aluminum Canopy

DIVISION 11 EQUIPMENT

11 66 00	Gymnasium Equipment
11 66 43	Indoor Scoreboard

DIVISION 12 FURNISHINGS

12 11 00	Digitally Printed Vinyl Murals
12 21 13	Horizontal Louver Blinds
12 24 00	Window Shades
12 35 50	Educational Casework
12 35 53	Laboratory Casework
12 36 62	Simulated Stone Countertops
12 66 13	Telescoping Bleachers
12 93 00	Site Furnishing

DIVISION 13 SPECIAL CONSTRUCTION – not used

DIVISION 14 CONVEYING EQUIPMENT

14 24 00	Hydraulic Elevator
----------	--------------------

VOLUME 2

DIVISION 21 – FIRE SUPPRESSION

21 05 00	Common Work Results for Fire Protection
21 05 29	Hangers and Supports for Fire Suppression System
21 05 48.13	Vibration Controls for Fire Suppression System
21 11 13	Fire Suppression System

DIVISION 22 PLUMBING

22 05 00	Common Work Results for Plumbing
22 05 10	Sanitary Pipe Testing
22 05 12	Water Pipe Testing
22 05 29	Plumbing Hangers and Supports
22 05 48.13	Vibration Controls for Plumbing Piping Equipment
22 08 00	Commissioning of Plumbing Systems
22 11 16	Domestic Water Piping
22 13 16	Sanitary Waste and Vent Piping
22 13 21	Acid Waste and Vent Systems
22 14 13	Storm Drainage Piping
22 20 23	Gas Piping
22 30 00	Plumbing Equipment
22 40 00	Plumbing Fixtures

DIVISION 23 MECHANICAL

23 05 00	Common Work Results for HVAC
23 05 13	Common Motor Requirements for HVAC Equipment
23 05 14	Variable Frequency Drives
23 05 16	Expansion Fittings and Loops for HVAC Piping
23 05 19	Meters and Gages for HVAC Piping
23 05 23	General Duty Valves for HVAC Piping
23 05 29	Hangers and Supports for HVAC Piping and Equipment

23 05 48	Vibration and Seismic Controls for HVAC Piping and Equipment
23 05 53	Identification for HVAC Piping and Equipment
23 05 93	Testing, Adjusting, and Balancing for HVAC
23 07 13	Duct Insulation
23 07 16	HVAC Equipment Insulation
23 07 19	HVAC Piping Insulation
23 08 00	Commissioning of HVAC Systems
23 09 23	Direct Digital Controls
23 09 93	Sequences of Operation for HVAC Controls
23 21 13	Hydronic Piping
23 21 23	Hydronic Pumps
23 22 00	Condensate Piping
23 23 00	Refrigerant Piping
23 25 19	Flushing and Cleaning of Hydronic Piping Systems
23 31 13	Metal Ducts
23 31 18	Fabric Duct
23 33 00	Air Duct Accessories
23 33 19	Duct Silencers
23 34 00	HVAC Fans
23 34 23	High Plume Blower Systems
23 36 00	Air Terminal Units
23 37 13	Diffusers, Registers, and Grilles
23 37 23	HVAC Gravity Ventilators
23 43 00	Electronic Bi-Polar Ionization Air Cleaners
23 43 13	UVC Emitters
23 73 13	Modular Indoor Central Station Air Handling Units
23 74 13	Packaged Outdoor Central Station Air Handling Units
23 74 13.1	High Capacity Outside Air Packaged Outdoor Central-Station Air-Handling Units
23 81 26	Ductless Mini Split System Air Conditioners
23 82 39.19	Electric Unit Heaters

DIVISION 26 - ELECTRICAL

26 05 00	Common Work Results for Electrical
26 05 19	Low Voltage Electrical Power Conductors and Cables
26 05 26	Grounding and Bonding for Electrical Systems
26 05 29	Hangers and Supports for Electrical Systems
26 05 33	Raceway and Boxes for Electrical Systems
26 05 53	Identification for Electrical Systems
26 05 73.19	Arc-Flash Hazard Analysis
26 08 00	Commissioning of Electrical Systems
26 09 43	Digital Lighting Controls
26 20 00	Electrical Distribution Equipment
26 27 26	Wiring Devices
26 43 00	Surge Protection Devices (SPDs) for Low Voltage Electrical Power Circuits
26 50 00	Lighting

DIVISION 27 – TECHNOLOGY & AUDIO VISUAL

27 00 00	Basic Materials and Methods
27 32 43	Campus Radio Antenna System
27 51 23	Intercom and Clock Network
27 51 23.80	Local Sound Reinforcing Systems

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

28 05 00	General Electronic Safety Systems Requirements
28 05 44	Emergency Responder Radio Antenna System
28 13 00	Access Control System

28 16 00	Intrusion Detection System
28 23 00	IP Security Camera System
28 23 16	Aiphone Access Control System
28 31 00	Fire Alarm System

DIVISION 31 – EARTHWORK

31 13 13.13	Waste Material Disposal
31 20 00	Earthwork
31 23 00	Construction of Underground Utilities
31 23 23.13	Bank Sand Backfill
31 23 23.16	Cement Stabilized Sand Bedding and Backfill
31 31 16	Termite Control
31 32 13.17	Cement Stabilized Subgrade
31 32 13.19	Lime Stabilized Subgrade
31 32 13.20	Hydrated Lime and Lime Slurry
31 32 13.21	Lime Fly Ash Stabilized Subgrade
31 41 00	Trench Safety
31 50 00	Excavation Support and Protection

DIVISION 32 – EXTERIOR IMPROVEMENTS

32 01 90	Exterior Landscape Maintenance
32 13 13	Concrete Paving
32 16 13	Concrete Curb, Gutter, Sidewalks and Driveways
32 18 23.18	Knitted Nylon Synthetic Turf System with Foam Pad
32 31 19	Wrought Iron Fences and Gates
32 80 00	Irrigation
32 90 00	Planting
32 92 00	Turf and Grasses
32 92 13	Hydro-Mulch Seeding
32 92 23	Fertilizer
32 92 23.16	Solid Sod

DIVISION 33 – UTILITIES

33 01 30.13	Sanitary Sewer TCEQ Manhole Requirements
33 11 00	Water Distribution System PVC
33 33 13	Sanitary Sewer Lines
33 41 00	Storm Sewer and Appurtenances
33 44 19	Storm Water Management

DIVISION 34 - TRANSPORTATION

34 41 13	Traffic Signals
34 41 14	School Zone Flasher Assemblies

END OF DOCUMENT 00 00 10

SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE PROTECTION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEM
- C. SECTION 21 11 13 – FIRE SUPPRESSION SYSTEMS.
- D. SECTION 28 31 00 - FIRE DETECTION AND NOTIFICATION SYSTEMS.

1.2 SUMMARY

- A. Provide all work for mechanical, plumbing and fire protection systems required in the project to be properly installed, tested and performing their intended function.
- B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all systems. All work shall be accomplished by workmen skilled in the various trades involved.
- C. Phased Construction:
 - 1. This project consists of work that must be accomplished in a specific sequence on premium time to avoid interruption of services to existing portions of the buildings and mechanical, plumbing and fire protection systems that must remain operational.
 - 2. Contractor shall include any and all temporary services required to keep the Owner occupied portions of the buildings operation without interruption of HVAC, plumbing and fire protection services for the duration of the project.
 - 3. Refer to Architectural drawings for description of phasing, stage all mechanical, plumbing and fire protection work accordingly.
- D. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Engineer shall be notified of the discrepancy.

1.3 QUALITY ASSURANCE

- A. Shop drawings and hydraulic calculations are to be sealed by a NICET III or IV sprinkler designer licensed in the state of Texas.
- B. Perform all work in accordance with the latest edition of the applicable codes, specifications, local ordinances, industry standards, utility company regulations, nationally accepted codes.
- C. All materials and distribution, and utilization equipment shall be UL Listed.

- D. All equipment and materials shall be new, unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.
- E. Eliminate any abnormal sources of noise that are considered by the Architect or Engineer not to be an inherent part of the systems as designed without additional cost to the Owner

1.4 QUALIFICATION OF CONTRACTORS

- A. The Contractor for the fire protection installation shall be a certified fire protection contractor, licensed for the installation of automatic fire sprinkler systems and other fire protection equipment.
- B. An approved contractor for the work under this division shall be:
 - 1. A licensed specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system.
 - 2. Shop drawings and hydraulic calculations are to be sealed by a NICET III or IV sprinkler designer licensed in the state of Texas
 - 3. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.

1.5 DESIGN STANDARDS

- A. Fire Protection systems shall be designed and installed in accordance with the requirements of the most current version of the following codes, standards and design guides:
 - 1. The International Fire Prevention Code
 - 2. The International Building Code
 - 3. National Fire Protection Association (NFPA) Standards:
 - a. NFPA 101 - Life Safety Code
 - b. NFPA 13 - Installation of Sprinkler Systems
 - c. NFPA 14 - Installation of Standpipe and Hose Systems
 - d. NFPA 20 - Installation of Centrifugal Fire Pumps
 - e. NFPA 24 - Installation of Private Fire Service Mains
 - f. NFPA 25 - Inspection, Testing, and Maintenance of Water-based Fire Protection Systems
 - g. NFPA-2001 – Standard for Clean Agent Fire Extinguishing Systems
- B. Factory Mutual (FM) Approval Guide
- C. Underwriters Laboratories Inc. (UL)
- D. Owner's Insurance Underwriter Requirements

1.6 GENERAL REQUIREMENTS

- A. General Conditions: Refer to the General Conditions, the Supplementary General Conditions and the Special Conditions, all provisions of which apply to work under this section as if written in full herein.
- B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to

completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all systems. All work shall be accomplished by workmen skilled in the various trades involved.

- C. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Architect shall be notified of the discrepancy.
- D. All work performed under this specification shall be accomplished in accordance with the requirements and provisions of Section 23 00 00 - Mechanical General.

1.7 WORK INCLUDED

- A. Code compliance, research, design coordination, and installation of a complete and functional hydraulically calculated wet pipe sprinkler system that meets the approval, and is in accordance with the requirements of NFPA Fire Protection Standards listed in 1.4 (a), Underwriters Laboratory (UL), all local and state regulations, and these specifications.
- B. Alarm devices including alarm valves, flow switches/pressure switches, tamper switches and coordination with Fire Alarm and Detection Contractor.
- C. Shop drawings and calculations prepared and submitted in accordance with the requirement of all Authorities Having Jurisdiction.
- D. All permits and approvals of the fire protection system.
- E. SYSTEMS: Plumbing Systems installed and work performed under this Division of the Specifications shall include, but not necessarily be limited to, the following as noted below. The connection point for all systems from the site utilities shall be as 5'-0" from the exterior of the building unless specifically otherwise noted.
 - 1. Access Panels
 - 2. Floor, Wall, and Ceiling Plates
 - 3. Insulation
 - 4. Heattrace
 - 5. Piping and Equipment Identification
 - 6. Painting

1.8 COORDINATION WITH OTHER TRADES

- A. Coordinate the work of this division with all other divisions to ensure that all components of the mechanical, plumbing and fire protection system will be installed at the proper time and fit the available space.
- B. Locate and size all openings in work of other trades required for the proper installation of the mechanical, plumbing and fire protection system components.
- C. Make all mechanical, plumbing and fire protection connections to all equipment furnished by this division and as required by any other division.
- D. Electrical wiring, control equipment and motor starters indicated on the electrical drawings, except items otherwise specifically noted, shall be furnished and installed by the electrical trades. Items of electrical control equipment specifically mentioned to be furnished by the mechanical trades, either in these specifications or on the mechanical

drawings, shall be furnished, mounted and wired by this trade unless where otherwise specified in Division 26 or noted on the electrical drawings to be by the electrical trades. All wiring shall be in accordance with all requirements of the electrical Sections of these specifications.

- E. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment. All controllers furnished with mechanical equipment shall have overload protection in all phases. It shall be the responsibility of each subcontractor furnishing motors and devices to advise Electrical Contractor of exact function of systems to assure proper type of starter with correct number auxiliary contacts for proper operation of the system.
- F. The mechanical trades shall coordinate with the electrical to ensure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.
- G. The design of the electrical systems is based on the mechanical equipment specified and scheduled on the drawings. Where changes or substitutions are made that involve additional electrical work (larger-size motors, larger number of motors, additional wiring of equipment, etc.), the mechanical trades shall pay the electrical trades for the cost of the additional work, except for changes by bulletin.
- H. Motor control equipment which is furnished loose under Division 23 shall be delivered to the Electrical Contractor at the site for custody, erection in place, and wiring as specified.
- I. Smoke detection systems will be furnished and installed under Division 26 – electrical. Coordinate locations with Electrical Contractor.

1.9 DRAWINGS

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the mechanical, plumbing and fire protection equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers will be acceptable, it is the responsibility of the Contractor to determine if the equipment that the Contractor proposes to furnish will fit in the space. The drawings are not intended to show exact locations of pipes and ducts, or to indicate all offsets and fittings or supports, but rather to indicate approximate layout.
- B. The mechanical, plumbing and fire protection Drawings are necessarily diagrammatic in character and cannot show every connection in detail in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.

- C. When the mechanical, electrical, plumbing and fire protection drawings do not give exact details as to the elevation of pipe, conduit and ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Exposed piping and ductwork is generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.
- D. The locations, arrangement and extent of equipment, devices, and other appurtenances related to the installation of work shown on the Drawings are approximate. The Contractor shall not scale drawings, but shall refer to the architectural drawings for exact dimensions of building components. Should a conflict exist between the architectural and engineering drawings regarding dimensions and scale, the Contractor shall notify the Architect of the discrepancy for resolution.
- E. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

1.10 ORDINANCES, PERMITS AND DRAWING APPROVALS

- A. The Contractor shall file all requisite plans relating to this section of the specifications with the proper authorities, secure all permits and approvals and pay all resultant fees for work done under this section.
- B. All fire protection work shall comply with all laws, ordinances, rules, regulations and standards of the City, County, State and the Owner's Insurance Underwriter; all applicable sections of the National Fire Codes and the Codes and Standards of the National Fire Protection Association.
- C. If code or other requirements exceed the provisions shown on the Contract Documents, the Architect shall be notified in writing. Where requirements of the Contract Documents exceed Code requirements, work shall be furnished and installed in accordance with the Contract Documents. Any work done contrary to these requirements shall be removed and replaced at the Contractor's expense.

1.11 SUBSTITUTIONS

- A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability or record of satisfactory performance. See division 01 specification for additional requirements.
- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect at least **seven (7)** days prior to the date for receipt of proposals. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance and test data and any other

information necessary for an evaluation. The Architect's decision of approval or disapproval of a proposed substitution shall be final.

- C. The Architect and Owner reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final.
- D. **No substitutions will be considered after the Award of Contract.**
- E. Requests for Substitutions: Submit three (3) copies of each request for substitution. In each request identify the product or fabrication or installation method to be replaced by the substitution; include related Specifications Section and Drawing numbers, and complete documentation showing compliance with the requirements for substitutions. Include, as appropriate, with each request, the following information:
1. Product data, drawings and descriptions of products, fabrication and installation procedures.
 2. Samples, where applicable or requested.
 3. A detailed comparison of the significant qualities of the proposed substitution with those of the work originally specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect, where applicable.
 4. Coordination information, including a list of changes or modifications needed by other parts of the work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.
 5. A statement indicating the effect the substitution will have on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
 6. Cost information, including a proposal of the net change, if any in the Contract Sum.
 7. Certification by the Contractor to the effect that, in the Contractor's opinion, after thorough evaluation, the proposed substitution will result in work that in every significant respect is equal-to or better than the work required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
 8. A statement indicating the Contractor will reimburse the Owner and pay for all costs, including Architect/Engineer's re-design and evaluation costs resulting from the use of the proposed substitution
- F. Condition: The Contractor's request for substitution will be received and considered when extensive revisions to Contract Documents are not required, when the proposed changes are in keeping with the general intent of the Contract Documents, when the request is timely, fully documented and properly submitted, and when one (1) or more of the above conditions are satisfied, all as judged and determined by the Architect/Engineer; otherwise the requests will be returned without action except to record non-compliance with these requirements.

1.12 SUBMITTALS

- A. Provide shop drawings and complete product data as indicated in each specification section.

- B. Coordination Drawings: Using the mechanical ductwork shop drawings as a basis, provide a composite set of AutoCAD drawings in which the major mechanical, plumbing and fire protection equipment, ductwork and piping are superimposed on the architectural reflected ceiling plan and structural framing plan. Include spot elevations of bottom of steel along with finished ceiling height. Prepare at 1/8 inch scale or larger, one drawing per building area. Provide 1/4 inch scale enlargements of locations where special attention to rough-in dimensions as required to ensure all systems will fit within the available space.
- C. Shop Drawings will be reviewed and returned to the Contractor with one of the following categories:
1. **Reviewed:** No further submittal action is required. Submittal to be included in O & M Manual.
 2. **Revise and Resubmit:** Contractor to resubmit submittal as indicated in comments section of Engineer's Submittal Cover Letter.
 3. **Rejected:** Contractor to resubmit new submittal when alternate or substitution is not approved and be required to furnish product named in Specification and or Drawings.
 4. **Furnish as Corrected:** Contractor to submit letter verifying that required corrections noted on Engineer's Submittal Cover Letter have been received and complied with by manufacturer. If equipment on site is not in compliance with corrections noted, contractor shall be responsible for the cost of removing and replacing equipment.
- D. Materials and equipment which are purchased or installed without Submittal review and approval will be removed and replaced with specified equipment at Contractor's expense.
- E. Provide a specification review that consists of a copy of related specification section with notations indicating compliance or deviation with each element of specification.
- F. All approvals required by any code or enforcement authority, insurance underwriter, etc. shall be obtained prior to equipment being submitted to the Engineer.
- G. Review of submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.
- H. All submittals shall be identified by the equipment mark or tag identification numbers shown on the Contract Drawings. Each individual submittal item shall be marked to show which specification section pertains to the item.
- I. Submittals shall clearly indicate selection of model numbers, sizes, dimensions, electrical characteristics, etc. of the proposed equipment. Any proposed deviations from specified equipment shall be clearly indicated on the submittal.

1.13 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Division 1 - General Requirements and each specification section.

1.14 INTERFERENCE DRAWINGS

- A. Where field conditions prohibit the installation of the mechanical, plumbing or fire protection system components within the available space as indicated on drawings, the Contractor shall prepare a sketch to the minimum 1/8 inch scale, clearly depicting the conflict along with an alternate installation arrangement that satisfies the design intent of the documents without incurring additional cost.
- B. Obtain written approval of proposed interference resolution prior to proceeding with alternate installation.

1.15 EXISTING CONDITIONS

- A. The Contractor shall be familiar with the required scope of work to accomplish the work required by these documents. All demolition work implied or required shall be included in the scope of this contract.
- B. Outages of services are required by the new installation will only be permitted at a time approved by the Owner. The contractor shall allow the Owner a 2 week window in order to schedule required outages. The time allowed for outages will not be during normal operating hours unless otherwise approved by the Owner. All costs for outages, including overtime charges, shall be included in the contract amount.
- C. Work Sequence, Timing, Coordination with Owner:
 - 1. During the construction of this project, normal facility activities will continue in existing buildings until new buildings or renovated areas are completed. Plumbing, fire protection, lighting, electrical, communications, heating, air conditioning, and ventilation systems will have to be maintained in service within the occupied spaces of the existing building.
- D. Demolition and Work within Existing Buildings:
 - 1. In the preparation of these documents every effort has been made to show the approximate locations of, and connections to the existing piping, duct, equipment and other apparatus related to this phase of the work. However, the Contractor shall be responsible for verifying all existing conditions. The Contractor shall visit the existing site to inspect the facilities and related areas. The Contractor shall inspect and verify all details and requirements of all the Contract Documents, prior to the submission of a proposal. All discrepancies between the Contract Documents and actual job-site conditions shall be resolved by his contractor, who shall produce drawings which shall be submitted to the Architect/Engineer for review. All labor and materials required to perform the work described shall be part of this Contract.
 - 2. All equipment and/or systems noted on the Drawings "To Remain" shall be inspected and tested on site to certify working condition. A written report on the condition of all equipment to remain, including a copy of the test results and recommended remedial actions and costs shall be made by this Contractor to the Architect/Engineer for review.
 - 3. All equipment and/or systems noted on the Drawings "To Be Removed" shall be removed including associated system connections. Where duct or pipe is to be capped for future extension or end of line use, it shall be properly tagged with its function or service appropriately identified. Where existing equipment is to be removed or relocated and has an electric connection, the Electrical Contractor shall disconnect equipment and remove wiring back to panel or disconnect switch. Contractor shall remove or relocate equipment and associated disconnect.

4. During the construction and remodeling, portions of the Project shall remain in service. Construction equipment, material tools, extension cords, etc., shall be arranged so as to present minimum hazard or interruption to the occupants of the building. None of the construction work shall interfere with the proper operation of the existing facility or be so conducted as to cause harm or danger to persons on the premises. All fire exits, stairs or corridors required for proper access, circulation or exit shall remain clear of equipment, materials or debris. The General Contractor shall maintain barricades separating work area from occupied areas.
5. Certain work during the demolition and construction phases of construction may require temporary evacuation of the occupants. Coordinate and schedule all proposed evacuation with the Project Administrator at least seventy-two (72) hours in advance in writing.
6. Any salvageable equipment as determined by the Owner, shall be delivered to the Owner, and placed in storage at the location of his choice. All other debris shall be removed from the site immediately.
7. Equipment, piping or other potential hazards to the occupants of the building shall not be left overnight outside of the designated working or construction area.
8. Make every effort to minimize damage to the existing building and the owner's property. Repair, patch or replace as required any damage which might occur as a result of work at the site. Care shall be taken to minimize interference with the Owner's activities during construction and to keep construction disrupted areas to a minimum. Coordinate with the Owner and other trades in scheduling and performance of the work.
9. Include in the contract price all rerouting of existing pipe, duct, etc., and the reconnecting of the existing equipment and plumbing fixtures as necessitated by field conditions to allow the installation of the new systems regardless of whether or not such rerouting, reconnecting or relocating is shown on the drawings. Furnish all temporary pipe, duct, controls, etc., as required to maintain heating, cooling, ventilation and plumbing services for the existing areas.
10. All existing plumbing fixtures, pipe, duct, materials, equipment, controls and appurtenances not included in the remodel or alteration areas are to remain in place.
11. Pipe, duct, equipment and controls that are disconnected to perform remodeling work, shall be reconnected in such a manner as to leave systems in proper operating condition.
12. No portion of the fire protection systems shall be turned off, modified or changed in any way without the express knowledge and written permission of the Owner's representative in order to protect systems that shall remain in service.
13. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and operating system in cooperation with other trades with a minimum of disruption or downtime.
14. Refer to Architectural "Demolition and/or Alteration" plans for actual location of walls, ceiling, etc., being removed and/or remodeled.

1.16 EQUIPMENT, MATERIALS, BID BASIS

- A. Manufacturers' names, model numbers, etc. as specified on the Drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.
- B. Unless "approved equal" is specifically stated, bids shall be based on equipment named in the Specifications or on the Drawings as "base" products.
- C. "Equal product" and "approved equal" items listed shall conform to specified base items and shall be substantially equal in size, weight, construction quality and capacities.

The alternate equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question.

- D. The Contractor shall coordinate the installation of all fire protection equipment proposed for use in this project with all building trades (architectural, structural and electrical). Coordination shall be accomplished prior to, and shall be reflected in, the submittal of shop drawings for approval. Any modifications or revisions required by other trades as a result of the use of equipment other than the basis of design shall be made at no additional cost.

1.17 PRECONSTRUCTION CONFERENCE

- A. The Contractor shall schedule a meeting including the sprinkler sub-contractor, Owner, Architect and Engineer prior to the installation of any fire protection pipe hangers.

1.18 TRANSPORTATION, DELIVERY, STORAGE AND PROTECTION

- A. The Contractor shall provide and pay for all transportation, delivery, and storage required for all equipment and materials. Upon receipt of all equipment and materials, they shall be properly stored in their original shipping container to protect them from vandalism, theft, the elements, and other harm or damage. Any equipment or materials received in a damaged condition, or damaged after receipt, shall not be installed. Only new undamaged equipment in first-class operating condition shall be installed.
- B. All equipment and piping shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction.
- C. The Contractor shall closely coordinate the ordering and delivery of all mechanical equipment with other trades to assure that equipment will be delivered in time to be installed in the building without requiring special or temporary access or building modifications. Certain equipment may have to be installed prior to the erection of the building walls or roofs.

1.19 GUARANTEE

- A. All fire protection work described in the Contract Documents shall be guaranteed for a period of one (1) year from the date of final acceptance. This guaranty shall apply to all equipment, materials and workmanship. During the guaranty period, all defects shall be corrected in an acceptable manner, consistent with the quality of materials and workmanship of original construction, at no expense to the Owner.

1.20 SPARE EQUIPMENT

- A. The Contractor shall furnish and install a cabinet located in the fire service entry room with the quantity of each type of sprinklers and wrenches as required by NFPA 13:
 - 1. Facilities with less than 300 sprinklers – 6 minimum
 - 2. Facilities with 300 to 1000 sprinklers – 12 minimum
 - 3. Facilities with over 1000 sprinklers – 24 minimum

1.21 AS-BUILT DRAWINGS

- A. The Contractor shall maintain a record set of drawings indicating all changes in the work from that shown in the Contract Documents. Prior to final acceptance by the Owner, the Contractor shall assemble the complete set of as-built drawings that accurately reflects all changes to indicate actual final construction. All concealed piping shall be dimensionally located from at least two (2) column lines or major building structure elements. Drawings shall be a minimum of 1/8" scale.
- B. The original set of "as-built" drawings shall be scanned and transmitted to the Architect in both full size bond and PDF format.
- C. As Build Drawings: 2 sets are for the Owner's use and one set is for the Architect/Engineer's records). Delivery of these as-built prints and reproducible is a condition of final acceptance. Provide record drawings on one set each, PDF Format and AutoCad 2015 files on disk (CD Rom).
1. Number of Copies: Submit one set of marked up record prints.
 2. Number of Copies: Submit copies of record Drawings:
 - a. Initial Submittal:
 - 1) Submit PDF electronic files of scanned record prints and one of file prints.
 - 2) Submit record digital data files and one sets of plots.
 - 3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit PDF electronic files of scanned record prints and three sets of prints.
 - 2) Submit record digital data files and three sets of record digital data file plots.
 - 3) Plot each drawing file, whether or not changes and additional information were recorded.
- D. As-Built drawings should indicate the following information as a minimum:
1. Indicate all addendum changes to documents
 2. Remove Engineer's seal, name, address and logo from drawings.
 3. Mark documents AS-BUILT DRAWINGS.
 4. Clearly indicate: DOCUMENT PRODUCED BY.
 5. Indicate all changes to construction during construction. Indicate actual routing of all piping, ductwork, etc. that were deviated from construction drawings.
 6. Indicate exact location of all underground plumbing and flow line elevations.
 7. Indicate exact location of all underground mechanical piping and elevations.
 8. Indicate exact location of all underground electrical raceways and elevations.
 9. Correct schedule to reflect (actual) equipment furnished and manufacturer.
 10. During the execution of work, maintain a complete set of drawings and specifications upon which all locations of equipment, ductwork, piping, devices, and all deviations and changes from the construction documents in the work shall be recorded.
 11. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and mechanical valves.
 12. Exact location of all electrical equipment in and outside of the building.
 13. Fire Protection System documents revised to indicate exact location of all sprinkler heads and zone valves.
 14. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
 15. Cloud all changes.

1.22 START-UP-SERVICE

- A. The service of a factory-trained representative shall be provided on the jobsite for a minimum of one (1) day to provide the manufacturer's certification and start-up of all major equipment and systems including booster pumps, water heaters, sewage ejectors, lift stations, fuel oil systems, etc. A formal report is to be issued indicating any revisions required for certification of the assembly by the manufacturer. Instruction and training of the operator's personnel shall be provided following certification of the assembly.

1.23 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Prior to final acceptance by the Owner, the Contractor shall provide three (3) copies of an Operations and Maintenance Manual, Bound, indexed, and titled in three-ring, loose-leaf binders. These manuals shall each contain the following:
 - 1. Clear and concise instructions for operation, maintenance, adjustment, lubrication, wiring diagrams and trouble-shooting data for all mechanical equipment. This information shall be prepared by the manufacturer for particular size and model of equipment furnished.
 - 2. Parts list of all parts for equipment, with catalog numbers and other data necessary for ordering of replacement parts.
 - 3. Provide a competent manufacturer's service engineer for a minimum of two (2) days to instruct the operating personnel including the interpretation of all equipment diagrams. A diary of the training sessions shall be made by the instructing manufacturer's service engineer and witnessed by the Owner's representative and shall be included in the as-built submittal.
 - 4. Copies of all approved equipment shop drawings, sprinkler layout drawings, hydraulic calculations and as-built plans shall be submitted with the Operation and Maintenance manual.
 - 5. Index shall include type of equipment, manufacturer, and local representative with address and phone number.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. All sprinkler system equipment is to be UL Listed or FM Approved.

2.2 ACCESS PANELS

- A. Group valves together above suspended ceilings, walls, furred spaces to minimize the number of access panels, but with all valves freely accessible for maintenance. Locate all valves within 1'-0" of access point.
- B. Furnish access panels of proper size to service concealed valves and cleanouts. Panels shall be of the proper type for material in which they occur and are to be furnished by the Contractor, but installed by the particular trade for the material within which the access panel is installed.
- C. Panels shall have flush doors with No.16 USCG steel door and trim No. 16 USCG steel frame, metal wings for keying into construction, concealed hinges, and screwdriver operated stainless steel cam lock. Panels shall be shop coated with one coat of zinc

chromate primer. Valves above removable ceilings shall have tile clips by the Contractor for identification.

- D. Access panels are not allowed in gypsum ceilings in public spaces.

2.3 FLOOR, WALL & CEILING PLATES

- A. Furnish and install heavy gauge chromium plated steel wall and ceiling plates on all exposed pipes in finished areas where they pass through walls, ceilings, etc. Plates shall be of type that will remain permanently in position and where pipes are insulated they shall be of size necessary to cover insulated pipe.

2.4 GALVANIC PROTECTION

- A. Insulate joints between dissimilar metals with suitable isolation gasket and bolts with fiber ferrules and washers and/or suitable armored insulation fittings by Clearflow, Crane, Capital, or Epco, so there will be no contact between the metals or with insulating bushings

2.5 INSULATION

- A. The following shall be insulated:
1. All fire suppression water piping above grade (un-condition space).
 2. Acceptable manufacturers:
 - a. Manville Corporation.
 - b. Certain-Teed.
 - c. Owens Corning Fiberglass.
 - d. Knauf Insulation.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Mineral-Fiber, Glass fibers bonded with a thermosetting resin complying with the following:
1. Preformed Pipe Insulation: Comply with ASTM C 547, Type I, with factory-applied, all-purpose, vapor-retardant jacket.
 2. Blanket Insulation: Comply with ASTM C553, Type II, without facing.
 3. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades
 - a. Class I, Grade A for bonding glass cloth and tape to un-faced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to un-faced glass-fiber insulation.
 - b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
 - c. Class 2, Grade A, and comply with MIL-A-3316C. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 4. Vapor-Retarder Mastics: Fire and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C 19565C, Type II. For indoor applications, use mastics that have a VOC content of <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

5. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
 6. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
 7. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
- F. Cellular-Glass Insulation: Inorganic, foamed or cellulated glass, annealed, rigid, hermetically sealed cells, incombustible.
1. Preformed Pipe Insulation, without Jacket: Comply with ASTM C 552, Type II, Class I.
 2. Preformed Pipe Insulation, with Jacket: Comply with ASTM C 552, Type II, Class 2.
- G. Field-Applied Jackets:
1. General: ASTM C 921, Type I, unless otherwise indicated.
 2. Foil and Paper Jacket: Not acceptable.
 3. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.
 - a. Adhesive: As recommended by insulation material manufacturer. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. PVC Jacket Color: White.
 - c. PVC Jacket Color: Color-code piping jacket as determined by existing conditions.
 - d. Not to be used for outdoors.
 4. Heavy PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 30-mil (0.75 mm) thick, high-impact, ultraviolet-resistant PVC.
 - a. Shapes: 45 and 90-degree, short and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
 - b. Adhesive: As recommended by insulation material manufacturer. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - c. Not to be used for outdoors.
 5. Aluminum Jacket: Aluminum roll stock, ready for shop or field cutting and forming to indicated sizes. Comply with ASTM B 209 (ASTM B 209M), 3003 alloy, H-14 temper.
 - a. Finish and Thickness: Smooth finish, 0.010 (0.25 mm) inch thick.
 - b. Moisture Barrier: 1-mil thick, heat-bonded polyethylene and kraft paper.
 - c. Elbows: preformed 45 and 90-degree, short and long-radius elbows; same material, finish, and thickness as jacket.
 6. Joint Sealants: For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- H. Accessories and Attachments
1. Bands: stainless steel ASTM A666, Type 304, 3/4 inch (20 mm) wide; 0.02 inch (0.050 mm) thick.
- I. Vapor Retardants
1. Mastics: Use materials as recommended by the insulation material manufacturer that are compatible with insulation materials, jackets, and substrates. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II. For indoor applications,

use mastics that have a VOC content of <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)

2.6 HEAT CABLE FOR FREEZE PROTECTION OF PIPING

- A. Provide electric heat tracing on all domestic water piping and sanitary traps exposed to areas subject to freezing.
- B. Provide a complete UL Listed, CSA Certified, or FM Approved system of heating cables, components, and controls to prevent pipes from freezing.
- C. Electric heat cable shall be installed linearly along the bottom of the pipe and allowance shall be made for all fittings, valves, pipe supports, etc. Cable shall be installed prior to insulation of the piping system.
- D. Electric cable shall be capable of maintaining a minimum water temperature of 40 degrees F at an ambient air temperature of 0 degrees F.
- E. The electric cable shall be the self-regulating type that responds to varying localized temperature conditions by varying the heat output along its length. This shall be accomplished by a self-regulating core, which varies its resistance continuously with changes in temperature. A constant wattage heater is unacceptable.
- F. Provide a thermostat control, which de-energizes the heating cable when the ambient air temperature is above 40 degrees F (adjustable). The heat cable shall be entirely self-regulating while energized.
- G. Provide all power connection hardware, splices, end seals, etc., to accomplish installation. All hardware shall be by the same manufacturer as the cable.
- H. Electric heating cable and accessories shall be UL Listed. Electric heating cable shall conform to all requirements of Division 26 - Electrical Requirements.
- I. Electric heating cable shall be Raychem XL-Trace or approved equal, 5 watts per foot.
- J. All piping shall be insulated with 1" thick fiberglass insulation.
- K. Heating-cable circuit shall be protected by a ground-fault device for equipment protection. This requirement is in accordance with section 427-22 of the NEC-2002.
- L. All heating cable components shall be UL Listed, CSA Certified, or FM Approved for use as part of the system to provide pipe freeze protection. Component enclosures shall be rated NEMA 4X to prevent water ingress and corrosion. Installation shall not require the installing contractor to cut into the heating-cable core to expose the bus wires. Connection systems that require the installing contractor to strip the bus wires or that use crimps or terminal blocks, shall not be acceptable.

2.7 PIPING SYSTEMS IDENTIFICATION

- A. A marker showing the service and an arrow indicating the direction of flow shall be applied on the following equipment installed under this section of the Specifications:
 - 1. All above ground fire protection standpipe and sprinkler piping
 - 2. All above ground sprinkler drainage piping

- B. A marker showing the service and an arrow indicating the direction of flow shall be applied on all of the following piping systems applicable to the project installed under this section of the Specifications:
 - 1. Sprinkler piping
 - 2. Dry Sprinkler piping
 - 3. Drain piping
 - 4. Pre-Action piping
 - 5. Clean Agent piping
 - 6. FDC piping
- C. Piping identification shall be applied on all piping systems in areas of exposed construction and in areas with accessible or lay-in ceilings. The piping shall be labeled at each wall and floor penetration (both sides), and at connections to equipment. In addition, straight runs of piping shall be labeled at intervals not greater than 25 feet.
- D. The letter size and background color shall conform to the Identification of Pipe System ANSI A-13-1. The vinyl plastic markers shall be as manufactured by Seton Name-Plate Company, W. H. Brady Company, or Westline products.
- E. Each valve in the Plumbing and Fire Protection systems is to be provided with an individually numbered valve tag (stamped numbered tags). Provide Identification Tags on all Emergency fixture and unit or Shut off valves.
- F. Valve tags are to be brass or plastic laminate, 1-1/2" minimum diameter with brass chain and hook for securing to the valve.
- G. Valve tags will include a "P" or "FP" lettering designation to indicate the appropriate system. Numbering shall be consecutive for each service of either the Plumbing or Fire Protection systems. All valves on pumps shall be similar to the valve tags specified above, except they shall be 2-1/2" in diameter, black with white number 2" high for attaching to valve stem by means of brass hook or small solid link brass chain. Tags shall be similar to Seton 2961-25.
- H. A printed list or schematic drawing shall be compiled for each system indicating the location and detailed description of the system or equipment served.
- I. One copy of each list shall be framed and mounted at the location designated by the Building Engineer. An additional copy of each list is to be included in the Operations and Maintenance Manual.

2.8 EQUIPMENT LABELING

- A. All equipment shall be labeled. This shall include all pumps, water heaters, storage tanks, and other similar equipment.
- B. Equipment labeling shall be one of the following, unless noted or specified otherwise.
 - 1. Permanently attached plastic laminate signs with 1" high lettering.
 - 2. Stencil painted identification, 2" high letters, with standard fiberboard stencils and standard black (or other appropriate color) exterior stencil enamel.

2.9 PAINTING

- A. All piping exposed to public sight such as standpipe and drain piping in stairwells, or exposed to exterior, shall be primed and painted with two coats of an enamel-based paint. The color shall be as directed by the Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas for conditions under which work is to be performed. Report in writing to the Architect all conditions that will adversely affect satisfactory execution of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. The Drawings are diagrammatic and the final arrangement of the work shall suit field conditions, the characteristics of the materials used and coordination with all other disciplines and the building components and finishes. Verify all dimensions in the field. Access and clearances must be provided and maintained for the proper operation, maintenance service and repair of the work.
- B. No sprinklers are to be installed prior to the building being completely sealed in from external moisture and conditions.
- C. All standpipe, sprinkler and drain piping exposed to sight in stairwells is to be painted with two coats of an epoxy based paint, color to be selected by the Architect.
- D. All equipment and materials shall be installed according to manufacturer's recommendations and shall meet the requirements of NFPA and the Owner's Insurance Underwriter.
- E. All sprinklers in spaces visible to public view shall be located symmetrically in relation to ceiling design elements, lighting fixtures, speakers, diffusers, etc. All ceiling components are to be indicated on the submittal drawings as noted previously to ensure coordination with all ceiling elements and devices. Piping to sprinklers in these areas is to be provided with arm-overs to allow for exact placement of sprinklers.
- F. Sprinklers shall be installed at the centerpoint of all 2' x 2' lay-in ceiling tiles, and at the centerpoint or 1' from the ends of 4' x 2' ceiling tiles.
- G. Where pipe is installed above suspended ceilings, it shall be located in the clear space above the suspended ceiling and the pendent sprinklers shall be located to clear the ceiling supporting grid system, the ceiling mounted fixtures, and air conditioning ducts and outlets.
- H. The Contractor shall install additional pendent sprinkler heads under all ductwork or other obstructions which are over 48" wide in accordance with NFPA-13 in areas of exposed construction.
- I. Provide a pressure gauge at the top level of all standpipes.
- J. Provide tracer wire on all pipe installed below slab outside building; locate leads in accessible location for future use in trouble shooting.
- K. Horizontal branch piping shall be pitched to mains per NFPA. Locate all sprinkler mains a minimum of 24" above any finished ceiling.

- L. Hydraulic information placards with permanent markings indicating the hydraulic design criteria for each separate system should be installed on each riser.
- M. Provide basket type metal guards over sprinkler heads to protect them from damage in mechanical rooms, main electrical and telephone equipment, storage rooms and all unfinished areas where the head is less than 7 feet-6 inches above finished floor.
- N. All threads for fire department connections shall match the local Fire Department connecting threads and requirements.
- O. Building shall be 100 percent fully sprinklered.
- P. Sprinkle Zones shall comply with NFPA 13, for areas limitations, provide a minimum of TWO sprinkler systems with separate alarm check valve assemblies.
- Q. Fire Alarm System: Coordinate with Division 26 to provide connections to all supervised devices and flow switches as well as any other items requiring connection to the fire alarm system, provide all wiring and equipment.
- R. Stages: At each side of each stage provide a complete Authorities having Jurisdiction and NFPA compliant class III standpipe system with 1.5" and 2.5" fire department hose connections. Mount hose connections in Potter-Romer lockable, clear glass front cabinet. Coordinate exact location of standpipes with stage equipment.
- S. Maintain a minimum 3' horizontal separation between any recessed, pendant sprinkler head and any wall, partition, furr-down, or other vertical surface.
- T. Provide protection in all gymnasium areas.
- U. If a deluge system is required, the system shall be installed so that the deluge system will not engage during a fire drill and/or in fire test mode.

3.3 PREPARATION

- A. Arrangements shall be made to have the openings, inserts, sleeves, blockouts, and such other incidentals set in place ahead of the construction work, where practical, to eliminate the need of cutting and patching. If coring becomes necessary for installation of the work, it shall be done under this section. All holes shall be neatly patched and finished to match the adjoining work in a manner approved by the Architect. All coring shall be performed in a manner not to weaken the structural parts and the manner and method shall be submitted to the Structural Engineer for approval.

3.4 SLEEVES AND ESCUTCHEONS

- A. The Contractor shall furnish and set pipe sleeves and inserts for all work under this section and shall be responsible for their proper and permanent location. In the event that failure to do so requires cutting and patching, the remedial work shall be the responsibility of the Contractor.
- B. All pipes passing through floors, walls or partitions shall be provided with sleeves having an internal diameter 1-1/2" (3/4" annular space) larger than the outside diameter of the pipe or insulation on covered lines, except as otherwise specified herein.

- C. Sleeves for all pipes through walls, beams and partitions shall finish flush with the finish line of the walls, beams and partitions.
- D. Sleeves for all piping shall extend 1/2" above finish floor, (except where under partitions, the sleeves shall be flush with the bottom of the partition) and after the installation of pipe shall be packed and made watertight with fire stopping sealant to maintain separations and fire ratings.
- E. Where pipes pass under footings and through exterior walls, sleeves shall be of galvanized steel pipe and shall be not less than 4" larger than the pipe being sleeved. Sleeves shall be made watertight where passing through waterproofed surfaces, exterior wall, and floor slabs on grade. Waterproofing shall be done by means of a steel slip on welding flange, continuously welded at the center of the sleeve and shall be painted with one coat of bitumastic paint inside and outside. The space between sleeve and pipe shall be packed with oakum to within 2" of each face of the wall; (to within 2" of the top of sleeve at floors). The remaining space shall be packed and made watertight with a waterproof mastic. Mechanical expansion type rubber seals such as manufactured by Calpico Ind. and Thunderline Corporation are acceptable as alternate method of water proofing piping penetrations.
- F. Sleeves through floors or interior masonry walls shall be of galvanized steel pipe or wrought iron pipe size except where located in concealed pipe spaces where they may be of 22 gauge galvanized sheet steel if fire rating is maintained.
- G. Sleeves through interior masonry partitions shall be of 22-gauge galvanized sheet steel.
- H. Sleeves for piping to receive insulation shall be large enough to allow continuous insulation through sleeves.
- I. Spacing between or location of pipe sleeves in floor slabs, structural beams or structural walls shall be subject to the Structural Engineer's approval.
- J. Where pipes pass under load bearing footings they shall pass through a coated steel pipe sleeve as described above and extend past a 45 degree line out from the bottom of the load bearing structure. Concrete shall be used as backfill in the portions of trench within the 45 degree pressure line.
- K. Escutcheons shall be provided around all exposed pipe passing through walls, partitions, ceilings and floors in finished spaces. Escutcheons shall be of sufficient outside diameter to cover the sleeve opening and shall fit snugly around the insulated or bare pipe and to the wall, partition, floor or ceiling.
- L. Supply piping (domestic and /or fire water) shall not pass under footings or through grade beams unless noted otherwise.

3.5 CLEANING

- A. The entire underground and above ground sprinkler system shall be cleaned and flushed in accordance with NFPA 13, 24, 25.
- B. Capped connections shall be located at the ends of sprinkler main piping to facilitate flushing and cleaning of systems.
- C. Remove all trash and debris from site and dispose of legally.

- D. All equipment shall be thoroughly cleaned and left in a satisfactory condition for proper operation at project completion. All equipment shall be partially or fully re-painted as required to provide an appearance of new equipment.

3.6 DEMONSTRATION

- A. To obtain complete and final acceptance of the fire protection system, all inspections, approvals, examination and acceptance tests required by the Authority Having Jurisdiction shall be arranged and paid for under this Section.
- B. Sprinkler Contractor shall provide necessary equipment and test materials for testing of the installation.
- C. Testing of the completed sprinkler system for acceptance shall be witnessed by an Owner's representative. Testing should be coordinated with the Authority Having Jurisdiction.
- D. Provide the Owner with as-built drawings and equipment data at completion of construction. As-built drawings shall include an overall graphic drawing of areas covered by each sprinkler zone. This is to include auxiliary drains and inspector test locations. This is to be updated and displayed at riser room. New graphic to include existing systems.
- E. Complete set of as-built drawings (Per NFPA) to be provided to document box at FACP. Drawings to include hydraulic calculation plate information. As-built to be provided in cad and PDF formats to district.
- F. Zone calculation plates to be permeant type (metal or laminate) with printed information attached to each riser.
- G. Provide completed Underground and Aboveground Contractor's material and Test Certificates per NFPA 13 at time of acceptance of test.
- H. Inspections test to be piped into nearest drain to support flow.

3.7 PAINTING

- A. Where exposed in any MEP equipment room, all fire protection piping shall be painted red.
- B. Paint prior to the installation of sprinkler heads; replace any sprinkler heads that come in contact with paint with new heads.

3.8 WORKMANSHIP

- A. All work shall be coordinated with the work to be performed or installed under other sections of these Specifications.
- B. All work shall be executed in a workmanlike manner by workmen skilled in this type of work and shall present a neat appearance when completed.
- C. Offsets shall be provided as required to avoid interference and conflicts with other work, to maximize headroom, or to improve the appearance of pipe runs. All pipe supports, structural members, hangers and other apparatus necessary to support firmly

and substantially the various components of the systems shall be provided under this section.

- D. Nameplates, catalog numbers and rating identifications shall be securely attached to equipment with screws or rivets. Adhesives or cements will not be permitted.
- E. The subcontractor shall be responsible for the protection of the work from injury and shall protect all apparatus with suitable enclosures.

3.9 ERECTION AND INSTALLATION

- A. Installation and workmanship requirements are specified hereinafter.
- B. This subcontractor shall be responsible for the furnishing and installing of all support steel, hangers, rods, clamps, etc., to provide adequate support of all Fire Protection equipment specified herein. All support assemblies shall be UL Listed or FM Approved.

3.10 TESTS

- A. Tests of all fire protection systems and equipment, underground and inside piping including alarm and detection devices shall be scheduled with one (1) week prior notification to a local representative of the Underwriter and the Architect. All tests and test procedures shall be in accordance with the applicable NFPA standards. After completion of all tests, the "Contractor's Materials and Test Certificate" shall be submitted to the Architect.
- B. The Contractor shall supply all materials, labor, utilities and power required for testing. Preliminary tests shall be performed to prove work is satisfactory prior to requesting a test inspection. Sectional tests shall be made before insulation or concealing any piping.
- C. Repair all defects disclosed by tests or, if required by the Architect, replace defective work with new systems and materials at no additional cost to the Owner. Repairs to piping systems shall be made with new material. No caulking of screwed joints, cracks or holes will be accepted. Make tests in stages to facilitate work of others.
- D. The Contractor shall be responsible for the repair and/or replacement cost installed and finishes damaged by leaks, tests and/or repair and replacement of his work at no additional expense to the Owner.
- E. Prior to final acceptance by the Owner, submit the "Contractor's Material and Test Certificates" indicating system compliance with all applicable sections of NFPA.

3.11 INSTRUCTION OF OWNER'S PERSONNEL

- A. Prior to final inspection, conduct an on-site training program to instruct the Owner's operating personnel in the operation and maintenance of the mechanical systems.
 - 1. Provide the training during the Owner's regular working day.
 - 2. The Instructors shall each be experienced in their phase of operation and maintenance of building mechanical systems and with the project.

- B. Time to be allocated for instructions.
 - 1. Minimum of 8 hours dedicated instructor time.
 - 2. 4 hours on each of 2 days.
- C. Before proceeding with the on-site training program, submit the program syllabus; proposed time and dates; and other pertinent information for review and approval.
 - 1. One copy to the Owner.
 - 2. One copy to the Architect/Engineer.
- D. The Owner will provide a list of personnel to receive instructions, and will coordinate their attendance at the agreed upon times.
- E. Use the operation and maintenance manuals as the basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut down of each item of equipment.
- G. Demonstrate equipment functions (both individually and as part of the total integrated system).
- H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.
- I. Submit a report within one week after completion of the training program that instructions have been satisfactorily completed. Give time and date of each demonstration and hours devoted to the demonstration, with a list of people present.
- J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.
- K. Provide a copy of the report and the certificate in an appropriately tabbed section of each "Operation and Maintenance Manual":

3.12 OPERATION AND MAINTENANCE MANUALS

- A. Form of Manuals:
 - 1. Prepare data in form of an instructional manual for use by Owner's personnel.
 - 2. Format:
 - a. Size: 8-1/2" x 11".
 - b. Text: Manufacturer's printed data or neatly typewritten
 - 3. Drawings:
 - a. Provide reinforced punched binder tab and bind in text.
 - b. Fold larger drawings to size of text pages.
 - 4. Provide fly leaf indexed tabs for each separate product or each piece of operating equipment
 - 5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
 - a. Title of Project
 - b. Identity of separate structures as applicable.
 - c. Identity of general subject matter covered in the manual
 - 6. Binder as specified.
- B. Content of Manual:
 - 1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
 - a. Contractor, name of responsible principal, address and telephone number.
 - b. A list of each product required to be included, indexed to content of the volume.
 - c. List with each product, name, address and telephone number of:

- 1) Subcontractor or installer
 - 2) Maintenance contractor as appropriate.
 - 3) Identify area of responsibility of each
 - 4) Local source of supply for parts and replacement
 - d. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
 2. Product Data:
 - a. Include those sheets pertinent to the specific product.
 - b. Annotate each sheet to:
 - 1) Identify specific product or part installed.
 - 2) Identify data applicable to installation.
 - 3) Delete references to inapplicable information. (All options not supplied with equipment shall be marked out indicated in some manner).
 3. Drawings:
 - a. Supplement product data with drawings as necessary to illustrate:
 - 1) Relations of component parts of equipment and systems.
 - 2) Control and flow diagrams.
 - b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
 - c. Do not use Project Record Documents as maintenance drawings.
 4. Written text, as required to supplement product data for the particular installation:
 - a. Organize in consistent format under separate headings for different procedures.
 - b. Provide logical sequence of instructions for each procedure.
 5. Copy of each warranty, bond and service contract issued.
 - a. Provide information sheet for Owner's personnel, giving:
 - 1) Proper procedures in event of failure.
 - 2) Instances that might affect validity of warranties or bonds
 6. Shop drawings, coordination drawings and product data as specified.
- C. Sections for Equipment and Systems
1. Content for each unit of equipment and system as appropriate:
 - a. Description of unit and component parts
 - 1) Function, normal operating characteristics, and limiting conditions.
 - 2) Performance curves, engineering data and tests.
 - 3) Complete nomenclature and commercial number of replaceable parts
 - b. Operating procedures:
 - 1) Start up, break-in, routine and normal operating instructions.
 - 2) Regulation, control, stopping, shut down and emergency instructions.
 - 3) Summer and winter operating instructions.
 - 4) Special operating instructions
 - c. Maintenance procedures:
 - 1) Routine operations
 - 2) Guide to trouble-shooting.
 - 3) Disassembly, repair and reassembly.
 - 4) Alignment, adjusting and checking.
 - 5) Routine service based on operating hours.
 - d. Servicing and lubrication schedule. List of lubricants required.
 - e. Manufacturer's printed operating and maintenance instructions.
 - f. Description of sequence of operation by control manufacturer
 - g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
 - 1) Predicted life of part subject to wear.
 - 2) Items recommended to be stocked as spare parts.
 - h. As installed control diagrams by controls manufacturer.
 - i. Complete equipment internal wiring diagrams.
 - j. Each Contractor's coordination drawings.

- k. As installed color coded piping diagrams.
 - l. Charts of valve tag number, with location and function of each valve.
 - m. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
 - n. Other data as required under pertinent sections of the specifications.
2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
 3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications
 4. Provide complete information for products specified in Division 23.
 5. Provide certificates of compliance as specified in each related section.
 6. Provide start up reports as specified in each related section.
 7. Provide signed receipts for spare parts and material.
 8. Provide training report and certificates.
 9. Provide backflow preventer certified test reports.

END OF SECTION 21 05 00

SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE PROTECTION.
- C. SECTION 21 11 13 – FIRE SUPPRESSION SYSTEMS.
- D. SECTION 28 31 00 - FIRE DETECTION AND NOTIFICATION SYSTEMS.

1.2 DESCRIPTION

- A. This section describes the following:
 - 1. Hangers, supports and anchors for the fire protection equipment, tanks and piping systems.
 - 2. Supplementary steel for support or attachment of fire protection tanks, equipment and piping to general construction elements of the project.

1.3 REFERENCES

- A. General:
 - 1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
 - 2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
- B. Code of Federal Regulations 29 CFR 1910.7 Definitions and Requirements for a Nationally Recognized Testing Laboratory (NRTL).
- C. National Fire Protection Association (NFPA):
 - 1. NFPA-13 Installation of Sprinkler Systems.
 - 2. NFPA-14 Installation of Standpipe and Hose Systems.
- D. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA):
 - 1. Seismic Restraint Manual: Guidelines for Mechanical Systems - latest edition for the support of ductwork.
- E. UL Fire Resistance Directory, latest edition.

1.4 SUMMARY

- A. Provide a complete system of pipe hangers and supports for all plumbing and fire protection equipment and piping.
- B. Section Includes:
 - 1. Pipe, duct, and equipment hangers and supports.
 - 2. Anchors, equipment bases and supports.

3. Sleeves and seals.
4. Flashing, counter flashing and pipe stacks.
5. Firestopping.

1.5 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.6 SUBMITTALS

- A. Product Data:
1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- B. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- C. Manufacturer's Installation Instructions:
1. Hangers and Supports: Submit special procedures and assembly of components.
 2. Firestopping: Submit preparation and installation instructions.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- E. Submit calculations showing compliance with Division 01 Section "Lateral Force Procedures" for seismic bracing of ductwork and piping.

1.7 QUALITY ASSURANCE

- A. Comply with Division 21 Section "Common Results for Fire Suppression."
- B. Supports for Sprinkler Piping: Comply with NFPA 13.
- C. Supports for Standpipes: Comply with NFPA 14.
- D. Do not use black steel devices, components, fasteners, etc. within the Clean Room interstitial space or in any related air flow path. Steel items shall be plated, galvanized, painted, or coated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees Fahrenheit.

- B. Maintain this minimum temperature before, during, and for minimum three (3) days after installation of firestopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. Unistrut Corp.
 - 2. B-Line Systems.
 - 3. Grinnell.
 - 4. Superstrut,
 - 5. Anvil.
- B. Pipe Supports:
 - 1. Conform to MSS SP58.
 - 2. Hangers for Pipe sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel ring, UL listed, Grinnell Fig. 69 or equal. Use plastic coated hangers at all uninsulated copper piping.
 - 3. Hangers for Pipe sizes two (2) inches and Larger: Carbon steel, black or galvanized, adjustable, clevis, UL listed, Grinnell Fig. 260 or equal.
 - 4. Multiple or Trapeze Hangers: 12 gauge (2.67 mm) channel complete with nuts, pipe clamps, pipe straps, and drive-in end caps. Furnish cushion strip on all uninsulated copper piping and; cast iron roll and stand for hot pipe sizes 6 inches and over.
 - 5. Pipe Supported Tight to Wall, Floor, or Ceiling: Superstrut A1200, Unistrut P1000, or equal, 12 gauge channel complete with pipe clamps, nuts, bolts, and end caps. Furnish cushion strip on all uninsulated copper piping and adjustable steel yoke and cast iron roll for hot-pipe sizes 6 inches and over.
 - 6. Vertical Support: Steel riser clamp, UL listed, Grinnell Fig. 261, Superstrut C720, or equal.
 - 7. Floor Support for Pipe Sizes to 4 Inches (101.6 mm) and Cold Pipe Sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.
 - 8. Floor Support for Hot Pipe Sizes 6 Inches (152.4 mm) and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support
 - 9. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.
 - 10. CPVC Tube Support: CTS sized hangers or supports free of sharp edges.

2.2 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 ATTACHMENT TO STRUCTURE

- A. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
- B. Connection to Existing Concrete Structure: Concrete anchors conforming to Division 03 Section "Concrete Accessories".

- C. For Suspension from New Formed Concrete Structure: B-Line B3014, Grinnell Figure 282, Superstrut 452, or equal, adjustable concrete insert.
- D. For Support on New Concrete: Galvanized steel headed bolts.
- E. Welded Connection to Steel Beams: B-Line B3083, Grinnell, Superstrut, or equal, steel welded beam attachment.
- F. Clamp Connection to Steel Beams: B-Line, Grinnell, Superstrut, or equal, beam clamp with retaining clip style as required by load.

2.4 SUPORTS, BRACING, AND ACCESSORIES

- A. Miscellaneous Steel: Angles, channels, brackets, rods, clamps, etc., of new materials conforming to ASTM A36. Hot-dip galvanize all steel parts after fabrication where used outdoors or inside the penthouse.
- B. Fasteners: All bolts and nuts, except as otherwise specified, shall conform to ASTM Standard Specifications for Low Carbon Steel Externally and Internally Threaded Standard Fasteners, Designation A307. Bolts shall have heavy hexagon heads, and nuts shall be of the hexagon heavy series. All bolts, washers, nuts, anchor bolts, screws and other hardware used outdoors or inside the penthouse shall be galvanized, and all galvanized nuts shall have a free running fit. Provide bolts of ample size and strength for the purpose intended. All ferrous metal components below grade shall be stainless steel.
- C. Sheet Metal Screws: Plated, size 10 minimum.
- D. Pre-engineered duct and pipe bracing systems may be Mason Industries Seismic Sway Brace System or equal.

2.5 SLEEVES

- A. Sleeves for Pipes through Non-fire Rated Floors and Walls: 18 gage thick galvanized steel.
- B. Provide chrome plated escutcheon plates on pipes passing through walls, floors, and ceilings exposed to view. Provide stainless steel sheet metal for exterior walls.
- C. Sealant: Acrylic

2.6 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline Link-Seal, Inc., or approved equal.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.7 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Unistrut Corp., or approved equal.

- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.8 FIRESTOPPING

- A. Manufacturers:
 - 1. Dow Corning Corp. Model.
 - 2. 3M fire Protection Products Model.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam Firestopping Compounds: Multiple component foam compound.
 - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 - 7. Firestop Pillows: Formed mineral fiber pillows.
- C. Color: Dark gray Black As selected from manufacturer's full range of colors.
- D. Plastic Tube and Pipe: Ensure that the appropriate firestop assembly is used for plastic piping systems. Refer to manufacturer's system selector for more information.

2.9 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
 - 1. Mineral fiberboard.
 - 2. Mineral fiber matting.
 - 3. Sheet metal.
 - 4. Plywood or particle board.
 - 5. Alumina silicate fire board.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- D. General:
 - 1. Furnish UL listed products or products tested by independent testing laboratory.
 - 2. Select products with rating not less than rating of wall or floor being penetrated.
- E. Non-Rated Surfaces:
 - 1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.

2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing or damming materials to arrest liquid material leakage.
- D. Do not drill or cut structural members.
- E. Do not crush insulation with pipe clamp. Provide high density pipe insulation to accommodate pipe clamp or hanger.
- F. Do not attach beam clamp on to bottom of steel joist.

3.2 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe four (4) inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with MSS SP 58.
- B. Supports for Gas Piping:
 1. Horizontal supports for steel and copper gas piping, threaded or welded, are every six (6) feet for 1/2 inch, every eight (8) feet for 3/4 inch and one (1) inch, and every ten (10) feet for 1-1/4 inches or larger.
 2. Vertical supports for steel gas piping, threaded or welded, are every six (6) feet for 1/2 inch, eight (8) feet for 3/4 inch and one (1) inch, and every floor for 1-1/4 inch and larger.
- C. Place hangers within 12 inches of each horizontal elbow.
- D. Use hangers with 1-1/2 inch minimum vertical adjustment.

- E. Support horizontal cast iron pipe adjacent to each hub, with five (5) feet maximum spacing between hangers. Support hubless cast iron at every other joint unless over four (4) feet then support at each joint. Support copper every six (6) feet for 1-1/2 inch and smaller; every ten (10) feet for two (2) inches and larger.
- F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Provide clearance in hangers and from structure and other equipment for installation of insulation.
- L. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
- M. Support PEX tubing every 32 inches unless a continuous support such as Uponor PEX-a Pipe Support is used. Then:
 - 1. 1/2 - 3/4 inch pipe: 6 feet
 - 2. 1 - 3 inch pipe: 8 feet
- N. Install PEX tubing in accordance with the Uponor Plumbing Design Assistance Manual or the Uponor Professional Plumbing Installation Guide.

3.4 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors one (1) inch above finished floor level. Caulk sleeves.
- E. Where piping penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with firestopping insulation or caulk. Firestopping required at all penetrations of rated floor and walls.
- F. Install chrome plated steel escutcheons at finished surfaces.

3.5 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating. Refer to Architectural drawings for location of all rated walls and floors.

- D. Fire Rated Surface:
 - 1. Seal opening at floor and wall as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

- E. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Install type of sealant or caulk suitable for application.
 - 2. Install escutcheons where pipe, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - 3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.

END OF SECTION 21 05 29

SECTION 21 05 48.13 - VIBRATION CONTROLS FOR FIRE-SUPPRESSION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE PROTECTION.
- C. SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEM
- D. SECTION 21 11 13 – FIRE SUPRESSION SYSTEMS.
- E. SECTION 28 31 00 - FIRE DETECTION AND NOTIFICATION SYSTEMS

1.2 DEFINITIONS

- A. IBC: International Building Code.

1.3 PERFORMANCE REQUIREMENTS

- A. It is the intent of this specification to provide vibration isolation supports for all equipment, piping and ductwork as may be required to prevent transmission of vibration to the building structure. It will be the Contractor's responsibility to select and install vibration isolators which will enable the noise criteria standards to be met, to the extent that the noise can be controlled by the vibration isolators.
- B. All vibration isolation devices, including auxiliary steel bases and pouring forms, shall be designed and furnished by a single manufacturer or supplier.
- C. Unless otherwise noted or scheduled, spring type vibration isolators shall be used for all equipment driven by motors of 0.5 HP and larger. Deflections as tabulated are minimums and it shall be the responsibility of the isolation manufacturer to determine the amount of spring deflection required for each isolator to achieve optimum performance in order to prevent the transmission of objectionable vibrations and meet the noise criteria referenced herein.
- D. Unless otherwise noted, equipment driven by motors 0.25 HP and smaller shall be isolated by means of Type ND elastomeric mounts or Type HD elastomeric hangers properly sized for 0.35 inch deflection.
- E. All elastomeric isolators shall be of high quality synthetic rubber with anti-ozone and anti-oxidant additives.
- F. Design and treat vibration isolators for resistance to corrosion. Furnish phosphatized steel components with epoxy powder paint coating. Components exposed to the weather shall be epoxy powder paint coated or hot-dipped galvanized. Furnish zinc electroplated nuts, bolts and

washers. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer.

- G. Isolators for equipment installed outdoors shall be designed to provide adequate restraint due to normal wind conditions and to withstand wind loads of 30 lbs./sq.ft. Wind loading shall be applied to all exposed surface of the isolated equipment in order to identify worst case load.
- H. All spring isolators shall be completely stable in operation and shall be designed for not less than 50 percent reserve deflection beyond actual operating conditions. All spring isolators must be completely stable in operation and have a Kx/Ky ratio of at least 1:1.
- I. All isolation materials and flexible connectors shall be of the same manufacturer and shall be selected and certified using published or factory certified data. Any variance or non-compliance with these specification requirements shall be corrected by the contractor at no additional cost to the Owner. Manufacturer may purchase other manufactured products in order to meet this specification and shall guarantee outsourced product as a single point of responsibility. Outsourced products must be identified as such in the submittal for approval.
- J. The contractor and manufacturer of the isolation and equipment shall refer to the isolator schedule which lists isolator types and isolator deflections.
- K. Deflection table is based on maintaining rooms at the following maximum sound levels, in Noise Criteria (NC) as defined by ASHRAE and ANSI S1.8.
 - 1. Offices
 - a. Executive: 30
 - b. Conference rooms: 30
 - c. Private: 35
 - d. Open-plan areas: 35
 - e. Computer/business machine areas: 40
 - f. Public circulation: 40
 - 2. Schools
 - a. Lecture and classrooms: 30
 - b. Open-plan classrooms: 35
 - 3. Libraries: 25
 - 4. Theaters
 - a. Theater: 25
 - b. Stage house: 25
 - c. Trap room: 25
 - d. Orchestra pit: 25
 - e. Rehearsal rooms: 25
 - f. Teaching studios: 30
 - g. Practice rooms: 30
 - h. Ensemble rooms: 30
 - i. Shop: 45

1.4 ACTION SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.

- B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate assembly, materials, thickness, dimensional data, and layout as well as connection details.
- C. Product Data: Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating materials and dimensional data. All steel bases and concrete inertia bases shall be completely detailed. Include clearly outlined procedures for installing and adjusting the isolators.
- D. Design Data: Submit calculations indicating maximum room sound levels are not exceeded.
- E. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.
- F. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.
- G. Manufacturer's Field Reports: Indicate vibration isolation installation is complete and in accordance with instructions. Provide a copy of field report to Architect/Engineer.
- H. Shop Drawings:
 - 1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. All fire suppression systems vibration and sound control products shall conform to ASHRAE criteria for average noise criteria curves for all equipment at full load conditions.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATOR TYPES

- A. All vibration isolators described in this section shall be the product of a single manufacturer. Submittals and certification sheets shall be in accordance with Specification 1.3 of this section.
 - 1. Manufacturers:
 - a. Mason Industries
 - b. Kinetics Noise Control
 - c. Amber / Booth
 - d. Vibration Eliminator
- B. Type WSW: Two layers of 3/8-inch thick neoprene pad consisting of square waffle modules separated horizontally by a 16-gauge galvanized shim. Where the load bearing area of the

equipment is not the same size/shape as the load bearing area/shape of the pad, load distribution plates, minimum ¼" thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized. Pads shall be sized for approximate deflection of 0.12 inch to 0.16 inch.

- C. Type ND: Neoprene mountings shall have minimum static deflection of 0.35 inch. All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Bolt holes on the bottom and a tapped hole with a mounting bolt and washer shall be provided. Steel rails shall be used above the mountings under equipment such as small vent sets to compensate for the overhang. Where the load bearing area of the equipment or support structure is not the same size/shape as the load bearing area/shape of the pad, load distribution plates, minimum ¼" thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized.
- D. Type SLF: Spring isolators shall be free-standing and laterally stable without any housing and complete with a steel-washer-reinforced molded neoprene cup of 1/4-inch neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have minimum additional travel to solid equal to 50 percent of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height.
- E. Type SLR: Restrained spring mountings shall have an SLF mounting as described in Specification 2.1 C, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position under outdoor equipment, there must be an internal isolation pad in addition to the friction pad on bottom.
- F. Type HD: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch thick neoprene element. The neoprene element shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers.
- G. Type 30N: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch thick neoprene elements at the top and a steel spring as described in 2.1 C, seated in a steel-washer-reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30-degree arc from side to side before contacting the cup bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30-degree capability.
- H. Type PC30N: Hangers shall be as described in Specification 2.1 F, but they shall be precompressed and locked at the rated deflection by means of a resilient up stop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30-degree capability.

- I. Type WBI/WBD: Horizontal thrust restraints shall consist of a spring element in series with a neoprene molded cup, as described in paragraph 2.1 C, with the same deflection as specified for the mountings or hangers supporting the unit. The spring element shall be designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 1/4-inch movement at start and stop. The assembly shall be furnished with a rod and angle brackets for attachment to both the equipment and the ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrical on either side of the unit.
- J. Type SLR-MT: Restrained air spring mountings shall be manufactured with upper and lower steel sections connected by a replaceable flexible DuPont Kevlar reinforced neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of 3 Hz. Air springs shall be designed for a burst pressure that is a minimum of three times the published maximum operating pressure. Restrained air springs shall be within a rigid housing that includes vertical limit stops to prevent air spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch {12mm} shall be maintained around restraining bolts and between the housing and the air springs so as not to interfere with the air spring action. Limit stops shall be out of contact during normal operation. Air spring systems shall be connected to a supplementary air supply compressor (supplied with the air spring system) through a Mason Industries air spring control panel and equipped with three leveling valves to maintain level within plus or minus 0.125". Air spring mounts are to be located between the supporting steel and the roof or the grillage and dunnage as shown on the drawings when there is no provision for direct mounting. Submittals shall include natural frequency, load and damping tests performed by an independent lab or acoustician.

2.2 BASES

- A. Type WF: A welded integral structural steel fan and motor base with NEMA standard motor slide rails and holes drilled to receive the fan and motor slide rails. Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split-case pumps shall be large enough to support suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 14 inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height-saving brackets shall be employed in all mounting locations to maintain a 1-inch operating clearance under base.
- B. Type ICS: Vibration isolation manufacturer shall provide steel members welded to height-saving brackets to cradle equipment having legs or bases that do not require a complete supplementary base. Members shall have sufficient rigidity to prevent misalignment of equipment.
- C. Type RBMK. Vibration isolation manufacturer shall furnish structural steel concrete pouring forms for floating concrete bases. Wood formed bases, formed steel bases and sheet metal formed bases are not acceptable. Bases for split-case pumps shall be large enough to provide for suction and discharge elbows. Bases may be T or L shaped where space is a problem. Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 6 inches. The base depth need not exceed 12 inches unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of 1/2-inch bars welded in place on 6-inch centers running both ways in a layer 1-1/2

inches above the bottom. Forms shall be furnished with steel templates to hold the anchor bolt sleeves and anchor bolts while concrete is being poured. Recessed height-saving brackets shall be employed in all mounting locations to maintain a 1-inch operating clearance under base.

2.3 FLEXIBLE PIPE CONNECTIONS

- A. Type SFDEJ, SFEJ, SFDCR or SFU and Control Rods CR: Flanged and threaded rubber flexible joints shall be peroxide cured EPDM throughout with Kevlar tire cord reinforcement. Substitutions must have certifiable equal or superior characteristics. The raised face rubber flanges must encase solid steel rings to prevent pull out. Flexible cable wire is not acceptable. Sizes 1-1/2" through 14" shall have a ductile iron external ring between the two spheres. Sizes 16" through 24" may be single sphere. Sizes 3/4" through 2" may have one sphere, bolted threaded flange assemblies and cable retention. Minimum ratings through 14" shall be 250psi at 170°F and 215psi at 250°F, 16" through 24" 180psi at 170°F and 150psi at 250°F. Higher published rated connectors may be used where required. Safety factors shall be a minimum of 3/1. All flexible joints must be factory tested to 150% of maximum pressure for 12 minutes before shipment. The piping gap shall be equal to the length of the flexible joint under pressure. Control rods passing through 1/2" thick Neoprene washer bushings large enough to take the thrust at 1000psi of surface area may be used on unanchored piping where the manufacturer determines the condition exceeds the flexible joint rating without them. Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer.

2.4 MECHANICAL ANCHOR BOLTS

- A. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.5 ADHESIVE ANCHOR BOLTS

- A. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PIPING ISOLATION

- A. Horizontal Pipe Isolation: All pumped water, pumped condensate and refrigerant piping size 1-1/4 inch and larger within mechanical rooms and on pipe size 2 inch and larger outside mechanical rooms shall be isolated. Outside equipment rooms this piping shall be isolated for the greater of 50 feet or 100 pipe diameters from externally isolated equipment. For the first 3 support locations from externally isolated equipment provide Type 30N hangers or Type SLF floor mounts with the same deflection as equipment isolators. All other piping within the equipment rooms shall be isolated with the same specification isolators with a 1" inch minimum deflection. Install piping hangers at regular intervals according the pipe hanger schedule. Where floor supports are required, provide sufficient spring capacity to absorb expansion and contraction of piping, and yet to permit piping to function as a floating system. Size hangers for 200 percent rated load. Coordinate selection of piping supports with equipment supports to accommodate expansion and contraction without creating excessive stresses at equipment connections.
- B. Pipe Riser Isolation: All vertical pipe risers 1-1/4 inch and larger, where specifically shown and detailed on riser drawings shall be fully supported by Type SW SLF isolators with brackets. Refer to details on Drawings. Steel spring deflection shall be 3/4 inch minimum. In locations where added deflection is required due to pipe expansion/contraction, the spring deflection shall be a minimum of 4 times the anticipated deflection change. Springs shall be selected to keep the riser in tension. Wall sleeves for take-offs from riser shall be sized for insulation O.D. plus two times the anticipated movement to prevent binding. Provide Type SWS wall sleeves. In addition to submittal data requirements previously outlined, riser diagrams and calculations shall be submitted for approval. Calculations must show anticipated expansion and contraction at each support point, initial and final loads on the building structure, and spring deflection changes. Submittal data shall include certification that the piping system has been examined for excessive stresses and that none will exist in the design proposed.

3.3 INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 Cast-in-Place Concrete.
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Locate isolation hangers as near the overhead support structure as possible.
- D. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.
- E. Install isolated inertia base frames and steel bases on isolator units as indicated so that a minimum of one (1) inch clearance below base will result when supported equipment has been installed and loaded for operation.
- F. Install flexible pipe connectors to equipment supported by vibration isolation. Provide line size flexible connectors.

- G. Comply with manufacturer's instructions for the installation and load application of vibration isolation materials and products. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation or shipment.
- H. Install cables so they do not bend across edges of adjacent equipment or building structure.
- I. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- J. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- K. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- L. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.

4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 5. Test to 90 percent of rated proof load of device.
 6. Measure isolator restraint clearance.
 7. Measure isolator deflection.
 8. Verify snubber minimum clearances.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

END OF SECTION 21 05 48.13

SECTION 21 11 13 - FIRE SUPPRESSION SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE PROTECTION.
- C. SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEM
- D. SECTION 28 31 00 - FIRE DETECTION AND NOTIFICATION SYSTEMS.

1.2 GENERAL REQUIREMENTS

- A. General Conditions: Refer to the General Conditions, the Supplementary General Conditions and the Special Conditions, all provisions of which apply to work under this section as if written in full herein.
- B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all systems. All work shall be accomplished by workmen skilled in the various trades involved.
- C. Contractor shall include within his bid all materials and Work to provide standpipe and 100% sprinkler protection for all areas in new construction or for the entire smoke compartment affected by renovation work.
- D. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Architect shall be notified of the discrepancy.
- E. Interface all new flow and valve supervisory switches with building fire and smoke alarm systems.
- F. *Provide temporary fire protection during the construction phase of Project. Inform and obtain approval from the Owner and General Contractor for any interruptions of existing fire protection, domestic water or fire alarm systems. Adhere to ADM1131 Facilities Planned Utility Outages Policy for outage and shutdown requests.*
- G. All work performed under this specification shall be accomplished in accordance with the requirements and provisions of Section 23 00 00 - Mechanical General.

1.3 WORK INCLUDED

- A. Code compliance, research, design coordination, and installation of a complete and functional hydraulically calculated wet pipe sprinkler system that meets the approval, and is in accordance with the requirements of NFPA Fire Protection Standards listed in

1.4 (a), Underwriters Laboratory (UL), all local and state regulations, and these specifications.

- B. Alarm devices including alarm valves, flow switches/pressure switches, tamper switches and coordination with Fire Alarm and Detection Contractor.
- C. Shop drawings and calculations prepared and submitted in accordance with the requirement of all Authorities Having Jurisdiction.
- D. All permits and approvals of the fire protection system.

1.4 SYSTEMS

- A. Systems to be provided under the Fire Protection design section shall be as listed below. The connection point to the site utility service for the fire protection system shall be at 5'-0" from the exterior of the building unless specifically otherwise noted.
 - 1. Pipes, fittings, and specialties
 - 2. Standpipe systems
 - 3. Automatic Sprinkler Systems
 - 4. Combination Standpipe/Automatic Sprinkler Risers
 - 5. Automatic Dry Sprinkler Systems
 - 6. Pre-action Sprinkler Systems
 - 7. Fire Department Valve Cabinets
 - 8. ESFR Sprinkler Systems

1.5 GUARANTEE

- A. All fire protection work described in the Contract Documents shall be guaranteed for a period of one (1) year from the date of final acceptance. This guaranty shall apply to all equipment, materials and workmanship. During the guaranty period, all defects shall be corrected in an acceptable manner, consistent with the quality of materials and workmanship of original construction, at no expense to the Owner.

1.1 DESIGN STANDARDS

- A. Fire Protection systems shall be designed and installed in accordance with the requirements of the most current version of the following codes, standards and design guides:
 - 1. The International Fire Prevention Code
 - 2. The International Building Code
 - 3. National Fire Protection Association (NFPA) Standards:
 - a. NFPA 101 - Life Safety Code
 - b. NFPA 13 - Installation of Sprinkler Systems
 - c. NFPA 14 - Installation of Standpipe and Hose Systems
 - d. NFPA 25 - Inspection, Testing, and Maintenance of Water-based Fire Protection Systems
- B. Factory Mutual (FM) Approval Guide
- C. Underwriters Laboratories Inc. (UL)
- D. Owner's Insurance Underwriter Requirements

1.2 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.3 DESIGN CRITERIA

- A. Any design documents issued to the contractor are for information only. The Contractor shall be responsible for all code research and obtaining all required flow test data and hydraulically designing a fire protection system that meets all applicable requirements. The Contractor shall arrange for, and conduct a flow test and coordinate its validity with the Authorities Having Jurisdiction.
- B. Upon award of the Contract, a new flow test from the two (2) hydrants nearest the site service entry is to be performed by the Contractor to confirm the flow and pressure characteristics of the existing water service. The completed flow test data along with a utility service map of the area is to be forwarded to the Engineer for confirmation of the existing water service.
- C. Where pre-design of the sprinkler system is required for submission for the building permit: The Fire Protection documents were prepared to be in compliance with all applicable codes and flow test data provided. The Contractor shall review all documents provided and report any modifications required to these documents to the Design Engineer during the shop drawing preparation stage.
- D. All sprinkler heads in occupied areas are to be fast response type heads (155 degrees – 165 degrees Fahrenheit).
- E. All occupied, heated spaces will be protected by wet sprinkler systems.
- F. Inspector test valves will be protected by wet sprinkler systems.
- G. Automatic sprinkler systems shall be designed to the available domestic water pressure available and shall be hydraulically calculated for the following design standards:
 1. NFPA 13 Systems

Area/ Usage	Hazard Classification	Density GPM/Sq. Ft.	Remote Area	Maximum Head Spacing	Interior Hose Stream
Mechanical Rooms, Electrical Rooms, Elevator Equipment Rooms, Maintenance/ Storage Rooms, Kitchen/ Food Service Areas and Laundry	Ordinary Group 1	.15	1,500 sq. ft.	130 sq. ft.	250 gpm
Wet Pipe System:					

- H. The fire protection system design shall include a minimum of 10 psi safety factor to allow for future losses in the water service pressure characteristics. The fire protection systems shall not be designed to operate if the residual pressure of the existing water service falls to 20 psi or lower at design flow requirements.

- I. The maximum allowable system velocities shall not exceed 20 fps unless alternate criteria are required by the Owner's Insurance Underwriter.

- J. Coordination:
 1. The Fire Protection Contractor shall review the complete set of project documents and coordinate his work with all other trades involved.
 2. Sprinkler head locations shall be coordinated with the architectural reflected ceiling plans. Locations of sidewall heads shall be coordinated with architectural interior elevations.
 3. The fire protection piping and head layout shall function in such a manner so as not to interfere with lighting fixtures, air distribution devices, equipment, piping, and ductwork.

- K. Sprinkler Systems
 1. Any design documents issued to the Contractor are for information only. The Contractor shall be responsible for the actual layouts, general routing of piping and additional sprinkler heads to meet all requirements.

- L. All underground mains and appurtenances are to be installed according to NFPA 24.

- M. Combination Standpipe/Automatic Sprinkler Risers
 1. Combined standpipe/sprinkler risers or Class I standpipe risers with fire department valves shall be installed in each stairwell within the facility. Automatic sprinkler connections will be supplied from combined standpipe/sprinkler risers with a floor control valve assembly at the required locations. Additional standpipes with 2-1/2" fire department valves are to be provided at required locations throughout the facility per the requirements of NFPA 14.
 2. Standpipes will be designed to provide a minimum of 500 gpm. Fire mains supplying standpipes will be hydraulically designed and sized to provide a minimum of 500 gpm at the most remote standpipe and 250 gpm for each additional standpipe to a maximum of 1,000 gpm.
 3. A two-outlet roof manifold complete with fire department valves, caps and chains, automatic ball drip, and isolation valve in a heated space shall be provided at the roof area adjacent to the roof access point.
 4. The fire protection system shall provide 100 psi at the most remote fire department connection; 65 psi may be allowed as a deductive alternate where acceptable to the local authorities and all applicable Owner design criteria.
 5. Standpipes and/or sprinkler connections that are equipped with pressure regulating valves shall be provided with 3" drain risers.

- N. Fire Protection System Alarms
 1. The fire protection contractor shall coordinate location and function of all flow, air pressure, supervisory switches, and other dry contacts with the fire alarm contractor.
 2. All control valves in the fire protection system shall be provided with supervisory switches wired for annunciation at the main FACP.
 3. Automatic sprinkler system connections shall be provided with flow switches adjacent to the zone control valve wired for annunciation at the main FACP.
 4. Upright automatic sprinklers will be provided in all elevator shafts and elevator machine rooms. The service to each of these spaces shall be provided with an individual control valve with a supervisory switch and a flow switch located in an adjacent room and wired for annunciation at the main Fire Alarm Control Panel (FACP).

1.4 EQUIPMENT, MATERIALS, BID BASIS

- A. Manufacturers' names, model numbers, etc. as specified on the Drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.
- B. Unless "approved equal" is specifically stated, bids shall be based on equipment named in the Specifications or on the Drawings as "base" products.
- C. "Equal product" and "approved equal" items listed shall conform to specified base items and shall be substantially equal in size, weight, construction quality and capacities. The alternate equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question.
- D. The Contractor shall coordinate the installation of all fire protection equipment proposed for use in this project with all building trades (architectural, structural and electrical). Coordination shall be accomplished prior to, and shall be reflected in, the submittal of shop drawings for approval. Any modifications or revisions required by other trades as a result of the use of equipment other than the basis of design shall be made at no additional cost.

1.5 TRANSPORTATION, DELIVERY, STORAGE AND PROTECTION

- A. The Contractor shall provide and pay for all transportation, delivery, and storage required for all equipment and materials. Upon receipt of all equipment and materials, they shall be properly stored in their original shipping container to protect them from vandalism, theft, the elements, and other harm or damage. Any equipment or materials received in a damaged condition, or damaged after receipt, shall not be installed. Only new undamaged equipment in first-class operating condition shall be installed.
- B. All equipment and piping shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction.
- C. The Contractor shall closely coordinate the ordering and delivery of all mechanical equipment with other trades to assure that equipment will be delivered in time to be installed in the building without requiring special or temporary access or building modifications. Certain equipment may have to be installed prior to the erection of the building walls or roofs.

1.6 PRECONSTRUCTION CONFERENCE

- A. The Contractor shall schedule a meeting including the sprinkler sub-contractor, Owner, Architect and Engineer prior to the installation of any fire protection pipe hangers.

1.7 SUBMITTALS

- A. It is the responsibility of the Contractor to coordinate the design with the work of all other disciplines so as to avoid conflicts. Where necessary piping shall be offset around ducts, structural members or other obstructions, while maintaining effective coverage, drains shall be provided per NFPA requirements.

- B. Review of the Drawings and hydraulic calculations by PBK is for coordination with the design concept for the project, and for assurance that they have been prepared in a timely manner. PBK is entitled to rely on the technical sufficiency and timely delivery of these documents, as well as on the computations performed by the subcontractor. PBK shall not be required to review or verify those computations or designs for compliance with applicable laws, statutes, ordinances, building codes, and rules and regulations.
- C. Fire Protection shop drawings shall include all data required by NFPA Section 13. Shop drawing plans shall indicate all lights, grilles, soffits, alarms, speakers and other ceiling components, as well as hydraulic node points, to ensure coordination. The Contractor shall submit shop drawings to and secure approval of the Owner's Underwriter, local authority and/or state authorities prior to submission to the Engineer. The Contractor shall not commence work, purchase, or provide any materials to the job site without obtaining shop drawing approval. Shop drawings shall include copies of all hydraulic calculations providing design densities, where applicable. In addition, shop drawings submittals shall include printed catalog specifications and data sheets for all of the following as applicable:
1. Fire department valves
 2. Sprinkler heads and accessories
 3. Siamese Fire Department connection
 4. Fire valve cabinets
 5. Test header
 6. Roof manifold
 7. Backflow preventer
 8. Cutting oil indicating compatibility with the CPVC sprinkler piping
- D. A letter signed by an officer of the Contractor's company shall be included in the submittal book that states the following items meet or exceed the requirements of the specifications:
1. Pipe and fittings
 2. Valves
 3. Pipe supports
 4. Pipe accessories
 5. Pipe labels and valve tags
 6. Flow switches
 7. Tamper switches
- E. All required submittal data other than fire protection shop drawings shall be transmitted simultaneously in hard ring binders with the associated specification section and the item submitted clearly identified. Partial submittals will be returned without review unless previously agreed to by the Engineer.
- F. The Contractor shall not proceed with any work without final approved submittal data bearing all approval stamps.
- G. Shop drawings and hydraulic calculations are to be sealed by a NICET III or IV sprinkler designer licensed in the state of Texas.
- H. Provide a specification review that consists of a copy of related specification section with notations indicating compliance or deviation with each element of specification.

1.8 SPARE EQUIPMENT

- A. The Contractor shall furnish and install a cabinet located in the fire service entry room with the quantity of each type of sprinklers and wrenches as required by NFPA 13:

1. Facilities with less than 300 sprinklers – 6 minimum
2. Facilities with 300 to 1000 sprinklers – 12 minimum
3. Facilities with over 1000 sprinklers – 24 minimum

PART 2 - PRODUCTS

2.1 GENERAL

- A. All sprinkler system equipment is to be UL Listed or FM Approved.
- B. Manufacturers.
 1. Pipe.
 - a. Wheatland Tube
 - b. Youngstown Tube Company
 - c. Bull Moose Tube
 - d. Paragon
 2. Sprinkler and Alarm Valve.
 - a. Viking Corp
 - b. Globe Fire Sprinkler Corp
 - c. Tyco
 - d. Reliable
 - e. Victaulic Company
 3. Valve
 - a. Milwaukee
 - b. NIBCO
 - c. Bray
 - d. Mueller Co
 - e. Tyco Fire
 - f. Victaulic Company
 - g. Crane
 4. Specialty Valve
 - a. Potter-Roemer
 - b. Croker
 - c. Guardian Fire Equipment
 - d. Elkhart Brass Mfg
 - e. Tyco Fire
- C. All piping, materials and equipment used in the installation of sprinkler and standpipe systems shall be new and listed as approved by the Underwriters' Laboratories, Inc., List of Inspected Fire Protection Equipment and Materials and the Factory Mutual Testing Laboratories List of Approved Equipment, Fire Protection Devices and Devices Involving Fire Hazard and shall be the latest design of the manufacturer.
- D. Pressure ratings of pipe, fittings, valves, gauges and all other water carrying appurtenances shall be suitable for the designed system pressures in which they are installed.
- E. The installing Contractor shall identify piping, fire department connections, valves and hydraulic design information in accordance with applicable NFPA Standards.

2.2 MATERIALS

- A. All piping shall be made in the USA and be labeled according to City and /or State manufacturers. Pipe shall be protected with MIC shield coating.
- B. All materials, pipe, valves and equipment furnished under this section shall be new and approved by NFPA, Underwriters Laboratories Inc. (UL), Factory Mutual (FM) and American Water Works Association (AWWA) where applicable.
- C. Pipe and Fittings:
1. Piping – Schedule 40 ASTM A-53, A-795, A-135, black steel piping for branches (1 inch – 2 inches) and schedule 10 ASTM A-53, A-795, A-135 (2-1/2 inches – 8 inches) black steel for mains.
 - a. Piping (piping only, excluding fittings) for dry systems shall be Schedule 40 ASTM 53 galvanized steel in all pipe sizes, screwed galvanized cast or malleable iron fittings through 2”, grooved couplings for 2-1/2” and larger pipe sizes.
 - b. Buried Water Service Entrance Piping.
 - 1) Pipe - Cement mortar lined ductile iron.
 - 2) Fittings – Cement mortar lined ductile iron using mechanical joints.
 - 3) Optionally, where building structural components permit, water service entrance may be composed of a single extended 90 degree fitting of fabricated 304 stainless steel tubing, maximum Working pressure of 175 psi with grooved-end connection on the outlet (building) side and a cast iron pipe size coupler on the underground (inlet) side.
 - 4) All pipe and fittings shall be encased with polyethylene film having a minimum thickness of 8 mils.
 2. Fittings under 2-1/2 inches screwed cast iron, 175-pound S.W.P., 2-1/2 inches and larger, flanged, or grooved pipe and fittings to accept a bolted type clamp with gasket.
 3. Grooved Couplings & Fittings: ductile iron with gasket and two bolts, 300 psi working pressure. Victaulic, Firelock fittings.
 4. Flanges – cast iron, 175 pound S.W.P., with threaded inlet, or Victaulic Mod. #741.
 5. Hangers to meet NFPA 13 spacing and type.
- D. Control Valves: All control valves are to be electrically supervised. A pressure gauge, water flow switch and test connection with drain shall be provided downstream. The installation shall be per NFPA 13 requirements.
1. 2-1/2 inches and under – 175 psi, Milwaukee “Butterball” with built-in tamper switches.
 2. Over 2-1/2 inches – UL listed and FM approved, 175 psi, butterfly valves or OS&Y with tamper switch.
 3. All butterfly valves shall have a built in tamper resistant switch for supervision of the open position. The switch shall be contained within a NEMA Type 1, general purpose indoor rated housing. Either unauthorized removal of the switch housing (when the valve is open) or closing the valve, shall cause the switch contacts to change position. The switch shall have four conductors to accommodate connections to Style 4 or Style 6 signaling line circuit devices.
- E. Check Valves:
1. Check valves 2-1/2 inches and larger shall be iron body swing check with cast brass hinge, rod, and brass faced discs.

2. Check valves 2 inches and smaller shall be UL listed brass body and all brass fitted.
- F. Alarm Check Valves: Shall be for vertical installation, cast iron, complete with retard chamberport to alarm, pressure gauges, main drain, electric alarm pressure switch with dual contacts suitable for either open or closed circuit.
1. Control valve, check valve, and pressure or flow switch tied to fire alarm system and sprinkler alarm bell.
 - a. 2-1/2" to 3, Class 150, iron body, bronze disc, flanged or groove ends, TYCO Fire Products LP; AV-1-300, UL Listed for fire service.
 - b. 4" and larger, Class 150, iron body, bronze trim, flanged ends, TYCO Fire Products LP; AV-1-300, flanged, UL Listed for fire service.
- G. Switches:
1. Water Flow Switches: Shall be paddle type water flow alarm (or pressure switch of retard chamber) and with double contacts for either open or closed circuit operation for connection to building fire alarm system.
 2. Tamper Switches: Shall be designed as an integral part of control valve assembly or tamper switch shall have double acting, spring loaded plunger to activate a single-pole double-throw switch for valve supervision of OS&Y type control valves.
- H. Fire Department Connections (as indicated on plans):
1. Fire department connection shall be 2-way exposed Siamese type, 2-1/2" x 2-1/2" x 4" size, cast brass body, polished chrome finish for all exposed surfaces, cast brass escutcheon, and brass female hose inlets having individual clapper valves, plugs, and chains. Assembly shall be located with the center line of the hose inlets at 2'-6" above adjacent grade. Inlet threading shall be National Standard or same as municipal fire department, as required. Assembly shall be UL Listed, FM Approved. Wall Mounted: Potter Roemer 5710 series or approved equal.
 2. Free Standing: Potter Roemer 5760 series or approved equal.
- I. Sprinkler Head Escutcheons.
1. Finish for all escutcheons shall match the finish of sprinkler heads on which they are used. Use white cover plates for white painted soffits and white acoustical ceiling tile, black cover plates for black lay-in acoustical ceiling tile, custom color to match specialty ceilings.
- J. Water Motor Gong
1. Provide a water motor gong. No Electric Bell.
- K. Fire Valve Cabinet
1. 1810 Series cabinets accommodate a single 2-1/2" (6.4 cm) fire dept valve with cap and chain; 1810-10 Series cabinets accommodate a single 2-1/2" (6.4 cm) fire dept valve, 2-1/2" x 1-1/2" Reducer and 1-1/2" Cap.
 2. Cabinet shall be 20-gauge steel with polyester coating, recessed with flush full metal hinged door with cam catch and integral shelf for fire extinguisher. Cabinet shall be Potter-Roemer 1810 series or approved equal.
- L. Roof Manifold
1. Wall mount manifold to be three outlet horizontal configuration, cast brass body with threaded 2-1/2" male outlets complete with valves, chains and caps, rough brass finish. Provide accessible indicating type shut off valve with supervisory

switch (normally closed) and automatic ball drip to roof. Roof manifold to be Potter-Roemer 5880 series or approved equal.

2.3 STAND PIPES

- A. Provide a complete stand pipe system with 2 ½" fire hose connections in compliance with Authority Having Jurisdiction Fire Marshal's requirements for the entire building with separate stand-pipes at auditorium stage and entrance to the auditorium.
 - 1. Building system shall provide a 2 ½" fire hose connection at each landing of each egress stairwell and additional connections throughout the facility in order to provide complete fire hose coverage based on a 150 foot of hose with 50 foot of water spray. Locate fire hose connections in Fire Marshal and Architect approved locations such as stairwells and mechanical rooms and provide required signage. Contractor shall include stand pipe water flow requirements in hydraulic calculation for sizing of all fire water main piping and fire pump. Contractor shall include in submittal a plan showing location of all fire hose connections for approval by Authority Having Jurisdiction Fire Marshal prior to fabrication and rough-in. System shall also comply with NFPA 13 for hose connections for fire department use.
 - 2. Provide a complete stand pipe system on each side of the auditorium stage.
 - 3. Provide a complete stand pipe system on each side of the entrance to the auditorium.

2.4 AUTOMATIC SPRINKLER SYSTEM MATERIALS

- A. The underground fire protection service shall be provided with thrust blocks and rods and clamps at the service entry.
- B. Automatic sprinklers shall be provided as follows:
 - 1. Public Spaces with Gypsum and Lay-in Ceilings
 - a. Fully concealed type sprinklers, glass element, or fusible link style, quick response sprinklers shall be provided in all areas with gypsum ceilings unless otherwise noted. Temperature rating of sprinklers shall be 155 – 165 degrees. Ceiling coverplate shall be factory painted to match the adjacent ceiling color; submit painted sample to the Architect for approval. Sprinkler to be Tyco, Reliable, Victaulic or Viking Horizon Mirage concealed sprinkler or approved equal.
 - b. Small frame glass element, semi-recessed, quick response pendent sprinklers shall be provided in all areas with lay-in ceilings unless otherwise noted. Temperature rating of sprinklers shall be 155 – 165 degrees. Sprinkler and escutcheon to be white finish. Sprinkler to be Tyco, Reliable or Viking Microfast Model M series with Model E-1 escutcheon.
 - 2. Back-of-House Spaces and Unfinished Spaces with no Ceiling
 - a. Quick response upright pendent sprinklers shall be provided in all areas with no ceiling. Temperature rating is to be 165 degrees unless conditions require higher temperature. Finish of sprinkler to be rough brass. Sprinkler to be Tyco, Reliable or Viking Microfast Model M.
 - 3. Kitchen Coolers and Freezers
 - a. Standard response semi-recessed chrome plated dry pendent sprinklers with sprinkler guards will be provided in all coolers and freezers. Barrel length shall be a minimum of 12" from the base of the tee to the top of the freezer. Sprinkler and escutcheon shall be polished chrome finish. Sprinkler shall be Tyco, Reliable or Viking Model M.
 - 4. Pool areas

- a. All sprinkler heads in pool areas, pool equipment room, sanitized room and acid room shall be US Listed/FM Approved quick-response Stainless Steel heads (155 degrees Fahrenheit). Heads must be wax coated. Viking VK338 and VK339 or equal
5. Exterior Overhangs and Elevator Shafts
 - a. Standard response chrome plated dry horizontal sidewall or upright sprinklers are to be provided. Barrel length shall be a minimum of 12". Sprinkler and escutcheon shall have UL Listed polyester or Teflon corrosion protection at exterior overhangs and rough brass finish at elevator shafts. Sprinkler shall be Viking Model M.
- C. All outdoor sprinkler heads shall be wax coated.
- D. Alternate acceptable manufacturers with equivalent sprinklers are Automatic, Central, Anvil International, Gem and Reliable.
- E. Sprinkler guards shall be installed on all sprinklers 7'-0" or less above floor.
- F. Provide sprinklers at the highest and lowest level of all stairwells.
- G. Provide sidewall sprinklers at the top end and bottom of all elevator hoistways. Sprinklers may be omitted from traction elevators on non-combustible elevator shafts and cabs which meet the requirements of ASME A.17.1 and where acceptable to the local authorities.
- H. Provide sprinklers in electrical rooms and elevator machine rooms unless specifically prohibited by local authorities; the sprinkler supply to each space shall be provided with a supervised valve and flow switch. Coordinate the intermediate temperature rating of the sprinkler head in all elevator machine rooms with the electrical contractor to ensure sprinkler operation will not occur prior to activation of the heat detector and the shunt trip circuit breaker.
- I. Sidewall sprinklers shall be installed in all electrical rooms, electrical closets and elevator machine rooms where adequate coverage is provided. Upright sprinklers shall be installed in these spaces when coverage limitations of the sidewall sprinklers are exceeded. Piping shall not be installed above any electrical equipment, switchboard or panelboard. Piping shall offset around surface mounted light fixtures where possible, provide a minimum of 6" clearance below the bottom of the light fixtures at all locations.
- J. The property is to be fully sprinklered throughout per the requirements of NFPA unless specifically noted otherwise. Elimination of sprinklers in electrical rooms, elevator shafts and elevator machine rooms shall be clearly indicated on the shop drawing submittal noting the exception applied for the deletion of sprinklers in these spaces.
- K. The Contractor shall provide and place suitable signs indicating the purpose of each control valve, test connection, main and auxiliary drain, etc., as required.
- L. Provide higher intermediate temperature rated sprinklers in all areas required due to service conditions and as required by NFPA 13.
- M. Provide sprinkler connections to all required food service hood suppression systems.
- N. Sprinkler guards shall be installed on all sprinklers located in cafeteria and the gym.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas for conditions under which work is to be performed. Report in writing to the Architect all conditions that will adversely affect satisfactory execution of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. The Drawings are diagrammatic and the final arrangement of the work shall suit field conditions, the characteristics of the materials used and coordination with all other disciplines and the building components and finishes. Verify all dimensions in the field. Access and clearances must be provided and maintained for the proper operation, maintenance service and repair of the work.
- B. No sprinklers are to be installed prior to the building being completely sealed in from external moisture and conditions.
- C. All standpipe, sprinkler and drain piping exposed to sight in stairwells is to be painted with two coats of an epoxy based paint, color to be selected by the Architect.
- D. All equipment and materials shall be installed according to manufacturer's recommendations and shall meet the requirements of NFPA and the Owner's Insurance Underwriter.
- E. All sprinklers in spaces visible to public view shall be located symmetrically in relation to ceiling design elements, lighting fixtures, speakers, diffusers, etc. All ceiling components are to be indicated on the submittal drawings as noted previously to ensure coordination with all ceiling elements and devices. Piping to sprinklers in these areas is to be provided with arm-overs to allow for exact placement of sprinklers.
- F. Sprinklers shall be installed at the centerpoint of all 2' x 2' lay-in ceiling tiles, and at the centerpoint or 1' from the ends of 4' x 2' ceiling tiles. For every sprinkler head, tap main/branch pipe serving each individual sprinkler head shall come from the top of pipe to prevent trash from collecting at head. (Piping laterals to a sprinkler head is FORBIDDEN off the bottom of the main or lateral piping system).
- G. Where pipe is installed above suspended ceilings, it shall be located in the clear space above the suspended ceiling and the pendent sprinklers shall be located to clear the ceiling supporting grid system, the ceiling mounted fixtures, and air conditioning ducts and outlets.
- H. The Contractor shall install additional pendent sprinkler heads under all ductwork or other obstructions which are over 48" wide in accordance with NFPA-13 in areas of exposed construction.
- I. Dry pipe systems shall be specified as installed with the longitudinal weld seam located above the horizontal centerline of the pipe, and with drain valves installed at all low points regardless of trapped water volume. Require that mains and branch lines be pitched at least 1/2 in. per 10 ft in all locations, including in non-refrigerated areas (areas not subject to freezing).
- J. Provide a pressure gauge at the top level of all standpipes.

- K. Provide tracer wire on all pipe installed below slab outside building; locate leads in accessible location for future use in trouble shooting.
- L. Horizontal branch piping shall be pitched to mains per NFPA. Locate all sprinkler mains a minimum of 24" above any finished ceiling.
- M. Hydraulic information placards with permanent markings indicating the hydraulic design criteria for each separate system should be installed on each riser.
- N. Provide basket type metal guards over sprinkler heads to protect them from damage in mechanical rooms, main electrical and telephone equipment, gymnasium areas, storage rooms and all unfinished areas where the head is less than 7 feet-0 inches above finished floor.
- O. All threads for fire department connections shall match the local Fire Department connecting threads and requirements.
- P. Building shall be 100 percent fully sprinklered.
- Q. Sprinkle Zones shall comply with NFPA 13, for areas limitations, provide a minimum of TWO sprinkler systems with separate alarm check valve assemblies.
- R. Fire Alarm System: Coordinate with Division 26 to provide connections to all supervised devices and flow switches as well as any other items requiring connection to the fire alarm system, provide all wiring and equipment.
- S. Stages: At each side of each stage provide a complete Authorities having Jurisdiction and NFPA compliant class III standpipe system with 1.5" and 2.5" fire department hose connections. Mount hose connections in Potter-Romer lockable, clear glass front cabinet. Coordinate exact location of standpipes with stage equipment.
- T. Maintain a minimum 3' horizontal separation between any recessed, pendant sprinkler head and any wall, partition, furr-down, or other vertical surface.
- U. If a deluge system is required, the system shall be installed so that the deluge system will not engage during a fire drill and/or in fire test mode.

3.3 CLEANING

- A. The entire underground and above ground sprinkler system shall be cleaned and flushed in accordance with NFPA 13, 24, 25.
- B. Capped connections shall be located at the ends of sprinkler main piping to facilitate flushing and cleaning of systems.
- C. Remove all trash and debris from site and dispose of legally.
- D. All equipment shall be thoroughly cleaned and left in a satisfactory condition for proper operation at project completion. All equipment shall be partially or fully re-painted as required to provide an appearance of new equipment.

3.4 TESTS

- A. Tests of all fire protection systems and equipment, underground and inside piping including alarm and detection devices shall be scheduled with one (1) week prior notification to a local representative of the Underwriter and the Architect. All tests and test procedures shall be in accordance with the applicable NFPA standards. After completion of all tests, the "Contractor's Materials and Test Certificate" shall be submitted to the Architect.
- B. The Contractor shall supply all materials, labor, utilities and power required for testing. Preliminary tests shall be performed to prove work is satisfactory prior to requesting a test inspection. Sectional tests shall be made before insulation or concealing any piping.
- C. Repair all defects disclosed by tests or, if required by the Architect, replace defective work with new systems and materials at no additional cost to the Owner. Repairs to piping systems shall be made with new material. No caulking of screwed joints, cracks or holes will be accepted. Make tests in stages to facilitate work of others.
- D. The Contractor shall be responsible for the repair and/or replacement cost installed and finishes damaged by leaks, tests and/or repair and replacement of his work at no additional expense to the Owner.
- E. Prior to final acceptance by the Owner, submit the "Contractor's Material and Test Certificates" indicating system compliance with all applicable sections of NFPA.

END OF SECTION 21 11 13

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide all work for mechanical, plumbing and fire protection systems required in the project to be properly installed, tested and performing their intended function.
- B. All materials and equipment for the potable water system shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.
- C. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition for all systems. All work shall be accomplished by workmen skilled in the various trades involved.
- D. Phased Construction:
 - 1. This project consists of work that must be accomplished in a specific sequence on premium time to avoid interruption of services to existing portions of the buildings and mechanical, plumbing and fire protection systems that must remain operational
 - 2. Contractor shall include any and all temporary services required to keep the Owner occupied portions of the buildings operation without interruption of HVAC, plumbing and fire protection services for the duration of the project.
 - 3. Refer to Architectural drawings for description of phasing, stage all mechanical, plumbing and fire protection work accordingly.
- E. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Engineer shall be notified of the discrepancy.

1.3 QUALITY ASSURANCE

- A. Perform all work in accordance with the latest edition of the applicable codes, specifications, local ordinances, industry standards, utility company regulations, nationally accepted codes.
- B. All materials and distribution, and utilization equipment shall be UL Listed.
- C. All equipment and materials shall be new, unused and of United States Domestic manufacture and comply with the Buy America Act, unless approved otherwise by engineer or owner.
- D. Eliminate any abnormal sources of noise that are considered by the Architect or Engineer not to be an inherent part of the systems as designed without additional cost to the Owner.

- E. An approved contractor for the work under this division shall be:
 - 1. A licensed specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system.
 - 2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.

1.4 WORK INCLUDED

- A. SYSTEMS: Plumbing Systems installed and work performed under this Division of the Specifications shall include, but not necessarily be limited to, the following as noted below. The connection point for all systems from the site utilities shall be as 5'-0" from the exterior of the building unless specifically otherwise noted.
 - 1. Domestic cold, hot and hot water recirculation systems
 - 2. Sanitary, drainage, waste and vent systems
 - 3. Natural gas/propane gas system
 - 4. Primary and emergency storm drainage systems
 - 5. Propane/air mixture gas systems
 - 6. Grease waste and waste systems from food service areas
 - 7. Domestic water softening system
 - 8. Compressed air system
 - 9. Fuel Oil system
- B. Contract quality control including workmanship, manufacturer's instructions, mock-ups and demonstrations.
 - 1. MOCK-UPS
 - a. Assemble and erect the specified equipment and products complete, with specified anchorage and support devices, seals and finishes.
 - b. Do not proceed with any work involving a mock-up, until the related mock-up has been approved in writing.
 - c. Acceptable mock-ups in place shall be retained in the completed work.
 - d. Perform tests and submit results as specified.
 - 2. SCHEDULING MOCK-UPS
 - a. Schedule demonstration and observation of mock-ups, in phases, with Architect/Engineer.
 - 1) Rough-in.
 - 2) Finish with all appurtenances in place.
 - 3) Insulation installed.
 - 4) Demonstrations

1.5 COMPLETE PERFORMANCE OF WORK

- A. All labor, materials, apparatus, and appliances essential to the complete and proper functioning of the systems described and/or indicated herein, or which may be reasonably implied as essential, whether mentioned in the Contract Drawings and specifications or not, shall be provided by the Contractor. The entire installation shall be ready in every respect for the satisfactory and efficient operation when completed.
- B. Provide all rigging required for complete installation and furnish drawings showing necessary points of support, reactions and supplementary bracing. This shall be submitted for approval by the Owner. Should any shoring be required, provide same after Owner's approval.

- C. Become thoroughly acquainted with the work involved, obtain and verify at the building all measurements necessary for the proper installation of work. Furnish to other Contractors any information relating to work of this division necessary for the proper installation of their contracts. Confer with other Contractors for finish adjacent to work of this section and arrange to have visible portions of the work (such as access doors, grilles, escutcheons, etc.) fit in and harmonize with the finish in a manner satisfactory to the Architects.
- D. Transmit to trades doing work of other sections all information required for work to be provided under their respective sections (such as fresh water connections, foundations, electric wiring, access doors, and the like) in ample time for installation.
- E. Where disagreements occur between the plans and the specifications, or within either document itself, the item or arrangement of better quality, greater quantity or higher cost shall be included in the Base Bid.

1.6 COORDINATION WITH OTHER TRADES

- A. Coordinate the work of this division with all other divisions to ensure that all components of the mechanical, plumbing and fire protection system will be installed at the proper time and fit the available space.
- B. Locate and size all openings in work of other trades required for the proper installation of the mechanical, plumbing and fire protection system components.
- C. Make all mechanical, plumbing and fire protection connections to all equipment furnished by this division and as required by any other division.
- D. Electrical wiring, control equipment and motor starters indicated on the electrical drawings, except items otherwise specifically noted, shall be furnished and installed by the electrical trades. Items of electrical control equipment specifically mentioned to be furnished by the mechanical trades, either in these specifications or on the mechanical drawings, shall be furnished, mounted and wired by this trade unless where otherwise specified in Division 26 or noted on the electrical drawings to be by the electrical trades. All wiring shall be in accordance with all requirements of the electrical Sections of these specifications.
- E. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment. All controllers furnished with mechanical equipment shall have overload protection in all phases. It shall be the responsibility of each subcontractor furnishing motors and devices to advise Electrical Contractor of exact function of systems to assure proper type of starter with correct number auxiliary contacts for proper operation of the system.
- F. The mechanical trades shall coordinate with the electrical to ensure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.
- G. The design of the electrical systems is based on the mechanical equipment specified and scheduled on the drawings. Where changes or substitutions are made that involve additional electrical work (larger-size motors, larger number of motors, additional wiring of equipment, etc.), the mechanical trades shall pay the electrical trades for the cost of the additional work, except for changes by bulletin.

- H. Motor control equipment which is furnished loose under Division 23 shall be delivered to the Electrical Contractor at the site for custody, erection in place, and wiring as specified.
- I. Smoke detection systems will be furnished and installed under Division 26 – electrical. Coordinate locations with Electrical Contractor.

1.7 DRAWINGS

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the mechanical, plumbing and fire protection equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers will be acceptable, it is the responsibility of the Contractor to determine if the equipment that the Contractor proposes to furnish will fit in the space. The drawings are not intended to show exact locations of pipes and ducts, or to indicate all offsets and fittings or supports, but rather to indicate approximate layout.
- B. The mechanical, plumbing and fire protection Drawings are necessarily diagrammatic in character and cannot show every connection in detail in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- C. When the mechanical, electrical, plumbing and fire protection drawings do not give exact details as to the elevation of pipe, conduit and ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Exposed piping and ductwork is generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.
- D. The locations, arrangement and extent of equipment, devices, and other appurtenances related to the installation of work shown on the Drawings are approximate. The Contractor shall not scale drawings, but shall refer to the architectural drawings for exact dimensions of building components. Should a conflict exist between the architectural and engineering drawings regarding dimensions and scale, the Contractor shall notify the Architect of the discrepancy for resolution.
- E. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

1.8 SUBSTITUTIONS

- A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability or record of

satisfactory performance. See division 01 specification for additional requirements.

- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect at least **seven (7)** days prior to the date for receipt of proposals. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance and test data and any other information necessary for an evaluation. The Architect's decision of approval or disapproval of a proposed substitution shall be final.
- C. The Architect and Owner reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final.
- D. **No substitutions will be considered after the Award of Contract.**
- E. Requests for Substitutions: Submit three (3) copies of each request for substitution. In each request identify the product or fabrication or installation method to be replaced by the substitution; include related Specifications Section and Drawing numbers, and complete documentation showing compliance with the requirements for substitutions. Include, as appropriate, with each request, the following information:
1. Product data, drawings and descriptions of products, fabrication and installation procedures.
 2. Samples, where applicable or requested.
 3. A detailed comparison of the significant qualities of the proposed substitution with those of the work originally specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect, where applicable.
 4. Coordination information, including a list of changes or modifications needed by other parts of the work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.
 5. A statement indicating the effect the substitution will have on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
 6. Cost information, including a proposal of the net change, if any in the Contract Sum.
 7. Certification by the Contractor to the effect that, in the Contractor's opinion, after thorough evaluation, the proposed substitution will result in work that in every significant respect is equal-to or better than the work required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
 8. A statement indicating the Contractor will reimburse the Owner and pay for all costs, including Architect/Engineer's re-design and evaluation costs resulting from the use of the proposed substitution.

9. Condition: The Contractor's request for substitution will be received and considered when extensive revisions to Contract Documents are not required, when the proposed changes are in keeping with the general intent of the Contract Documents, when the request is timely, fully documented and properly submitted, and when one (1) or more of the above conditions are satisfied, all as judged and determined by the Architect/Engineer; otherwise the requests will be returned without action except to record non-compliance with these requirements.

1.9 SUBMITTALS

- A. Provide shop drawings and complete product data as indicated in each specification section.
- B. Coordination Drawings: Using the mechanical ductwork shop drawings as a basis, provide a composite set of AutoCAD drawings in which the major mechanical, plumbing and fire protection equipment, ductwork and piping are superimposed on the architectural reflected ceiling plan and structural framing plan. Include spot elevations of bottom of steel along with finished ceiling height. Prepare at 1/8 inch scale or larger, one drawing per building area. Provide 1/4 inch scale enlargements of locations where special attention to rough-in dimensions as required to ensure all systems will fit within the available space.
- C. Shop Drawings will be reviewed and returned to the Contractor with one of the following categories:
 1. **Reviewed:** No further submittal action is required. Submittal to be included in O & M Manual.
 2. **Revise and Resubmit:** Contractor to resubmit submittal as indicated in comments section of Engineer's Submittal Cover Letter.
 3. **Rejected:** Contractor to resubmit new submittal when alternate or substitution is not approved and be required to furnish product named in Specification and or Drawings.
 4. **Furnish as Corrected:** Contractor to submit letter verifying that required corrections noted on Engineer's Submittal Cover Letter have been received and complied with by manufacturer. If equipment on site is not in compliance with corrections noted, contractor shall be responsible for the cost of removing and replacing equipment.
- D. Materials and equipment which are purchased or installed without Submittal review and approval will be removed and replaced with specified equipment at Contractor's expense.
- E. Provide a specification review that consists of a copy of related specification section with notations indicating compliance or deviation with each element of specification.
- F. All approvals required by any code or enforcement authority, insurance underwriter, etc. shall be obtained prior to equipment being submitted to the Engineer.
- G. Review of submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.
- H. All submittals shall be identified by the equipment mark or tag identification numbers shown on the Contract Drawings. Each individual submittal item shall be marked to show which specification section pertains to the item.

- I. Submittals shall clearly indicate selection of model numbers, sizes, dimensions, electrical characteristics, etc. of the proposed equipment. Any proposed deviations from specified equipment shall be clearly indicated on the submittal.

1.10 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Division 1 - General Requirements and each specification section.

1.11 INTERFERENCE DRAWINGS

- A. Where field conditions prohibit the installation of the mechanical, plumbing or fire protection system components within the available space as indicated on drawings, the Contractor shall prepare a sketch to the minimum 1/8 inch scale, clearly depicting the conflict along with an alternate installation arrangement that satisfies the design intent of the documents without incurring additional cost.
- B. Obtain written approval of proposed interference resolution prior to proceeding with alternate installation.

1.12 EXISTING CONDITIONS

- A. The Contractor shall be familiar with the required scope of work to accomplish the work required by these documents. All demolition work implied or required shall be included in the scope of this contract.
- B. Outages of services are required by the new installation will only be permitted at a time approved by the Owner. The contractor shall allow the Owner a 2 week window in order to schedule required outages. The time allowed for outages will not be during normal operating hours unless otherwise approved by the Owner. All costs for outages, including overtime charges, shall be included in the contract amount.
- C. Work Sequence, Timing, Coordination with Owner:
 1. During the construction of this project, normal facility activities will continue in existing buildings until new buildings or renovated areas are completed. Plumbing, fire protection, lighting, electrical, communications, heating, air conditioning, and ventilation systems will have to be maintained in service within the occupied spaces of the existing building.
- D. Demolition and Work within Existing Buildings:
 1. In the preparation of these documents every effort has been made to show the approximate locations of, and connections to the existing piping, duct, equipment and other apparatus related to this phase of the work. However, the Contractor shall be responsible for verifying all existing conditions. The Contractor shall visit the existing site to inspect the facilities and related areas. The Contractor shall inspect and verify all details and requirements of all the Contract Documents, prior to the submission of a proposal. All discrepancies between the Contract Documents and actual job-site conditions shall be resolved by his contractor, who shall produce drawings which shall be submitted to the Architect/Engineer for review. All labor and materials required to perform the work described shall be part of this Contract.
 2. All equipment and/or systems noted on the Drawings "To Remain" shall be inspected and tested on site to certify working condition. A written report on the condition of all equipment to remain, including a copy of the test results and recommended remedial actions and costs shall be made by this Contractor to the Architect/Engineer for review.

3. All equipment and/or systems noted on the Drawings "To Be Removed" shall be removed including associated system connections. Where duct or pipe is to be capped for future extension or end of line use, it shall be properly tagged with its function or service appropriately identified. Where existing equipment is to be removed or relocated and has an electric connection, the Electrical Contractor shall disconnect equipment and remove wiring back to panel or disconnect switch. Contractor shall remove or relocate equipment and associated disconnect.
4. During the construction and remodeling, portions of the Project shall remain in service. Construction equipment, material tools, extension cords, etc., shall be arranged so as to present minimum hazard or interruption to the occupants of the building. None of the construction work shall interfere with the proper operation of the existing facility or be so conducted as to cause harm or danger to persons on the premises. All fire exits, stairs or corridors required for proper access, circulation or exit shall remain clear of equipment, materials or debris. The General Contractor shall maintain barricades separating work area from occupied areas.
5. Certain work during the demolition and construction phases of construction may require temporary evacuation of the occupants. Coordinate and schedule all proposed evacuation with the Project Administrator at least seventy-two (72) hours in advance in writing.
6. Any salvageable equipment as determined by the Owner, shall be delivered to the Owner, and placed in storage at the location of his choice. All other debris shall be removed from the site immediately.
7. Equipment, piping or other potential hazards to the occupants of the building shall not be left overnight outside of the designated working or construction area.
8. Make every effort to minimize damage to the existing building and the owner's property. Repair, patch or replace as required any damage which might occur as a result of work at the site. Care shall be taken to minimize interference with the Owner's activities during construction and to keep construction disrupted areas to a minimum. Coordinate with the Owner and other trades in scheduling and performance of the work.
9. Include in the contract price all rerouting of existing pipe, duct, etc., and the reconnecting of the existing equipment and plumbing fixtures as necessitated by field conditions to allow the installation of the new systems regardless of whether or not such rerouting, reconnecting or relocating is shown on the drawings. Furnish all temporary pipe, duct, controls, etc., as required to maintain heating, cooling, ventilation and plumbing services for the existing areas.
10. All existing plumbing fixtures, pipe, duct, materials, equipment, controls and appurtenances not included in the remodel or alteration areas are to remain in place.
11. Pipe, duct, equipment and controls that are disconnected to perform remodeling work, shall be reconnected in such a manner as to leave systems in proper operating condition.
12. No portion of the fire protection systems shall be turned off, modified or changed in any way without the express knowledge and written permission of the Owner's representative in order to protect systems that shall remain in service.
13. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and operating system in cooperation with other trades with a minimum of disruption or downtime.
14. Refer to Architectural "Demolition and/or Alteration" plans for actual location of walls, ceiling, etc., being removed and/or remodeled.

1.13 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
- C. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.14 GENERAL ELECTRICAL REQUIREMENTS

- A. Provide electric motors, control panels, certain control and safety devices and control wiring when specified or required for proper operation of electrical systems associated with mechanical equipment specified in Division 23.
- B. Electrical materials and work provided shall be in accordance with Division 26.
- C. Notify Architect/Engineer in writing 14 days before bids are due if it is necessary to increase horsepower of any motors or change any electrical requirements listed or shown. After this period, costs incurred because of changes shall be assumed by the responsible Contractor.

1.15 ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

- A. Mechanical equipment with factory assembled and/or attached electric equipment shall be Underwriters' Laboratories (UL) listed as an assembly when such listing is available from UL, and shall meet the latest edition of the National Electrical Code.
- B. Unless otherwise specified, the electrical supply being furnished is a 480 volt, 3 phase, 3 wire, 60 hertz source. A neutral connection will not be provided, the manufacturer shall include any transformers for equipment requiring other voltages (277volt, 220 volt, 120 volt, 24 volt, etc.).
- C. Electric Motors:
 - 1. For each piece of equipment requiring electric drive, provide a motor having starting and running characteristics consistent with torque and speed requirements of the driven machine.
 - 2. Manufacturers furnishing motors shall verify motor horsepower with the characteristic power curves of driven equipment on shop drawings.
 - 3. Each motor shall be furnished in accordance with Section 23 05 13 - Common Motor Requirements For HVAC Equipment.
 - 4. Contractor shall verify electrical characteristics of each motor with electrical drawings.
 - 5. Motors which are shipped loose from equipment shall be set by supplying subcontractor.
 - 6. Alignment of motors factory coupled to equipment and motors field coupled to equipment shall be rechecked by millwright after all connections (belt drives, gear drives, impellers, piping, etc.) have been completed and again after 48 hours of operation in designed service.
 - 7. Where possible, motors shall be factory mounted.

1.16 AS BUILT DRAWINGS

- A. The Contractor shall maintain a record set of drawings indicating all changes in the work from that shown in the Contract Documents. Prior to final acceptance by the Owner, the

Contractor shall assemble the complete set of as-built drawings that accurately reflects all changes to indicate actual final construction. All concealed piping shall be dimensionally located from at least two (2) column lines or major building structure elements. Drawings shall be a minimum of 1/8" scale.

- B. The original set of "as-built" drawings shall be scanned and transmitted to the Architect in both full size bond and PDF format.
- C. As Build Drawings: 2 sets are for the Owner's use and one set is for the Architect/Engineer's records). Delivery of these as-built prints and reproducible is a condition of final acceptance. Provide record drawings on one set each, PDF Format and AutoCad 2015 files on disk (CD Rom).
 - 1. Number of Copies: Submit one set of marked up record prints.
 - 2. Number of Copies: Submit copies of record Drawings:
 - a. Initial Submittal:
 - 1) Submit PDF electronic files of scanned record prints and one of file prints.
 - 2) Submit record digital data files and one sets of plots.
 - 3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit PDF electronic files of scanned record prints and three sets of prints.
 - 2) Submit record digital data files and three sets of record digital data file plots.
 - 3) Plot each drawing file, whether or not changes and additional information were recorded.
- D. As-Built drawings should indicate the following information as a minimum:
 - 1. Indicate all addendum changes to documents.
 - 2. Remove Engineer's seal, name, address and logo from drawings.
 - 3. Mark documents AS-BUILT DRAWINGS.
 - 4. Clearly indicate: DOCUMENT PRODUCED BY.
 - 5. Indicate all changes to construction during construction. Indicate actual routing of all piping, ductwork, etc. that were deviated from construction drawings.
 - 6. Indicate exact location of all underground plumbing and flow line elevations.
 - 7. Indicate exact location of all underground mechanical piping and elevations.
 - 8. Indicate exact location of all underground electrical raceways and elevations.
 - 9. Correct schedule to reflect (actual) equipment furnished and manufacturer.
 - 10. During the execution of work, maintain a complete set of drawings and specifications upon which all locations of equipment, ductwork, piping, devices, and all deviations and changes from the construction documents in the work shall be recorded.
 - 11. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and mechanical valves.
 - 12. Exact location of all electrical equipment in and outside of the building.
 - 13. Fire Protection System documents revised to indicate exact location of all sprinkler heads and zone valves.
 - 14. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
 - 15. Cloud all changes.

1.17 START-UP-SERVICE

- A. The service of a factory-trained representative shall be provided on the jobsite for a minimum of one (1) day to provide the manufacturer's certification and start-up of all

major equipment and systems including booster pumps, water heaters, sewage ejectors, lift stations, fuel oil systems, etc. A formal report is to be issued indicating any revisions required for certification of the assembly by the manufacturer. Instruction and training of the operator's personnel shall be provided following certification of the assembly.

1.18 COORDINATION OF TRADES

- A. The Contractor shall give full cooperation to other trades, and shall furnish all information necessary to permit the work of all trades to be installed satisfactorily and with least possible interference or delay.
- B. Piping and other plumbing equipment shall not be installed without first coordinating the installation of same with other trades. The Contractor, at his own expense, shall relocate all uncoordinated piping and other plumbing equipment installed should they interfere with the proper installation and mounting of electrical, HVAC equipment, ceilings and other architectural or structural finishes.
- C. The Contractor shall coordinate the elevations of all piping and equipment above ceilings and in exposed areas with the work of all other disciplines prior to installation.
- D. In areas where more than one trade is required to use common openings in beams, joists, chases, shafts and sleeves for the passage of conduits, raceways, piping, ductwork and other materials, the Contractor must coordinate the positions of all piping and equipment to be furnished under this section so that all items including the materials and equipment of other trades may be accommodated within the space available.
- E. The Contractor shall confirm that work installed under this section does not interfere with the clearances required for finished columns, pilasters, partitions, walls or other architectural or structural elements as shown on the Contract Documents.
- F. Work that is installed under this Contract which interferes with the architectural design or building structure, shall be removed and relocated as required at no additional cost to the Contract.
- G. All offsets, fittings, valves, devices and accessories which may be required are to be provided under this Contract. The Contractor shall examine the entire set of Contract Documents and carefully investigate the structural and finish conditions affecting all his work and shall arrange such work accordingly for the complete satisfactory operation of all systems, providing such fittings, traps, valves, devices and accessories as may be required to meet such conditions.

1.19 WARRANTY

- A. All equipment furnished and installed under this Contract shall be provided with the manufacturer's standard warranty unless otherwise noted.
- B. The Contractor shall make good all defects in material, equipment, or workmanship disclosed within a period of one (1) year from date of building acceptance by the Owner. The phrase "make good" shall mean to furnish promptly, without charge, all work necessary to remedy the defects to the satisfaction of the Engineer.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. All equipment, materials, accessories, etc. used shall be new and of current production unless specified otherwise. Equipment not specified in the Contract Documents shall be suitable for the intended use and shall be subject to approval by the Engineer.
- B. All equipment, products and materials shall be free of defects and shall be constructed to operate in a safe manner without excessive noise, vibration, leakage, or wear.
- C. All equipment shall bear the inspection label of Underwriters Laboratories Inc.
- D. All equipment and material for similar applications or systems shall be provided from the same manufacturer unless noted otherwise.
- E. Cast iron soil pipe and fittings shall bear the collective trademark of the Cast Iron Soil Pipe Institute.

2.2 ACCESS PANELS

- A. Manufacturers:
 - 1. Mifab.
 - 2. Acudor
 - 3. Elmdor
 - 4. Milcor
 - 5. PPP
- B. Group valves together above suspended ceilings, walls, furred spaces to minimize the number of access panels, but with all valves freely accessible for maintenance. Locate all valves within 1'-0" of access point. Minimum size requirements.
 - 1. 18"x18" for electrical related items.
 - 2. 24"x24" for plumbing isolation valves and electrical related items.
 - 3. 36"x24" for mechanical HVAC equipment.
- C. Furnish access panels of proper size to service concealed valves and cleanouts. Panels shall be of the proper type for material in which they occur and are to be furnished by the Contractor, but installed by the particular trade for the material within which the access panel is installed.
- D. Panels shall have flush doors with No.16 USCG steel door and trim No. 16 USCG steel frame, metal wings for keying into construction, concealed hinges, and screwdriver operated stainless steel cam lock. Panels shall be shop coated with one coat of zinc chromate primer. Valves above removable ceilings shall have tile clips by the Contractor for identification.
- E. Access panels are not allowed in gypsum ceilings in public spaces.

2.3 INSULATION

- A. The following shall be insulated:
 - 1. All domestic cold water piping above grade except at horizontal chase branch piping to individual plumbing fixtures.

2. All domestic cold water piping above grade (15'-0" only from service entry). –
 3. All hot water and hot water return piping except at horizontal chase branch piping to individual plumbing fixtures.
 4. All horizontal storm drain piping and roof drain bodies.(SD and OD included)
 5. All water piping exposed to areas subject to freezing, refer to "Heat Cable for Freeze Protection of Piping" under Part 2.4 of Section 22 05 00 for additional requirements.
- B. Domestic hot, cold, hot water recirculation, primary storm drainage, and waste drainage piping shall be insulated with 4 lb. density sectional fiberglass insulation with a thermal conductivity not to exceed 0.24 with white all service jacket and vapor barrier. All joints and seams shall be sealed vapor tight. All seams and staples shall then be covered with "All Service Jacket" three-inch wide tape. Insulation shall be used for exposed piping.
- C. Materials as specified in this section shall be manufactured by Johns Manville Micro-Lok AP-T, Knauf ASJ/SSL, Owens Corning ASJ/SSL or equal. Insulation thicknesses shall be as shown in the following table below as minimum requirements. Where different thickness required by code or local jurisdiction, higher standard to be used:

Minimum Pipe Insulation			Insulation Thickness for Pipe Sizes				
Piping System Types	Fluid Temperature Range		1 in. and Less	1-1/4 to 2 in.	2-1/2 to 4 in.	5 and 6 in.	8 in. and Larger
	°C	F	In.	In.	In.	In.	In.
PLUMBING							
Domestic Water	Ambient	Ambient	0.5	1.0	1.0	1.0	--
Domestic Hot Water And Hot Water Recirculation	43-71	110-160	1.0	1.5	1.5	1.5	--
Above Grade Drains and Piping Receiving Condensate or Ice Machine Discharge	4.5-15.5	40-60	0.5	1.0	1.0	1.5	--
Horizontal Storm Drainage	Ambient	Ambient	--	--	1.0	1.0	1.0

- D. Insulate all horizontal storm drain piping with fiberglass insulation and with service jacket. For exposed locations provide 1" thick rigid insulation with rigid jacket. Insulate from roof drain body, past first elbow all the way to change to vertical direction, including y-fittings.
- E. All interior horizontal storm drainage piping systems and roof drain bodies are to be insulated with blanket type glass fiber bonded with thermosetting resin with white vinyl vapor retarding facing, 2" wide stapling/taping tab. Insulation shall be used in concealed spaces.
- F. Insulate all above slab horizontal sanitary waste piping carrying air-conditioning condensate with minimum 1"-1.5" fiberglass insulation with jacket from floor drain, including traps, all the way to change in direction to vertical.
- G. In natatorium, including equipment rooms, all exposed plumbing piping shall be insulated and protected by a complete aluminum jacketing system. Provide color coded, printed pipe label 10' on center identifying pipe service type (gas, domestic water, storm water, etc.).
- H. Aluminum Jacket:

1. Jacket for piping shall be 0.016 inch thick type 3105 aluminum with factory applied one mil polykraft moisture barrier
2. Fitting covers shall be factory made 0.024 inch type 1100 aluminum to match pipe covering.
3. Aluminum jacketing shall be provided for all exposed piping.
4. Manufacturers:
 - a. Childers
 - b. Pabco
 - c. RPR

2.4 HEAT CABLE FOR FREEZE PROTECTION OF PIPING

- A. Provide electric heat tracing on all domestic water piping and sanitary traps exposed to areas subject to freezing.
- B. Manufacturers:
 1. Thermon
 2. Emerson-Chromalox
 3. Pyrotenax
 4. Briscoe
 5. Raychem
- C. Provide a complete system of self-regulating heating cable on all domestic water piping in crawl spaces, un-conditioned attic spaces and outdoors and any other locations subject to freezing. System shall be UL Listed, CSA Certified, or FM Approved system of heating cables, components, and controls to prevent pipes from freezing.
- D. Electric heat cable shall be installed linearly along the bottom of the pipe and allowance shall be made for all fittings, valves, pipe supports, etc. Cable shall be installed prior to insulation of the piping system.
- E. Electric cable shall be capable of maintaining a minimum water temperature of 40 degrees F at an ambient air temperature of 0 degrees F.
- F. The electric cable shall be the self-regulating type that responds to varying localized temperature conditions by varying the heat output along its length. This shall be accomplished by a self-regulating core, which varies its resistance continuously with changes in temperature. A constant wattage heater is unacceptable.
- G. Provide a thermostat control, which de-energizes the heating cable when the ambient air temperature is above 40 degrees F (adjustable). The heat cable shall be entirely self-regulating while energized.
- H. Provide all power connection hardware, splices, end seals, etc., to accomplish installation. All hardware shall be by the same manufacturer as the cable.
- I. Electric heating cable and accessories shall be UL Listed. Electric heating cable shall conform to all requirements of Division 26 - Electrical Requirements.
- J. Electric heating cable shall be Raychem XL-Trace or approved equal, 5 watts per foot. Heat trace shall operate at 120 volts, A.C., without the use of transformers. Provide quantity of 120 volt branch circuits as required to serve heat trace load, maximum 1800 watts per circuit.
- K. All piping shall be insulated with 1" thick fiberglass insulation.

- L. Heating-cable circuit shall be protected by a ground-fault device for equipment protection. This requirement is in accordance with section 427-22 of the NEC-2002.
- M. All heating cable components shall be UL Listed, CSA Certified, or FM Approved for use as part of the system to provide pipe freeze protection. Component enclosures shall be rated NEMA 4X to prevent water ingress and corrosion. Installation shall not require the installing contractor to cut into the heating-cable core to expose the bus wires. Connection systems that require the installing contractor to strip the bus wires or that use crimps or terminal blocks, shall not be acceptable.

2.5 HEAT CABLE FOR TEMPERATURE MAINTENANCE OF PIPING

- A. Provide electric heat tracing on all domestic hot water piping to maintain the temperature of the water in the piping that is downstream of the hot water loop up to within 24" of the fixtures being served to meet all the mandates of the Green Code per the City of [Insert City Name].
- B. Manufacturers:
 - 1. Thermon
 - 2. Emerson-Chromalox
 - 3. Pyrotenax
 - 4. Briscoe
 - 5. Raychem
- C. Provide a complete system of self-regulating heating cable on all domestic hot water piping that is non-circulated. System shall be UL Listed, CSA Certified, or FM Approved system of heating cables, components, and controls to maintain water temperature.
- D. Electric heat cable shall be installed linearly along the top of the pipe when passing through pipe hangers and at the 4 or 8 o'clock position on linear runs and not compressed or pinched between two objects and allowance shall be made for all fittings, valves, pipe supports, etc. Penetrations through fire rated assemblies shall have its own sleeve sealed with fire resistant material equal to STI firestop. Attach the cable to the pipe every two feet with RAYCHEM AT-180 pipe tape. Cable shall be installed prior to insulation of the piping and after all testing of the hot water system is complete.
- E. Electric cable shall be capable of maintaining a minimum water temperature of 105 degrees F and a maximum temperature of 140 degrees F, at an ambient air temperature of 50 degrees F.
- F. The electric cable shall be the self-regulating type that responds to varying localized temperature conditions by varying the heat output along its length. This shall be accomplished by a self-regulating core, which varies its resistance continuously with changes in temperature. A constant wattage heater is unacceptable.
- G. Provide a thermostat control, which de-energizes the heating cable when the ambient air temperature is above 100 degrees F (adjustable). The heat cable shall be entirely self-regulating while energized.
- H. Provide all power connection hardware, splices, end seals, etc., to accomplish installation. All hardware shall be by the same manufacturer as the cable.
- I. Electric heating cable and accessories shall be UL Listed. Electric heating cable shall conform to all requirements of Division 26 - Electrical Requirements.

- J. Electric heating cable shall be Raychem HWAT-R2 or approved equal. Heat trace shall operate at 208 or 277 volts, A.C., without the use of transformers. Provide quantity of 208 or 277 volt branch circuits as required to serve heat trace load.
- K. All piping shall be insulated with minimum of 1" thick fiberglass insulation for piping up to 1" in diameter, for larger piping consult manufactures guidelines.
- L. Heating-cable circuit shall be protected by an integral ground-fault system for the HWAT-ECO-GF AND ACS-30 control system, so no additional protection is required.
- M. All heating cable components shall be UL Listed, CSA Certified, or FM Approved for use as part of the system to provide water temperature maintenance. Component enclosures shall be rated NEMA 4X to prevent water ingress and corrosion. Installation shall consist of a complete system of RayClic connection kits with a complete circuit that requires a power connection, an end seal and HWAT-ECO-GF controller to ensure proper water temperature. Splices and tees and other connection kits are used as needed. Installation shall be as recommended by the manufacturer.

2.6 FLASHING

- A. Vent pipes passing through roof shall be flashed watertight.
- B. The roof connections shall meet the approval of the manufacturer of the roofing materials and shall comply with the roof bond requirements.
- C. All vent piping shall be offset above ceilings or in attic space and as shown on the Drawings to penetrate roofs on the least visible sides of building.

2.7 FLOOR, WALL & CEILING PLATES

- A. Furnish and install heavy gauge chromium plated steel wall and ceiling plates on all exposed pipes in finished areas where they pass through walls, ceilings, etc. Plates shall be of type that will remain permanently in position and where pipes are insulated they shall be of size necessary to cover insulated pipe.

2.8 DRAIN PAN

- A. Furnish and install 18 - 24 ga galvanized steel pan under all plumbing pipes in the electrical room, IDF, and pan for the water heater. A drain pan shall have at least 2" in depth and extend 6" beyond the pipe or equipment.
- B. The drain pan shall be installed at least 6'-0" above electrical panel and gear access clearance and minimum within 6" below the pipe. Run copper drain line into the nearest floor receptacle or provide a float switch interface with BAS as applicable.
- C. Provide steel Unistrut and hanger for the drain pan support.
- D. Manufactures:
 - 1. Diversitech
 - 2. Killarney Metals
 - 3. Eastman
 - 4. Riverside Sheet Metal

2.9 TRACER WIRE

- A. General:
1. All trace wire and trace wire products shall be domestically manufactured in the U.S.A.
 2. All trace wire shall have HDPE insulation intended for direct bury, color coated per APWA standard for the specific utility being marked.
- B. Trace wire: (Copper clad Steel (CCS) trace wire)
1. Open-Trench Installation: direct burial #12 AWG Solid (0.0808" diameter), steel core soft drawn tracer wire, 250# average tensile break load, 30 mil high molecular-high density polyethylene jacket complying with ASTM-D-1248, 30volt rating. Color shall be "blue" for domestic water (potable) pipelines and "purple" for raw water (non-potable) pipelines. Manufactured by Copperhead Industries part number 1230-SF, or approved equal.
 2. Directional Bore or Jacked Installation: direct burial #12 AWG Solid (0.0808" diameter), steel core hard drawn extra high strength horizontal directional drill tracer wire, 1150# average tensile break load, 45 mil high molecular-high density polyethylene jacket complying with ASTM-D-1248, 30 volt rating. Color shall be "blue" for domestic water (potable) pipelines and "purple" for raw water (non-potable) pipelines. Manufactured by Copperhead Industries part number 1245-HS, or approved equal.
- C. Connectors: (Copper clad Steel (CCS) trace wire)
1. Splices along the continuous run of trace wire for repair of a wire break or replacement of failed segment of wire shall use 3M Brand DBR Direct Bury Splice Kit or approved equal. Approved alternatives must securely connect two or more wires, effectively moisture seal by means of a dielectric non-hardening silicone sealant, manufacturer approved for direct burial and rated for a minimum of 50V.
 2. Branch connections for laterals, turnouts, services and appurtenances shall use DryConn Direct Bury Lug Aqua, or approved equal. Approved alternatives must securely connect one or two wires to the main trace wire without cutting the main trace wire, effectively moisture seal by means of a dielectric non-hardening silicone sealant, manufacturer approved for direct burial and rated for a minimum of 50V.
 3. Non-locking, friction fit, twist-on or taped connectors are not acceptable. Twisting of copper wiring is not acceptable.
- D. Termination/Access: (Copper clad Steel (CCS) trace wire)
1. Terminal box, or "fink box", shall be flush mount type for installation at grade level. Terminal box shall be specifically manufactured for such application.
 2. Terminal Box shall consist of tubular housing, terminal board and removable round lid.
 3. Minimum dimensions shall be 5-1/2" diameter and 8" high. Base shall be sized to fit 4" schedule 40 PVC pipe.
 4. Housing and terminal board material shall be high strength ABS or polycarbonate plastic. All materials of construction shall be impervious to chemicals typically used for snow and ice removal and pavement and hardscape maintenance.
 5. Housing and lid shall be designed for service
 - a. Turf and landscape areas
 - 1) Light duty housing with plastic lid
 - b. Hardscape areas
 - 1) Heavy duty housing with cast iron or ductile iron lid
 - c. Roadway, driveway and parking lot applications not allowed

6. Terminal board shall have nickel plated brass terminals. Number of terminals shall be as required for specific installation with four spare terminals, minimum.
- E. Grounding: (Copper clad Steel (CCS) trace wire)
1. Grounding of trace wire shall be achieved by use of a drive-in magnesium grounding anode rod with a minimum of 20ft of #14 red HDPE insulated copper clad steel wire connected to anode (minimum 0.5 lb.) specifically manufactured for this purpose, and buried at the same elevation as the utility.
 2. Drive in Magnesium Anode: Copperhead Part # ANO-1005 (1.5 lb).

2.10 PIPING SYSTEMS IDENTIFICATION

- A. A marker showing the service and an arrow indicating the direction of flow shall be applied on all of the following piping systems applicable to the project installed under this section of the Specifications:
1. Acid vent piping
 2. Acid waste piping
 3. Condensate
 4. Domestic hot, cold, and hot water recirculation water piping
 5. Gas piping
 6. Storm drainage piping
 7. Overflow storm drainage piping
 8. Sanitary, waste and vent piping
- B. Piping identification shall be applied on all piping systems in areas of exposed construction and in areas with accessible or lay-in ceilings, as well as in the following locations:
1. Each wall, floor, and ceiling penetration (both sides).
 2. At connections to equipment.
 3. Close to valves or flanges.
 4. Intervals on straight pipe runs not to exceed 25 feet.
 5. Apply marker where view is obstructed.
- C. No adhesive labels shall be permitted, only "snap-around" or "snap-on" labels shall be permitted.
- D. The letter size and background color shall conform to the Identification of Pipe System ANSI A-13-1. Identify interior exposed piping and piping in accessible chases or plenums with a non-adhesive label by a manufacturer noted below, consisting of pipe marker and direction of flow arrow. Clean pipe prior to installation. Pipe markers shall consist of pipe system type and direction of flow arrow. Background colors of markers, arrows, and type for each type of system shall be the same. Meet ANSI / OSHA standards and clearly identify each system. Minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.
1. Vinyl plastic markers shall be manufactured by Seton Name-Plate Company (Snap-Around), W.H. Brady Company (Snap-On), or Westline "Tel-A-Pipe" Products (Snap-Around).
- E. Each valve in the Plumbing and Fire Protection systems is to be provided with an individually numbered valve tag (stamped numbered tags). Provide Identification Tags on all Emergency fixture and unit or Shut off valves.
- F. Valve tags are to be brass or plastic laminate, 1-1/2" minimum diameter with brass chain and hook for securing to the valve.

- G. Valve tags will include a "P" or "FP" lettering designation to indicate the appropriate system. Numbering shall be consecutive for each service of either the Plumbing or Fire Protection systems.
- H. A printed list or schematic drawing shall be compiled for each system indicating the location and detailed description of the system or equipment served.
- I. One copy of each list shall be framed and mounted at the location designated by the Building Engineer. An additional copy of each list is to be included in the Operations and Maintenance Manual.

2.11 EQUIPMENT LABELING

- A. All equipment shall be labeled. This shall include all pumps, water heaters, storage tanks, utility controllers and other similar equipment.
- B. Equipment labeling shall be with the followings, unless noted or specified otherwise.
 - 1. Submit schedule of equipment to be included and designations.
 - 2. Provide nameplates with 1/2" high letters and fastened with epoxy or screws.

PART 3 - EXECUTION

3.1 OWNER INSTRUCTION - GENERAL

- A. Provide on-site Owner training for all new equipment by factory trained specialists.
- B. Use Operation and Maintenance manuals and actual equipment installed as basis for instruction.
- C. At conclusion of on-site training program have Owner personnel sign written certification they have completed training and understand equipment operation. Include copy of training certificates in final Operation and Maintenance manual submission.
- D. No retainage shall be released until Owner has received all Operations and Maintenance manuals and as-built drawings and first O&M walk.
- E. Refer to individual equipment specifications for additional training requirements.
- F. All equipment and materials shall be completely installed, adjusted, and fully operational with all accessories and connections.
- G. Equipment, piping, ductwork, etc. shall fit into the spaces provided in the building and shall be installed at such times and in such a manner as to avoid damage and as required by the job progress. The Contractor shall coordinate work with other trades and locate work described herein to avoid interferences with structural, electrical and architectural work. Equipment, accessories and similar items requiring normal servicing or maintenance shall be accessible.
- H. The Engineer reserves the right to direct the removal of any item which, in his opinion, does not present an orderly and reasonably neat or workmanlike appearance. Such removal and replacement shall be done when directed by the Engineer and without additional cost to the Owner.
- I. Mounting heights, unless otherwise noted, are to the finished bottom of the device.

3.2 INSTRUCTION OF OWNER'S PERSONNEL

- A. Prior to final inspection, conduct an on-site training program to instruct the Owner's operating personnel in the operation and maintenance of the mechanical systems.
 - 1. Provide the training during the Owner's regular working day.
 - 2. The Instructors shall each be experienced in their phase of operation and maintenance of building mechanical systems and with the project.
- B. Time to be allocated for instructions.
 - 1. Minimum of 8 hours dedicated instructor time.
 - 2. 4 hours on each of 2 days.
- C. Before proceeding with the on-site training program, submit the program syllabus; proposed time and dates; and other pertinent information for review and approval.
 - 1. One copy to the Owner.
 - 2. One copy to the Architect/Engineer.
- D. The Owner will provide a list of personnel to receive instructions, and will coordinate their attendance at the agreed upon times.
- E. Use the operation and maintenance manuals as the basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut down of each item of equipment.
- G. Demonstrate equipment functions (both individually and as part of the total integrated system).
- H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.
- I. Submit a report within one week after completion of the training program that instructions have been satisfactorily completed. Give time and date of each demonstration and hours devoted to the demonstration, with a list of people present.
- J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.
- K. Provide a copy of the report and the certificate in an appropriately tabbed section of each "Operation and Maintenance Manual":

3.3 GENERAL REQUIREMENTS

- A. All equipment and materials shall be completely installed, adjusted, and fully operational with all accessories and connections.
- B. Equipment, piping, ductwork, etc. shall fit into the spaces provided in the building and shall be installed at such times and in such a manner as to avoid damage and as required by the job progress. The Contractor shall coordinate work with other trades and locate work described herein to avoid interferences with structural, electrical and

architectural work. Equipment, accessories and similar items requiring normal servicing or maintenance shall be accessible.

- C. The Engineer reserves the right to direct the removal of any item which, in his opinion, does not present an orderly and reasonably neat or workmanlike appearance. Such removal and replacement shall be done when directed by the Engineer and without additional cost to the Owner.
- D. Mounting heights, unless otherwise noted, are to the finished bottom of the device.

3.4 STORAGE AND PROTECTION OF MATERIALS

- A. During construction, all equipment shall be properly protected against damage, defacing and freezing with shipping cartons, plastic sheeting, shipping covers, etc.
- B. All open ends of piping and equipment shall be sealed with nipples and caps, plugs, test plugs until final connection to system is made.
- C. All equipment and piping shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction with covers by Sioux Chief, Zurn or the followings.
 - 1. Floor sink opening – Cover with heavy duty plywood or heavy-duty plastic cover by SmartGuard (using duct tape is not acceptable).
 - 2. Floor drain – Plastic cover by SmartGuard, Mifab allstar or equal (using duct tape is not acceptable).
 - 3. Pipe – Plastic cover by SmartGuard or equal (using duct tape is not acceptable).
 - 4. Fixtures – Provide plastic cover until final punch.
 - 5. Clean-out top - Mifab allstar or equal (using duct tape is not acceptable)
- D. Handle and store materials in accordance with manufacturer's and supplier's recommendations and in manner to prevent damage to materials during storage and handling. Replace damaged materials.
- E. Equipment and materials shall not be installed until such time as the environmental conditions of the job site are suitable to protect the equipment or materials. Equipment or materials damaged or which are subjected to these elements are unacceptable and shall be removed from the premises and replaced.

3.5 EXISTING WORK

- A. Disconnect mechanical, plumbing and fire protection systems in walls, floors, and ceilings scheduled for removal.
- B. Provide all required connections to maintain existing systems in service during construction.
- C. When performing work on operating systems use personnel experienced and trained in similar operations.
- D. Remove, relocate, and extend existing installations to accommodate new construction.
- E. Repair adjacent construction and finishes damaged during demolition and extension work.

- F. Normal facility activities will continue in existing areas. MEP systems servicing existing occupied spaces will have to be maintained in service. Schedule any required outages and system service interruptions with Owner and Architect. Submit a written request indicating service(s) to be interrupted along with proposed duration and summary of work to be performed during downtime.
- G. Removed Equipment:
 - 1. Store removed items at site; Owner retains rights to all removed items.
 - 2. Allow Owner ample time to review removed items and to designate which items to be kept by Owner.
 - 3. Dispose properly, off-site, all items Owner chooses not to keep.

3.6 DEMOLITION AND EXTENSION OF EXISTING MECHANICAL WORK

- A. Remove, relocate and extend existing installations to accommodate new construction.
- B. Remove abandoned piping to source of supply.
- C. Remove exposed abandoned piping systems, including abandoned systems above accessible ceiling finishes. Cut systems flush with walls and floors, and patch surfaces.
- D. Repair adjacent construction and finishes damaged during demolition and extension work.
- E. Maintain access to existing installations which remain active. Modify installation or provide access panels as appropriate.
- F. Extend existing installations using materials and methods compatible with existing installations, or as specified.

3.7 REMOVAL OF MATERIALS

- A. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage destination as directed by the Owner. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The contractor may, at his discretion and upon the approval of the Owner, substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.
- B. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean and repair and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involves.
- C. When items scheduled for relocation are found to be in damaged condition before work has been started on dismantling, the contractor shall call the attention of the Owner to such items and receive further instructions before removal. Items damaged in repositioning operations are the contractor's responsibility and shall be repaired or replaced by the contractor as approved by the Owner, at no additional cost to the Owner.

- D. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Owner. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner as hereinbefore specified.
- E. Include in the contract price all rerouting of existing conduits, wiring, outlet boxes, fixtures, etc., and the reconnecting of existing fixtures as necessitated by field conditions to allow the installation of the new systems. Furnish all temporary conduit, wiring, boxes, etc., as required to maintain lighting and power service for the existing areas with a minimum of interruption. Remove wire and conduit back to nearest accessible active junction box and extend to existing homeruns as required.
- F. The Contractor shall be responsible for loss or damage to the existing facilities and shall be responsible for repairing such loss or damage. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection and operational maintenance of all electrical services for the new and existing facilities, The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work.
- G. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork and equipment, etc., to provide this access and shall reinstall same upon completion of work in the areas affected.
- H. Where partitions, walls, floors, or ceilings of existing construction are being removed, all contractors shall remove and reinstall in locations approved by the Architect all devices required for the operation of the various systems installed in the existing construction

3.8 EXCAVATION, TRENCHING & BACKFILLING

- A. The Contractor shall perform all excavation to install the work herein specified and as indicated on the Drawings. During excavation, material for backfilling shall be piled back from the banks of the trench to avoid overloading and to prevent slides and cave-ins. All excavated materials not to be used for backfill shall be removed and disposed of by the Contractor. Grading shall be done to prevent surface water from flowing into trenches and others excavation and any water accumulating therein shall be removed by pumping. All excavation shall be made by open cut. No tunneling or boring shall be done except under pavement.
- B. The bottom of the trenches shall be graded to provide uniform bearing and support for conduits, cables, or duct bank on undisturbed soil at every point along its entire length. Overdepths shall be backfilled with loose, granular, moist earth, and tamped in 12" layers. Remove unstable soil that is not capable of supporting equipment or installation and replace with specified material for a minimum of 12" below invert of equipment or installation.
- C. The Contractor shall coordinate and provide pipe supports as required per structural drawings for any void form system, exiting the building or special requirements on backfill. As such, all piping shall be supported by an approved suspended system.

1. System Structure:
 - a. Provides a dimensionally stable underground void space that is independent from the overhead structural slab. The subterranean system shall support the weight of suspended lateral pipes, including all imposed loads, throughout the construction process.
 - b. The system shall be designed to have the ability to temporarily position and suspend the lateral pipes to the specified height and slope until permanently anchored to the overhead structural slab via securing hanger system. The open, underground system will then remain independent from the securing hangers.
 - c. The open space of the system beneath the structural slab is design to receive infill of vertical expansion from the underlying soils. If vertical pressure is applied to the edges of the system in contact with the soil, the uplifting soil pressure will become separate and allow the lateral pipes to be totally independent from the system.
 2. System components:
 - a. The system must maintain its structural integrity in all humid environment and shall have waterproof components related to its intended performance. All system components, excluding all-thread, nuts/washer. Shall be furnished by the designed, system manufacturer.
 - b. All vertical all-thread must have a component secured toward the top end and the permanent affixed into the concrete slab in order to maintain the specified elevations.
 - c. System shall be installed per manufacturer's requirements and recommendations.
- D. The trenches shall be backfilled with the excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel or soft shale, free from large clods of earth and stones, deposited in 6" layers and tamped until the crown of the pipe is covered by a minimum of 6" of tamped earth. The backfill under and beside the pipe shall be compacted for pipe support. Backfill shall be brought up evenly on both sides of the pipe so that the pipe remains aligned. In instances where the manufacturer's installation instructions for materials are more restrictive than those prescribed by the code, the material shall be installed in accordance with the more restrictive requirement. The backfilling shall be carried on simultaneously on both sides of the trench so that injurious pressures do not occur. The compaction of the filled trench shall be at least equal to 95% of the maximum density as determined by the Standard Proctor Test. Settling the backfill with water will not be permitted. Reopen any trenches not meeting compaction requirements or where settlement occurs, refill, compact, and restore the surface to the grade and compaction indicated, mounded over and smoothed off. A metallic lined underground warning tape shall be provided 12" below finished grade. The tape shall be identified as to the type of line per ANSI standard nomenclature and color.
- E. The trenches shall be backfilled with cement stabilized sand materials approved for backfilling, deposited in 6" layers and tamped until the crown of the pipe is covered by a minimum of 6" of material.
1. Use sand-cement mixture producing minimum unconfined compressive strength of 100 pounds per square inch (psi) in 48 hours.
 - a. Design will be based on strength specimens molded in accordance with ASTM D 558 at moisture content within 3 percent of optimum and within 4 hours of batching.
 - b. Determine minimum cement content from production data and statistical history. Provide no less than 1.1 sacks of cement per ton of dry sand.

2. Cement: Type I Portland cement conforming to ASTM C 150.
 3. Sand: Clean, durable sand meeting grading requirements for fine aggregates of ASTM C 33, or requirements for bank sand below, and the following requirements:
 - a. Classified as SW, SP, SW-SM, SP-SM, or SM by Unified Soil Classification System of ASTM D 2487.
 - b. Deleterious materials:
 - 1) Clay lumps, ASTM C 142 - less than 0.5 percent.
 - 2) Lightweight pieces, ASTM C 123; less than 5.0 percent.
 - 3) Organic impurities, ASTM C 40, color no darker than standard color.
 - 4) Plasticity index of 4 or less when tested in accordance with ASTM D 4318.
- F. Provide a layer of sand at least 6" deep under all plastic pipe installed in soil. Bell holes shall be excavated to ensure that the sewer pipe rests for its entire length upon a solid trench bottom.
- G. Tracer wires shall be installed adjacent to nonmetallic underground water, gas and main sewage lines under the building pad and stubbed up into a ground test well enclosure so that the tracer can connect to it. Tracer wire shall be color coded; yellow for natural gas; green for storm and sanitary sewer; and blue for potable water.
1. Installation:
 - a. Trace wire shall be installed in the same trench and inside bored holes and casing with pipe during pipe installation. It shall be secured to the pipe as required to insure that the wire remains adjacent to the pipe. The trace wire shall be securely bonded together at all wire joints with an approved watertight connector to provide electrical continuity, and it shall be accessible at all trace wire access points.
 - b. Except for approved spliced-in repair or replacement connections, tracer wire shall be continuous and without splices from each trace wire access point.
 - c. The tracer wire system shall be installed as a continuous single wire. No looping or coiling of wire is allowed.
 - d. Prior to backfill, install tracer wire on top of pipe and secure in place with ties or hitches at maximum 10-foot intervals in accordance with the Water Utilities Manual. Run tracer wire continuously along pipe and terminate in access points. Only adjacent valve boxes are acceptable access points. Where buried splices occur, use an electrical splicing kit 3M Brand DBR Direct Bury Splice Kit, or AGENCY approved equal. Provide no less than 24 inches of coiled wire at access points for attachment of pipe locating equipment. Each installed run of pipe shall be capable of being located using the tracer wire. Protect wire insulation from damage during installation and backfilling. Wire insulation that is broken, cut, or damaged shall be replaced.
 - e. At the point of connection between existing conductive pipes, the tracer wire shall not be connected to the iron pipe. This circumstance shall be treated as a mainline dead-end grounded using an approved waterproof connection to a grounding anode, buried at the same depth as the tracer wire. All such connection points shall be grounded.
 - f. Where existing tracer wire is encountered on an existing utility that is being extended or tied into, the new and existing tracer wire shall be connected using approved splice connectors, shall be properly grounded at the splice location as specified, and shall be completely waterproof to prohibit corrosion and loss of conductivity.
 - g. Tracer wire shall be laid flat and securely affixed to the pipe at the three o'clock position. The wire shall be protected from damage during the

- execution of the works. No breaks or cuts in the tracer wire or tracer wire insulation shall be permitted. At service saddles, the tracer wire shall not be allowed to be placed between the saddle and the main.
- h. At all main end caps, a minimum of 6 feet of tracer wire shall be extended beyond the end of the pipe, coiled and secured to the cap for future connections. The end of the tracer wire shall be spliced to the wire of a six pound zinc anode and is to be buried at the same elevations as the main. The tracer wire from the end cap shall be brought to a surface into test station box within the public right-of-way for future access.
 - i. Trace wire access points shall be accessible at all new water valve boxes. Concentrations of multiple proposed valves near pipe intersections, i.e. tees or crosses, may require more than one access point assembly in each concrete valve box collar.
 - j. At the point of connection between ductile iron water mains, with any non iron main, the tracer wire shall be properly connected to the iron pipe with a cad weld or approved equivalent. Tracer wire welds shall be completely sealed with the use of an approved mastic type sealer specifically manufactured for underground use. Mastic shall be applied in a thick coat a minimum of one quarter inch (1/4") thick and shall be protected from contamination by the backfill material with the use of a plastic membrane.
 - k. Trace wire systems must be installed as a single continuous wire, except where using approved connectors. No looping or coiling of wire is allowed.
 - l. Any damage occurring during installation of the trace wire must be immediately repaired by removing the damaged wire, and installing a new section of wire with approved connectors. Taping and/or spray coating shall not be allowed.
 - m. Open trench method:
 - 1) Tracer wire shall be placed a minimum of 8 inches above buried natural gas piping and nonmetallic piping for any service. For other utility piping systems tracer wire shall be laid directly upon pipe and attached at 8-10 ft. intervals with non-conductive tape. Additional attachment shall be provided at offsets and fittings in piping system. Tracer wire shall be placed carefully and great care shall be exercised during backfilling operations to maintain physical integrity and position relative to piping.
 - 2) Splices in tracer wire shall be kept to an absolute minimum. When splices are necessary they shall be made with tracer wire connectors as specified above. Other splicing methods not allowed.
 - n. Directional drilling method:
 - 1) Two tracer wires shall be provided with one wire as backup.
 - 2) Tracer wires shall be pulled through bore hole in conjunction with utility pipe. Wires shall be located on opposite sides of utility pipe.
 - 3) Tracer wire splices are not allowed in drilled sections.
 - o. Tracer wires shall be interconnected at intersections of mainlines and branches utilizing single three-way connector at each point of connection.
 - p. At a minimum, a terminal box shall be provided at each building utility service entrance and shall be located above piping within 5 ft. of point of entry into building.
 - q. Terminal boxes shall be located no greater than 1,000 linear feet of developed pipe length apart.

- r. Terminal boxes shall not be located in streets, drives, parking lots or other areas subject to vehicular traffic. Terminal boxes shall not be located in areas where access to box is impeded.
- s. Terminal boxes shall be installed flush with finished grade and centered in grade level concrete pad. Concrete pad shall be 18" by 18" minimum and shall be 6" thick.
- t. PVC pipe riser shall be firmly attached to bottom of terminal box housing and extended downward to an elevation approximately 12" above piping. Riser shall serve as a vertical conduit for guiding tracer wires into bottom of terminal box.
- u. Care shall be taken to extend tracer wire from utility pipe to terminal box in an orderly manner as backfill is placed.
- v. End of each tracer wire shall be properly landed on dedicated terminal within terminal box and securely tightened. 12-18" excess length shall be provided for each wire within box. Each terminal shall be clearly identified with permanent label. Where tracer wires for multiple utilities are terminated care shall be taken to ensure accuracy of identification at both ends.

2. Testing:

- a. All new trace wire installations shall be located using typical low frequency (512Hz) line tracing equipment, witnessed by the contractor, engineer and facility owner as applicable, prior to acceptance of ownership.
- b. This verification shall be performed upon completion of rough grading and again prior to final acceptance of the project.
- c. Final testing of each tracer wire shall be performed after backfill is complete and terminal boxes have been permanently installed and wires terminated. Test shall be witnessed by AE and Owner. It may be advisable for Contractor to perform preliminary test(s) during utility installation prior to final backfill and restoration. Testing shall be accomplished using typical low frequency line tracing equipment. Continuity testing in lieu of actual line tracing is not acceptable.

- H. Perform excavation and backfilling work in accordance with applicable portions of the earthwork section.

3.9 CONCRETE WORK

- A. Construct curbs, pads, vaults and similar supports for equipment where required.
- B. First floor and equipment yard: Provide minimum of 6" thick housekeeping pads at floor mounted equipment a minimum of 4" larger than the entire area occupied by equipment. The pads at the equipment yard must be elevated at 6" above finished floor (1st floor).
- C. Second floor and above: Provide 4" thick housekeeping pads at floor mounted equipment a minimum of 4" larger than the entire area occupied by equipment. Dowel pads to structural slab.
- D. Perform concrete work in accordance with applicable portions of Concrete sections. Minimum compressive strength of concrete shall be same as specified for slabs on grade.

3.10 CLEANING

- A. General cleaning of piping systems. Purge pipe of construction debris and contamination before placing the systems in service. Provide and install temporary connections as required to clean, purge and circulate.
- B. After all equipment has been installed, but prior to testing and balancing, all equipment, piping, etc. shall be thoroughly cleaned both inside and out with the following minimum requirements.
 - 1. Install temporary strainers at the inlet of pumps and other equipment as necessary where permanent strainers are not indicated. Keep strainers in service until the equipment has been tested, then remove either entire strainer or straining element only. Fit strainers with a line size blow down ball valve and pipe to nearest drain. Blow down strainers, remove and clean as frequently as necessary.
 - 2. Phase One: Initial flushing of system. Remove loose dirt, mill scale, weld beads, rust and other deleterious substances without damage to system components. Open valves, drains, vents and strainers at all system levels during flushing procedures. Flush until "potable water clear" and particles larger than 5 microns are removed.
 - 3. Connect dead-end supply and return headers, even if not shown on the drawings, and provide terminal drains in bottom of pipe end caps or blind flanges.
 - 4. Dispose of water in approved manner.
 - 5. Phase Two: Cleaning of Piping Systems. Remove, without chemical or mechanical damage to any system component, adherent dirt (organic soil), oil, grease, (hydrocarbons), soldering flux, mill varnish, piping compounds, rust (iron oxide) and other deleterious substances not removed by initial flushing. Flush system and replace with clean water.
 - 6. Phase Three: Final flushing and rinsing: Flush and rinse until "potable water clear" and particles larger than 5 microns are removed. Operate valves to dislodge any debris in valve body. Dispose of water in approved manner.
 - 7. Submit status reports upon completion of each phase of work on each system.
- C. After testing and balancing of systems as specified and just prior to Owner review and acceptance, all systems shall be finally cleaned and shall be left ready for use.

3.11 TESTING OF PIPING SYSTEMS

- A. General
 - 1. All piping systems shall be subjected, before being insulated or concealed, to testing with water or air as noted and shall hold tight at the pressure head stated for the time interval required without adding air or water. While any system is being tested required head or pressure shall be maintained until all joints are inspected.
 - 2. All tests shall be witnessed by the inspector having jurisdiction and the Owner's Representative, with a minimum 48-hour notice given these authorities.
 - 3. All equipment, material, labor and testing mediums required for testing any of the various systems or any part thereof shall be furnished by the Contractor.
 - 4. All connected equipment, accessories, etc. shall be isolated from piping systems prior to testing.
- B. Sanitary Piping Systems

1. Water test shall be applied to these drainage systems either in their entirety or in sections as required, after rough piping has been installed. If the system is tested in sections, each opening shall be tightly closed except the highest opening in the section under test. All sections shall be tested with a minimum of 10 feet of head. In testing successive sections, at least the upper 10 feet of the next section shall be tested so that no joint of piping in the building shall be submitted to a test of less than 10 feet of head. The water shall be kept in the system for at least 30 minutes before inspection starts; the system shall then be made tight at all points.
 2. Any points of the drainage systems to be tested with air instead of water shall be made by attaching an air compressor testing apparatus to any suitable opening and after closing all other inlets or outlets, forcing air into the system until there is a minimum gauge pressure of 5 psi. This pressure shall be held without the introduction of additional air for a period of at least 30 minutes.
 3. Exterior connections shall be tested as part of the interior systems.
- C. Interior Water Piping Systems
1. Upon completion of the entire water supply system or a section of it as required, it shall be tested prior to connection of fixtures and proved tight under a water/air pressure of 150 psi. Pressure shall hold for a period of one hour without introducing additional water/air. Water used for testing shall be from a potable source of supply. Defective joints or piping shall be replaced as required and all piping shall be retested.
- D. Exterior Water Piping System
1. All exterior domestic water piping shall be tested to 150 psi for a period of two hours.
- E. Defective Work
1. If inspection or tests show defects, such defective work or material shall be replaced and inspection and tests shall be repeated. All repairs to piping shall be made with new material. Caulking of screwed joints or holes is not acceptable.
- F. Additional Tests
1. Provide all additional tests such as smoke or pressure tests as required by the regulations or as directed by authorities making the inspection.
 2. Provide for any repeated test as directed by the Owner's Representative, to make all systems tight as required.
 3. Visual inspections of joints, valves, etc. shall be made as directed by the Engineer.

3.12 OPERATING TESTS

- A. After all mechanical systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect/Engineer. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

3.13 DISINFECTION OF WATER SYSTEM - INTERIOR AND EXTERIOR

- A. Prior to project completion, all potable water piping systems shall be disinfected per local code requirements.
- B. Whenever the authority having jurisdiction does not specify disinfection procedures, the new water piping system shall be thoroughly disinfected with a solution containing not less than 50 parts per million of available chlorine. The chlorinating material shall be either liquid chlorine or sodium hydrochloride solution, shall be introduced into the system and drawn to all points in the system. The disinfection solution shall be allowed to remain in the system for a period of eight hours, during which period all valves and faucets shall be opened and closed several times. After disinfection, the solution shall be flushed from the system with clear water until the residual chlorine content is not greater than 0.2 parts per million.
- C. This work is to be supervised or performed by an approved chemical testing laboratory and results sent to Engineer or his representative for verification.

3.14 OPERATION AND MAINTENANCE MANUALS

- A. Form of Manuals:
 - 1. Prepare data in form of an instructional manual for use by Owner's personnel.
 - 2. Format:
 - a. Size: 8-1/2" x 11".
 - b. Text: Manufacturer's printed data or neatly typewritten
 - 3. Drawings:
 - a. Provide reinforced punched binder tab and bind in text.
 - b. Fold larger drawings to size of text pages.
 - 4. Provide fly leaf indexed tabs for each separate product or each piece of operating equipment
 - 5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
 - a. Title of Project
 - b. Identity of separate structures as applicable.
 - c. Identity of general subject matter covered in the manual
 - 6. Binder as specified.
- B. Content of Manual:
 - 1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
 - a. Contractor, name of responsible principal, address and telephone number.
 - b. A list of each product required to be included, indexed to content of the volume.
 - c. List with each product, name, address and telephone number of:
 - 1) Subcontractor or installer
 - 2) Maintenance contractor as appropriate.
 - 3) Identify area of responsibility of each
 - 4) Local source of supply for parts and replacement
 - d. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
 - 2. Product Data:
 - a. Include those sheets pertinent to the specific product.
 - b. Annotate each sheet to:
 - 1) Identify specific product or part installed.
 - 2) Identify data applicable to installation.
 - 3) Delete references to inapplicable information. (All options not

supplied with equipment shall be marked out indicated in some manner).

3. Drawings:
 - a. Supplement product data with drawings as necessary to illustrate:
 - 1) Relations of component parts of equipment and systems.
 - 2) Control and flow diagrams.
 - b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
 - c. Do not use Project Record Documents as maintenance drawings.
 4. Written text, as required to supplement product data for the particular installation:
 - a. Organize in consistent format under separate headings for different procedures.
 - b. Provide logical sequence of instructions for each procedure.
 5. Copy of each warranty, bond and service contract issued.
 - a. Provide information sheet for Owner's personnel, giving:
 - 1) Proper procedures in event of failure.
 - 2) Instances that might affect validity of warranties or bonds
 6. Shop drawings, coordination drawings and product data as specified.
- C. Sections for Equipment and Systems
1. Content for each unit of equipment and system as appropriate:
 - a. Description of unit and component parts
 - 1) Function, normal operating characteristics, and limiting conditions.
 - 2) Performance curves, engineering data and tests.
 - 3) Complete nomenclature and commercial number of replaceable parts
 - b. Operating procedures:
 - 1) Start up, break-in, routine and normal operating instructions.
 - 2) Regulation, control, stopping, shut down and emergency instructions.
 - 3) Summer and winter operating instructions.
 - 4) Special operating instructions
 - c. Maintenance procedures:
 - 1) Routine operations
 - 2) Guide to trouble-shooting.
 - 3) Disassembly, repair and reassembly.
 - 4) Alignment, adjusting and checking.
 - 5) Routine service based on operating hours.
 - d. Servicing and lubrication schedule. List of lubricants required.
 - e. Manufacturer's printed operating and maintenance instructions.
 - f. Description of sequence of operation by control manufacturer
 - g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
 - 1) Predicted life of part subject to wear.
 - 2) Items recommended to be stocked as spare parts.
 - h. As installed control diagrams by controls manufacturer.
 - i. Complete equipment internal wiring diagrams.
 - j. Each Contractor's coordination drawings.
 - k. As installed color coded piping diagrams.
 - l. Charts of valve tag number, with location and function of each valve.
 - m. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
 - n. Other data as required under pertinent sections of the specifications.
 2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
 3. Additional requirements for operating and maintenance data as outlined in

respective sections of specifications

4. Provide complete information for products specified in Division 22.
5. Provide certificates of compliance as specified in each related section.
6. Provide start up reports as specified in each related section.
7. Provide signed receipts for spare parts and material.
8. Provide training report and certificates.
9. Provide backflow preventer certified test reports.
10. Provide gas piping pressure test report.

END OF SECTION 22 05 00

SECTION 22 05 10 – SANITARY PIPE TESTING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Acceptance testing of sanitary sewers including:
 - 1. Visual inspection of sewer pipes.
 - 2. Leakage testing of sewer pipes.
 - 3. Leakage testing of manholes/sampling well/interceptor.
 - 4. Television and Video Inspection.
- B. All tests listed in this Section are not necessarily required on this Project. Required tests are named in other Sections which refer to this Section for testing criteria and procedures.

1.3 MEASUREMENT AND PAYMENT

- A. Unit Prices.
 - 1. No payment will be made for acceptance testing under this Section. Include payment in unit price for work requiring acceptance testing.
 - 2. Refer to related Section - Measurement and Payment for unit price procedures

1.4 REFERENCES

- A. ASTM C 828 - Standard Test Method for Low Pressure Air Test of Vitrified Clay Pipe Lines.
- B. ASTM C 924 - Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method.
- C. ASTM D 3034 - Standard Specification for Type PSM Polyethylene (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- D. ASTM F 794 - Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
- E. ASTM F 1417 - Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air.
- F. ASTM C 1244 Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.

1.5 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data:

1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
- C. Test Plan: Before testing begins and in adequate time to obtain approval through submittal process, prepare and submit test plan for approval by Project Manager. Include testing procedures, methods, equipment, and tentative schedule. Obtain advance written approval for deviations from Drawings and Specifications.
- D. Manufacturer's Installation Instructions: Submit special procedures.
- E. Test Reports: Submit test reports for each test on each segment of sanitary sewer.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.
- B. Operation and Maintenance Data: Submit adjustment instructions.

1.7 QUALITY ASSURANCE

- A. Gravity flow sanitary sewers are required to have straight alignment and uniform grade between cleanouts and pipe junctions.
- B. Must meet Texas Commission on Environmental Quality (TCEQ) Testing Requirements Chapter-217-57.
- C. Repair, correct, and retest manholes or sections of pipe which fail to meet specified requirements when tested.
- D. Provide testing reports and video tape of television inspection as directed by Project Manager.
- E. Upon completion of tape reviews by Project Manager, Contractor will be notified regarding final acceptance of sewer segment.

1.8 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience.
- B. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.9 SEQUENCE AND SCHEDULING

- A. Perform testing as work progresses. Schedule testing so that no more than 1000 linear feet of installed sewer remains untested at one time.
- B. Coordinate testing schedules with Project Manager. Perform testing under observation of Project Manager.

1.10 WARRANTY

- A. Furnish five (5) year manufacturer warranty for leak free performance of packed expansion joints.

PART 2 - PRODUCTS

2.1 EXFILTRATION TEST

- A. Backflow Preventer: Provide a transient Backflow Preventer to use when water for testing will be taken from building system. Conform to local code requirements for type of backflow preventer use.
- B. Test Equipment:
 - 1. Pipe plugs.
 - 2. Pipe risers with 10-foot head of water (clear marked).

2.2 LOW PRESSURE AIR TEST

- A. Minimum Requirement for Equipment:
 - 1. Control panel.
 - 2. Low-pressure air supply connected to control panel.
 - 3. Pneumatic plugs: Acceptable size for diameter of pipe to be tested; capable of withstanding internal test pressure without leaking or requiring external bracing.
 - 4. Air hoses from control panel to:
 - a. Air supply.
 - b. Pneumatic plugs.
 - c. Sealed line for pressuring.
 - d. Sealed line for monitoring internal pressure.
- B. Testing Pneumatic Plugs: Place pneumatic plug in each end of length of pipe on ground. Pressurize plugs to 25 psig; then pressurize sealed pipe to 5 psig. Plugs are acceptable when they remain in place against test pressure without external aids.

2.3 SMOKE TESTING

- A. Equipment:
 - 1. Pneumatic plugs.
 - 2. Smoke generator as supplied by Superior Signal Company, or approved equal.
 - 3. Blowers producing 2500 scfm minimum.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Provide labor, equipment, tools, test plugs, risers, air compressor, air hose, pressure meters, pipe probe, calibrated weirs, or any other device necessary for proper testing and inspection.
- B. Isolate each floor or section being tested by inserting plugs into the test tees in the stacks. Plug or cap all other openings with test plugs or test caps
- C. If a cleanout or check valve has not been installed at the easement/property line, the cleanout or check valve shall be installed prior to testing. If there is no cleanout located outside the building foundation (within five feet of the foundation wall), then a cleanout

shall be installed. If the building lateral exits the foundation under an existing deck or concrete patio, the location of the building cleanout near the foundation may be modified on a case-by-case basis as determined by the Owner/Engineers.

3.2 VISUAL INSPECTION OF GRAVITY SANITARY SEWERS

- A. Check pipe alignment visually by flashing light between structures. Verify if alignment is true and no pipes are misplaced. In case of misalignment or damaged pipe, remove and relay or replace pipe segment.
- B. Cut 10'-0" pipe section and inspect to determine the integrity of the pipe condition

3.3 LEAKAGE TESTING FOR GRAVITY SYSTEM PIPES

- A. For a gravity system pipe that will transport wastewater by gravity flow, test gravity sanitary sewer pipes for leakage by either exfiltration or with low pressure air testing.
- B. Compensating for Ground Water Pressure:
 - 1. Where ground water exists, install pipe nipple at same time sewer line is placed. Use 1/2-inch capped pipe nipple approximately 10 inches long. Make installation through manhole wall on top of sewer line where line enters manhole.
 - 2. Immediately before performing line acceptance test, remove cap, clear pipe nipple with air pressure, and connect clear plastic tube to nipple. Support tube vertically and allow water to rise in tube. After water stops rising, measure height in feet of water over invert of pipe. Divide this height by 2.3 feet/psi to determine ground water pressure to be used in line testing.
- C. Drainage and Vent water test
 - 1. Determine ground water elevation.
 - 2. Plug sewer in downstream manhole, cleanout, vent, or floor as necessary.
 - 3. Plug incoming pipes in upstream manhole, cleanout, vent, or floor as necessary.
 - 4. Install riser pipe in outgoing pipe of upstream manhole when highest point in service lead (house service) is less than 12 feet the test pipe.
 - 5. A water test shall be applied to the drainage system either in its entirety or in sections. If applied to the entire system, all openings in the piping shall be tightly closed, except the highest opening, and the system shall be filled with water to the point of overflow. If the system is tested in sections, each opening shall be tightly plugged except the highest openings of the section under test, and each section shall be filled with water, but no section shall be tested with less than a 10-foot (3048 mm) head of water. In testing successive sections, at least the upper 10 feet (3048 mm) of the next preceding section shall be tested so that no joint or pipe in the building, except the uppermost 10 feet (3048 mm) of the system, shall have been submitted to a test of less than a 10-foot (3048 mm) head of water. This pressure shall be held for not less than 15 minutes.
- D. Drainage and Vent air test.
 - 1. Determine ground water elevation.
 - 2. Plug sewer in downstream manhole, cleanout, vent, or floor as necessary.
 - 3. Plug incoming pipes in upstream manhole, cleanout, vent, or floor as necessary.
 - 4. Plastic piping shall not be tested using air. An air test shall be made by forcing air into the system until there is a uniform gauge pressure of 5 psi (34.5 kPa) or sufficient to balance a 10-inch (254 mm) column of mercury. This pressure shall be held for a test period of not less than 15 minutes. Any adjustments to the test pressure required because of changes in ambient temperatures or the seating of gaskets shall be made prior to the beginning of the test period.

- E. Drainage and vent final test.
 - 1. The final test of the completed drainage and vent systems shall be visual and in sufficient detail to determine compliance with the provisions of local code. Where a smoke test is utilized, it shall be made by filling all traps with water and then introducing into the entire system a pungent, thick smoke produced by one or more smoke machines. When the smoke appears at stack openings on the roof, the stack openings shall be closed and a pressure equivalent to a 1-inch water column (248.8 Pa) shall be held for a test period of not less than 15 minutes.

3.4 AS-BUILT DRAWINGS

- A. The Contractor shall maintain a record set of drawings indicating all changes in the work from that shown in the Contract Documents. Prior to final acceptance by the Owner, the Contractor shall assemble the complete set of as-built drawings that accurately reflects all changes to indicate actual final construction. All concealed piping shall be dimensionally located from at least two (2) column lines or major building structure elements. Drawings shall be a minimum of 1/8" scale.
- B. Prior to transmittal of corrected drawings, obtain 3 sets of blue-line prints of each drawing, regardless of whether corrections were necessary and include in the transmittal (2 sets are for the Owner's use and one set is for the Architect/Engineer's records). Delivery of these as-built prints and reproducible is a condition of final acceptance. Provide record drawings on one set each (reproducible Dayrex, mylar film positives) and AutoCad 2000 files on disk (CD Rom).
- C. As-Built drawings should indicate the following information as a minimum:
 - 1. Indicate all changes to documents
 - 2. Remove Engineer's seal, name, address and logo from drawings.
 - 3. Mark documents AS-BUILT DRAWINGS.
 - 4. Clearly indicate: DOCUMENT PRODUCED BY.
 - 5. Indicate all changes to construction during construction. Indicate actual routing of all piping, ductwork, etc. that were deviated from construction drawings.
 - 6. Indicate exact location of all underground plumbing and flow line elevations.
 - 7. Indicate exact location of all underground mechanical piping and elevations.
 - 8. Indicate exact location of all underground electrical raceways and elevations.
 - 9. Correct schedule to reflect (actual) equipment furnished and manufacturer.
 - 10. During the execution of work, maintain a complete set of drawings and specifications upon which all locations of equipment, ductwork, piping, devices, and all deviations and changes from the construction documents in the work shall be recorded.

END OF SECTION 22 05 10

SECTION 22 05 12 – WATER PIPE TESTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Related Documents:
 - 1. Drawings and general provisions of the Subcontract apply to this Section.
 - 2. Review these documents for coordination with additional requirements and information that apply to work under this Section.
- B. Section includes:
 - 1. Visual inspection of pipes.
 - 2. Cleaning and flushing building piping systems.
 - 3. Testing building piping systems.
 - 4. Disinfecting building piping systems.
 - 5. Placing building piping systems in operation.
- C. All tests listed in this Section are not necessarily required on this Project. Required tests are named in other Sections which refer to this Section for testing criteria and procedures.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices.
 - 1. No payment will be made for acceptance testing under this Section. Include payment in unit price for work requiring acceptance testing.
 - 2. Refer to related Section - Measurement and Payment for unit price procedures

1.3 REFERENCES

- A. General:
 - 1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
 - 2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
 - 3. Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.
 - 4. Refer to Division 22 Section "Common Results for Plumbing" for codes and standards, and other general requirements.
- B. Code of Federal Regulations (CFR):
 - 1. 29 CFR 1910 Occupational Safety and Health Standards (OSHA)
- C. American Water Works Association (AWWA):
 - 1. AWWA C601 Disinfecting Water Mains
- D. Compressed Gas Association (CGA):
 - 1. CGA G4.1 Cleaning Equipment for Oxygen Service
- E. Factory Mutual Engineering (FM):
 - 1. FM Factory Mutual System Loss Prevention Data Sheets

- F. International Association of Plumbing and Mechanical Officials (IAPMO):
 - 1. IAPMO UPC Uniform Plumbing Code

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data:
 - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
- C. Test Plan: Before testing begins and in adequate time to obtain approval through submittal process, prepare and submit test plan for approval by Project Manager. Include testing procedures, methods, equipment, and tentative schedule. Obtain advance written approval for deviations from Drawings and Specifications.
- D. Manufacturer's Installation Instructions: Submit special procedures.
- E. Test Reports: Submit test reports for each test on each segment of sanitary sewer.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.
- B. Operation and Maintenance Data: Submit adjustment instructions.

1.6 QUALITY ASSURANCE

- A. Water to be discharged from flushing and disinfecting procedures shall be neutralized and disposed of in accordance with Division 01 Section "Special Procedures" or Division 33.
- B. The purpose of these procedures is to ensure that pressure tests are conducted safely and effectively. They cover pressure testing of new and existing pressure systems or components at a test pressure more than 0 psig. They apply to mechanics, supervisors, inspectors, custodians, and subcontractors responsible for pressure tests.
- C. Repair, correct, and retest manholes or sections of pipe which fail to meet specified requirements when tested.
- D. Provide testing reports and video tape of television inspection as directed by Project Manager.
- E. Upon completion of tape reviews by Project Manager, Contractor will be notified regarding final acceptance of sewer segment.

1.7 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience.

- B. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.8 SEQUENCE AND SCHEDULING

- A. Perform testing as work progresses. Schedule testing so that no more than 1000 linear feet of installed sewer remains untested at one time.
- B. Coordinate testing schedules with Project Manager. Perform testing under observation of Project Manager.

1.9 WARRANTY

- A. Furnish five (5) year manufacturer warranty for leak free performance of packed expansion joints.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Provide test equipment at the followings: Piping connection between pipe tested and water source; Equipment, materials, and facilities required to perform specified tests including but not limited to the following:
 - 1. Pumping equipment
 - 2. Calibrated water meter (within 6 months)
 - 3. Calibrated pressure gauges (within 6 months)
- B. Sectionalizing devices required including but not limited to the following:
 - 1. Flanges
 - 2. Valves
 - 3. Bulkheads
 - 4. Bracing
 - 5. Blocking

PART 3 - EXECUTION

3.1 CLEANING AND FLUSHING

- A. Water Piping Systems:
 - 1. After completion of all work in each section of the various water piping systems, and prior to testing, flush all piping to remove foreign material and to thoroughly clean the system. Flushing shall be continued until the water leaving the system is clear and acceptable to the Owner/Engineer, but in no case shall the flushing be performed for less than 10 minutes.
 - 2. Ensure that adequate quantities of water are available to produce a flushing velocity of not less than 2.5 fps (0.8 m/s).

3.2 HYDROSTATIC PRESSURE TEST

- A. General:
 - 1. Prior to acceptance and initial operation, inspect and test the piping systems to ensure that the design, materials, fabrication, and installation are in accordance with these specifications.
 - 2. Test piping prior to being enclosed, covered-up, or treated externally with insulation, tape wrapping, mastic coating, and like treatments.

3. Notify the Owner/Engineer at least 48 hours prior to testing, and conduct tests in the presence of an owner's Representative.
4. Piping systems shall show no pressure loss, unless noted otherwise, while being tested in accordance with this section of these specifications. When leakage or other defects are located, repair or replace the affected portion of the piping system and retest. In the event repairs, replacement, or additions are made following the pressure test, retest the affected piping. In the case of very minor repairs, replacement, or additions, the Owner/Engineer may, solely at its discretion, omit retesting provided precautionary measures are taken to assure sound construction.

B. General Test Procedures:

1. All valves shall be in full-open position during the test. Do not include any components (gauges, relief valves, instrumentation, and like items) as part of the tests that are not rated for the testing pressure.
2. Removes all persons not directly involved with the test from the immediate test area.
3. Removes pressure relief valves or non-reclosing relief device from the vessel or test boundary where the test pressure will exceed the set pressure of the valve or Holds down each valve by means of an appropriate test clamp and pressurizes both sides of non-reclosing relief devices. Installs temporary, higher-rated devices where practical.
4. Installs the calibrated test gauge so it is visible at all times.
5. Pressurizes the system, raising the pressure in the system gradually until the designated test pressure is achieved.
6. Do not attempt to modify a piping system when it is pressurized, including tightening leaking joints. Do not repair, replace, or retighten leaking joints or components until the pressure has been reduced to ambient level.
7. Measure test pressure with a manometer or with a pressure-measuring device designed and calibrated to read, record, or indicate the maximum test pressure. Record any pressure loss due to leakage during the pressure test period while the system is pressurized but isolated from the pressure source.
8. In general, test nonhazardous liquid, inert gas, and compressed air system at a minimum of 150% of the working pressure in the line. The test pressure for each piping system shall be not less than the following values, irrespective of the design maximum allowable working pressure (MAWP):

TEST SYSTEM	TEST PRESSURE (Gauge)	TES MEDIA	TEST DURATION
DCW, DHW,	225 psi gauge (1553 kPa)	CW	24 hours

9. Prepare test records of inspection and all tests performed. Indicate which portions of the piping system are in accordance these specifications. Briefly document test procedures, instruments and media used, and test pressures. Before requesting final approval of a piping installation, submit copies of test records for Owner/Engineer approval.

3.3 DISINFECTING CW/HW PIPING SYSTEM

- A. General: Clean and disinfect all cold water systems in accordance with AWWA C601 when the project is complete and when, by test, the system is proven to be free from leaks and ready for use.

- B. Disinfecting Procedure:
1. Connect the injection hose to the test connection.
 2. With the system completely full of water and the supply valve open, proceed to adjust every valve of the system so that a trickle of water flows from each.
 3. Inject the disinfectant slowly, at a uniform rate, until an orthotolidine test at each outlet shows a minimum chlorine residual concentration of 100 parts per million (ppm).
 4. Close all outlets and valves, including the valve connecting to the water-supply line and the 3/4-inch (19-mm) service cock on the solution-injection connection.
 5. Maintain the condition for 24 hours. If after 24 hours, orthotolidine tests indicate that the chlorine residual concentration has decreased below 50 ppm, repeat the disinfecting procedure until an approved result is obtained.
 6. When the residual chlorine requirements have been fulfilled, the part of the water system being disinfected shall be drained and flushed until the chlorine concentration of the discharged water has been reduced to an amount equivalent to the level normally present in the water supplied to the area. This part of the system shall again be isolated by valving off. All drainage and flushing water shall be directed to the sanitary sewer system.
 7. After checking that the residual chlorine concentration is not greater than control levels using the orthotolidine test, the Contractor shall take water samples after a 24 hour incubation period at predetermined locations of the isolated system. The sampling points shall be chosen so as to provide accurate information regarding the bacteriological quality of the water. Before putting this system into service, the results of these tests must show the water to completely free (i.e., <1 or none detected) from coliform organisms after a 24 hour incubation period.
 8. If the results of the bacteriological tests do not meet the standard specified above, the disinfection procedures shall be repeated until this standard is satisfied.
 9. Tie-in fittings to be placed in existing mains shall be sterilized either by immersing in a chlorine solution of 500 ppm for one-half hour or by swabbing with fire (5) percent hypochlorite solution.
 10. On system where a fire sprinkler riser is to be directly connected to an existing underground link that has been previously sterilized and terminates above ground, the double check valves, test cocks, and all pipe and fittings between the check valves and the termination of the underground line, are to be immersed in a 500 ppm chlorine solution for one (1) hour prior to assembly. The termination of the underground line is not be left uncovered any longer than necessary. The sterilization process is to be monitored by LBNL EH&S Division or his representation and an Owner/Engineer Inspector.
 11. Bennett Marine Utility Inc. shall issue a Certification Sterilization / Chlorination to the subcontractor to demonstrate satisfactory completion of the above procedure. The subcontractor shall submit the Certification to LBNL for their review.
- C. Disinfecting Agent: The Subcontractor will supply the disinfecting agent and the injecting apparatus, will inject the disinfecting agent into the system, and operate the valves.
- D. Preparation:
1. Provide a test connection for the system to be disinfected within 2-3 feet (0.6-0.9 m) of its junction with the water supply lines, for injecting the disinfectant into the system.
 2. Prepare the water-flow valves for sterilization.
 3. Thoroughly flush the system by fully opening every outlet and operating every fixture until clear water flows from all of them.

3.4 PREPARATION

- A. Provide labor, equipment, tools, test plugs, risers, air compressor, air hose, pressure meters, pipe probe, calibrated weirs, or any other device necessary for proper testing and inspection.
- B. Isolate each floor or section being tested by inserting plugs into the test tees in the stacks. Plug or cap all other openings with test plugs or test caps
- C. If a cleanout or check valve has not been installed at the easement/property line, the cleanout or check valve shall be installed prior to testing. If there is no cleanout located outside the building foundation (within five feet of the foundation wall), then a cleanout shall be installed. If the building lateral exits the foundation under an existing deck or concrete patio, the location of the building cleanout near the foundation may be modified on a case-by-case basis as determined by the Owner/Engineers.

3.5 AS-BUILT DRAWINGS

- A. The Contractor shall maintain a record set of drawings indicating all changes in the work from that shown in the Contract Documents. Prior to final acceptance by the Owner, the Contractor shall assemble the complete set of as-built drawings that accurately reflects all changes to indicate actual final construction. All concealed piping shall be dimensionally located from at least two (2) column lines or major building structure elements. Drawings shall be a minimum of 1/8" scale.
- B. Prior to transmittal of corrected drawings, obtain 3 sets of blue-line prints of each drawing, regardless of whether corrections were necessary and include in the transmittal (2 sets are for the Owner's use and one set is for the Architect/Engineer's records). Delivery of these as-built prints and reproducible is a condition of final acceptance. Provide record drawings on one set each (reproducible Dayrex, mylar film positives) and AutoCad 2000 files on disk (CD Rom).
- C. As-Built drawings should indicate the following information as a minimum:
 - 1. Indicate all changes to documents
 - 2. Remove Engineer's seal, name, address and logo from drawings.
 - 3. Mark documents AS-BUILT DRAWINGS.
 - 4. Clearly indicate: DOCUMENT PRODUCED BY.
 - 5. Indicate all changes to construction during construction. Indicate actual routing of all piping, ductwork, etc. that were deviated from construction drawings.
 - 6. Indicate exact location of all underground plumbing and flow line elevations.
 - 7. Indicate exact location of all underground mechanical piping and elevations.
 - 8. Indicate exact location of all underground electrical raceways and elevations.
 - 9. Correct schedule to reflect (actual) equipment furnished and manufacturer.
 - 10. During the execution of work, maintain a complete set of drawings and specifications upon which all locations of equipment, ductwork, piping, devices, and all deviations and changes from the construction documents in the work shall be recorded.

END OF SECTION 22 05 12

SECTION 22 05 29 - PLUMBING HANGERS AND SUPPORTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide a complete system of pipe hangers and supports for all plumbing and fire protection equipment and piping.

1.3 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- B. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- C. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
 - 2. Firestopping: Submit preparation and installation instructions.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees Fahrenheit.
- B. Maintain this minimum temperature before, during, and for minimum three (3) days after installation of firestopping materials.

- C. Provide ventilation in areas to receive solvent cured materials.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
1. Unistrut Corp.
 2. Erico Caddy.
 3. PHP System.
 4. Anvil/Anvil Strut.
 5. BLINE.
- B. Pipe Supports:
1. Conform to MSS SP58.
 2. Hangers for Pipe sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
 3. Hangers for Pipe sizes two (2) inches and Larger: Carbon steel, adjustable, clevis.
 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 5. Wall Support for Pipe sizes three (3) inches and Smaller: Cast iron hook.
 6. Wall Support for Pipe sizes four (4) inches and Larger: Welded steel bracket and wrought steel clamp.
 7. Vertical Support: Steel riser clamp.
 8. Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 9. Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 10. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 11. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.
 12. Non-metallic pipe support: Vinyl-coated Hangers.
 13. PEX Tube Support: CTS sized hangers or supports free of sharp edges.
 14. Galvanized steel to be used for outdoor installation.

2.2 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.
- B. Provide locking nuts on all rod extensions.
- C. Galvanized steel to be used for outdoor installation.

2.3 INSERTS

- A. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 SLEEVES AND ESCUTCHEONS

- A. The Contractor shall furnish and set pipe sleeves and inserts for all work under this section and shall be responsible for their proper and permanent location. In the event

that failure to do so requires cutting and patching, the remedial work shall be the responsibility of the Contractor.

- B. All pipes passing through floors, walls or partitions shall be provided with sleeves having an internal diameter 1-1/2" (3/4" annular space) larger than the outside diameter of the pipe or insulation on covered lines, except as otherwise specified herein.
- C. Sleeves for Pipes through Non-fire Rated Floors and Walls: 18 gage thick galvanized steel. Sleeves for all pipes through walls, beams and partitions shall finish flush with the finish line of the walls, beams and partitions.
- D. Sleeves for all piping shall extend 1/2" above finish floor, (except where under partitions, the sleeves shall be flush with the bottom of the partition) and after the installation of pipe shall be packed and made watertight with fire stopping sealant to maintain separations and fire ratings.
- E. Where pipes pass under footings and through exterior walls, sleeves shall be of galvanized steel pipe and shall be not less than 4" larger than the pipe being sleeved. Sleeves shall be made watertight where passing through waterproofed surfaces, exterior wall, and floor slabs on grade. Waterproofing shall be done by means of a steel slip on welding flange, continuously welded at the center of the sleeve and shall be painted with one coat of bitumastic paint inside and outside. The space between sleeve and pipe shall be packed with oakum to within 2" of each face of the wall; (to within 2" of the top of sleeve at floors). The remaining space shall be packed and made watertight with a waterproof mastic. Mechanical expansion type rubber seals such as manufactured by Calpico Ind. and Thunderline Corporation are acceptable as alternate method of water proofing piping penetrations.
- F. Sleeves through floors or interior masonry walls shall be of galvanized steel pipe or wrought iron pipe size except where located in concealed pipe spaces where they may be of 22 gauge galvanized sheet steel if fire rating is maintained.
- G. Sleeves for piping to receive insulation shall be large enough to allow continuous insulation through sleeves.
- H. Spacing between or location of pipe sleeves in floor slabs, structural beams or structural walls shall be subject to the Structural Engineer's approval.
- I. Where pipes pass under load bearing footings they shall pass through a coated steel pipe sleeve as described above and extend past a 45 degree line out from the bottom of the load bearing structure. Concrete shall be used as backfill in the portions of trench within the 45 degree pressure line.
- J. Provide chrome plated escutcheon plates on pipes passing through walls, floors, and ceilings exposed to view. Escutcheons shall be of sufficient outside diameter to cover the sleeve opening and shall fit snugly around the insulated or bare pipe and to the wall, partition, floor or ceiling. Provide stainless steel sheet metal for exterior walls. Welded water ring sleeve shall be used on all exterior wall and floor penetrations.
- K. Sealant: Acrylic

2.5 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline Link-Seal, Inc., or approved equal.

- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Unistrut Corp., or approved equal.
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.7 FIRESTOPPING

- A. Manufacturers:
 - 1. Dow Corning Corp. Model.
 - 2. 3M fire Protection Products Model.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam Firestopping Compounds: Multiple component foam compound.
 - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 - 7. Firestop Pillows: Formed mineral fiber pillows.
- C. Color: Dark gray Black As selected from manufacturer's full range of colors.
- D. Plastic Tube and Pipe: Ensure that the appropriate firestop assembly is used for plastic piping systems. Refer to manufacturer's system selector for more information.

2.8 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
 - 1. Mineral fiberboard.
 - 2. Mineral fiber matting.
 - 3. Sheet metal.
 - 4. Plywood or particle board.
 - 5. Alumina silicate fire board.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

- D. General:
 - 1. Furnish UL listed products or products tested by independent testing laboratory.
 - 2. Select products with rating not less than rating of wall or floor being penetrated.

- E. Non-Rated Surfaces:
 - 1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
 - 2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing or damming materials to arrest liquid material leakage.
- D. Do not drill or cut structural members.
- E. Do not crush insulation with pipe clamp. Provide high density pipe insulation to accommodate pipe clamp or hanger.
- F. Do not attach beam clamp on to bottom of steel joist.

3.2 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe four (4) inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with MSS SP 58.
- B. Supports for Gas Piping:
 - 1. Horizontal supports for steel and copper gas piping, threaded or welded, are every six (6) feet for 1/2 inch, every eight (8) feet for 3/4 inch and one (1) inch, and every ten (10) feet for 1-1/4 inches or larger.
 - 2. Vertical supports for steel gas piping, threaded or welded, are every six (6) feet for 1/2 inch, eight (8) feet for 3/4 inch and one (1) inch, and every floor for 1-1/4 inch and larger.

- C. Supports for Cast Iron Piping:
1. Vertical Piping:
 - a. Support vertical piping and tubing at base and at each floor.
 - b. Secure vertical piping at sufficiently close intervals to keep the pipe in alignment and to support the weight of the pipe and its contents. Support stacks at their bases and at sufficient floor intervals to meet the requirements of local codes. Approved metal clamps or hangers should be used for this purpose.
 - c. When vertical piping is to stand free of any support or if no structural element is available for support and stability during construction, secure the piping in its proper position by means of adequate stakes or braces fastened to the pipe.
 2. Horizontal Piping, Suspended:
 - a. Support horizontal piping and fittings at sufficiently close intervals to maintain alignment and prevent sagging or grade reversal. Support each length of pipe by an approved hanger located not more than 18 inches from the joint.
 - b. Support terminal ends of all horizontal runs or branches and each change of direction or alignment with an approved hanger.
 - c. Provide hangers as necessary to provide alignment and grade. Provide hangers at each horizontal branch connection. Adequate provision should be made to prevent shear. Where pipe and fittings are suspended in excess of eighteen inches by means of non-rigid hangers, a sway bracing to be provided.
 - d. An anchor or bracing to be provided on all storm drain pipe fittings.
 3. Place hangers within 12 inches of each horizontal elbow.
 4. Use hangers with 1-1/2 inch minimum vertical adjustment.
 5. Support horizontal cast iron pipe adjacent to each hub, with five (5) feet maximum spacing between hangers. Support hubless cast iron at every other joint unless over four (4) feet then support at each joint. Support copper every six (6) feet for 1-1/2 inch and smaller; every ten (10) feet for two (2) inches and larger.
 6. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
 7. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
 8. Support riser piping independently of connected horizontal piping.
- D. Supports for copper tubing:
1. The following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - d. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
 - e. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
 - f. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
 - g. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod
 2. Install supports for vertical copper tubing every 10 feet (3 m).
 3. Support vertical piping and tubing at base and at each floor.
- E. Supports for steel piping:

1. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 - d. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
 - e. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
 - f. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
 - g. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
 - h. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
 2. Install supports for vertical steel piping every 15 feet (4.5 m).
 3. Support vertical piping and tubing at base and at each floor.
- F. Supports for stainless-steel piping:
1. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 - d. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
 - e. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
 - f. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
 - g. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
 - h. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
 2. Install supports for vertical steel piping every 15 feet (4.5 m).
 3. Support vertical piping and tubing at base and at each floor.
- G. Supports for CPVC piping:
1. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 - d. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 - e. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 - f. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
 2. Install supports for vertical CPVC piping every 60 inches (1500 mm) for NPS 1 (DN 25) and smaller, and every 72 inches (1800 mm) for NPS 1-1/4 (DN 32) and larger.
 3. Support vertical piping and tubing at base and at each floor.
- H. Supports for PEX tubing:

1. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1 (DN 25) and Smaller: 32 inches (815 mm) with 3/8-inch (10-mm) rod. Or
 - b. 3/4" and smaller: 72 inches when a continuous support channel is used.
 - c. 1" and larger: 96 inches when a continuous support channel is used.
 2. Support vertical piping and tubing at base and at each floor.
 3. Install hangers for vertical PEX piping every 48 inches (1200 mm).
 4. Install PEX tubing in accordance with the Uponor Plumbing Design Assistance Manual or the Uponor Professional Plumbing Installation Guide.
- I. Supports for PVC piping:
1. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 2 (DN 50) and Smaller: 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 - c. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 - d. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 - e. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
 2. Install supports for vertical PVC piping every 48 inches (1200 mm).
 3. Support vertical piping and tubing at base and at each floor.
- J. Supports for PP piping:
1. Install vinyl-coated hangers for PP piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 - d. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 - e. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 - f. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
 2. Install supports for vertical PP piping every 60 inches (1500 mm) for NPS 1 (DN 25) and smaller, and every 72 inches (1800 mm) for NPS 1-1/4 (DN 32) and larger.
 3. Support vertical piping and tubing at base and at each floor.
 4. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.
- K. Supports for insulated piping:
1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation. (Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers)
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees. (Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers)
 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
 - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
 5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
- L. Supports for Vertical-Piping
1. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - a. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
 - b. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- M. Design hangers for pipe movement without disengagement of supported pipe.
- N. Provide clearance in hangers and from structure and other equipment for installation of insulation.
- O. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.

3.4 INSTALLATION - SLEEVES

- A. Exterior watertight entries, such as grade beam, basement wall, sump wall etc.: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors one (1) inch above finished floor level. Caulk sleeves.
- E. Where piping penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with firestopping insulation or caulk. Firestopping required at all penetrations of rated floor and walls.

- F. Install chrome plated steel escutcheons at finished surfaces.

3.5 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating. Refer to Architectural drawings for location of all rated walls and floors.
- D. Fire Rated Surface:
 - 1. Seal opening at floor and wall as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
- E. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Install type of sealant or caulk suitable for application.
 - 2. Install escutcheons where pipe, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - 3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.

END OF SECTION 22 05 29

SECTION 22 05 48.13 - VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 20 23 – GAS PIPING
- F. SECTION 22 22 00 – CONDENSATE PIPING
- G. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.2 DEFINITIONS

- A. IBC: International Building Code.

1.3 PERFORMANCE REQUIREMENTS

- A. It is the intent of this specification to provide vibration isolation supports for all equipment, piping and ductwork as may be required to prevent transmission of vibration to the building structure. It will be the Contractor's responsibility to select and install vibration isolators which will enable the noise criteria standards to be met, to the extent that the noise can be controlled by the vibration isolators.
- B. All vibration isolation devices, including auxiliary steel bases and pouring forms, shall be designed and furnished by a single manufacturer or supplier.
- C. Unless otherwise noted or scheduled, spring type vibration isolators shall be used for all equipment driven by motors of 0.5 HP and larger. Deflections as tabulated are minimums and it shall be the responsibility of the isolation manufacturer to determine the amount of spring deflection required for each isolator to achieve optimum performance in order to prevent the transmission of objectionable vibrations and meet the noise criteria referenced herein.
- D. Unless otherwise noted, equipment driven by motors 0.25 HP and smaller shall be isolated by means of Type ND elastomeric mounts or Type HD elastomeric hangers properly sized for 0.35 inch deflection.
- E. All elastomeric isolators shall be of high quality synthetic rubber with anti-ozone and anti-oxidant additives.

- F. Design and treat vibration isolators for resistance to corrosion. Furnish phosphatized steel components with epoxy powder paint coating. Components exposed to the weather shall be epoxy powder paint coated or hot-dipped galvanized. Furnish zinc electroplated nuts, bolts and washers. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer.
- G. Isolators for equipment installed outdoors shall be designed to provide adequate restraint due to normal wind conditions and to withstand wind loads of 30 lbs/sq.ft. Wind loading shall be applied to all exposed surface of the isolated equipment in order to identify worst case load.
- H. All spring isolators shall be completely stable in operation and shall be designed for not less than 50 percent reserve deflection beyond actual operating conditions. All spring isolators must be completely stable in operation and have a Kx/Ky ratio of at least 1:1.
- I. All isolation materials and flexible connectors shall be of the same manufacturer and shall be selected and certified using published or factory certified data. Any variance or non-compliance with these specification requirements shall be corrected by the contractor at no additional cost to the Owner. Manufacturer may purchase other manufactured products in order to meet this specification and shall guarantee outsourced product as a single point of responsibility. Outsourced products must be identified as such in the submittal for approval.
- J. The contractor and manufacturer of the isolation and equipment shall refer to the isolator schedule which lists isolator types and isolator deflections.
- K. Deflection table is based on maintaining rooms at the following maximum sound levels, in Noise Criteria (NC) as defined by ASHRAE and ANSI S1.8.
 - 1. Offices
 - a. Executive: 30
 - b. Conference rooms: 30
 - c. Private: 35
 - d. Open-plan areas: 35
 - e. Computer/business machine areas: 40
 - f. Public circulation: 40
 - 2. Schools
 - a. Lecture and classrooms: 30
 - b. Open-plan classrooms: 35
 - 3. Libraries: 25
 - 4. Theaters
 - a. Theater: 25
 - b. Stage house: 25
 - c. Trap room: 25
 - d. Orchestra pit: 25
 - e. Rehearsal rooms: 25
 - f. Teaching studios: 30
 - g. Practice rooms: 30
 - h. Ensemble rooms: 30
 - i. Shop: 45

1.4 ACTION SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.

- B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate assembly, materials, thickness, dimensional data, and layout as well as connection details.
- C. Product Data: Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating materials and dimensional data. All steel bases and concrete inertia bases shall be completely detailed. Include clearly outlined procedures for installing and adjusting the isolators.
- D. Design Data: Submit calculations indicating maximum room sound levels are not exceeded.
- E. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.
- F. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.
- G. Manufacturer's Field Reports: Indicate vibration isolation installation is complete and in accordance with instructions. Provide a copy of field report to Architect/Engineer.
- H. Shop Drawings:
 - 1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. All Plumbing systems vibration and sound control products shall conform to ASHRAE criteria for average noise criteria curves for all equipment at full load conditions.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATOR TYPES

- A. All vibration isolators described in this section shall be the product of a single manufacturer. Submittals and certification sheets shall be in accordance with Specification 1.3 of this section.
 - 1. Manufacturers:
 - a. Mason Industries
 - b. Kinetics Noise Control
 - c. Amber / Booth
 - d. Vibration Eliminator
- B. Type WSW: Two layers of 3/8-inch thick neoprene pad consisting of square waffle modules separated horizontally by a 16-gauge galvanized shim. Where the load bearing area of the equipment is not the same size/shape as the load bearing area/shape of the pad, load distribution plates, minimum 1/4" thick galvanized steel, shall be utilized to ensure the load

bearing capacity of the pad is maximized. Pads shall be sized for approximate deflection of 0.12 inch to 0.16 inch.

- C. Type ND: Neoprene mountings shall have minimum static deflection of 0.35 inch. All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Bolt holes on the bottom and a tapped hole with a mounting bolt and washer shall be provided. Steel rails shall be used above the mountings under equipment such as small vent sets to compensate for the overhang. Where the load bearing area of the equipment or support structure is not the same size/shape as the load bearing area/shape of the pad, load distribution plates, minimum ¼" thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized.
- D. Type SLF: Spring isolators shall be free-standing and laterally stable without any housing and complete with a steel-washer-reinforced molded neoprene cup of 1/4-inch neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have minimum additional travel to solid equal to 50 percent of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height.
- E. Type SLR: Restrained spring mountings shall have an SLF mounting as described in Specification 2.1 C, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position under outdoor equipment, there must be an internal isolation pad in addition to the friction pad on bottom.
- F. Type HD: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch thick neoprene element. The neoprene element shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers.
- G. Type 30N: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch thick neoprene elements at the top and a steel spring as described in 2.1 C, seated in a steel-washer-reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30-degree arc from side to side before contacting the cup bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30-degree capability.
- H. Type PC30N: Hangers shall be as described in Specification 2.1 F, but they shall be precompressed and locked at the rated deflection by means of a resilient up stop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30-degree capability.
- I. Type WBI/WBD: Horizontal thrust restraints shall consist of a spring element in series with a neoprene molded cup, as described in paragraph 2.1 C, with the same deflection as specified for the mountings or hangers supporting the unit. The spring element shall be designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 1/4-inch movement at start and stop. The assembly shall be furnished with a rod and angle

brackets for attachment to both the equipment and the ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrical on either side of the unit.

- J. Type SLR-MT: Restrained air spring mountings shall be manufactured with upper and lower steel sections connected by a replaceable flexible DuPont Kevlar reinforced neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of 3 Hz. Air springs shall be designed for a burst pressure that is a minimum of three times the published maximum operating pressure. Restrained air springs shall be within a rigid housing that includes vertical limit stops to prevent air spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch {12mm} shall be maintained around restraining bolts and between the housing and the air springs so as not to interfere with the air spring action. Limit stops shall be out of contact during normal operation. Air spring systems shall be connected to a supplementary air supply compressor (supplied with the air spring system) through a Mason Industries air spring control panel and equipped with three leveling valves to maintain level within plus or minus 0.125". Air spring mounts are to be located between the supporting steel and the roof or the grillage and dunnage as shown on the drawings when there is no provision for direct mounting. Submittals shall include natural frequency, load and damping tests performed by an independent lab or acoustician.

2.2 BASES

- A. Type WF: A welded integral structural steel fan and motor base with NEMA standard motor slide rails and holes drilled to receive the fan and motor slide rails. Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split-case pumps shall be large enough to support suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 14 inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height-saving brackets shall be employed in all mounting locations to maintain a 1-inch operating clearance under base.
- B. Type ICS: Vibration isolation manufacturer shall provide steel members welded to height-saving brackets to cradle equipment having legs or bases that do not require a complete supplementary base. Members shall have sufficient rigidity to prevent misalignment of equipment.
- C. Type RBMK. Vibration isolation manufacturer shall furnish structural steel concrete pouring forms for floating concrete bases. Wood formed bases, formed steel bases and sheet metal formed bases are not acceptable. Bases for split-case pumps shall be large enough to provide for suction and discharge elbows. Bases may be T or L shaped where space is a problem. Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 6 inches. The base depth need not exceed 12 inches unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of 1/2-inch bars welded in place on 6-inch centers running both ways in a layer 1-1/2 inches above the bottom. Forms shall be furnished with steel templates to hold the anchor bolt sleeves and anchor bolts while concrete is being poured. Recessed height-saving brackets shall be employed in all mounting locations to maintain a 1-inch operating clearance under base.

2.3 FLEXIBLE PIPE CONNECTIONS

- A. Type SFDEJ, SFEJ, SFDCR or SFU and Control Rods CR: Flanged and threaded rubber flexible joints shall be peroxide cured EPDM throughout with Kevlar tire cord reinforcement. Substitutions must have certifiable equal or superior characteristics. The raised face rubber flanges must encase solid steel rings to prevent pull out. Flexible cable wire is not acceptable. Sizes 1-1/2" through 14" shall have a ductile iron external ring between the two spheres. Sizes 16" through 24" may be single sphere. Sizes 3/4" through 2" may have one sphere, bolted threaded flange assemblies and cable retention. Minimum ratings through 14" shall be 250psi at 170°F and 215psi at 250°F, 16" through 24" 180psi at 170°F and 150psi at 250°F. Higher published rated connectors may be used where required. Safety factors shall be a minimum of 3/1. All flexible joints must be factory tested to 150% of maximum pressure for 12 minutes before shipment. The piping gap shall be equal to the length of the flexible joint under pressure. Control rods passing through 1/2" thick Neoprene washer bushings large enough to take the thrust at 1000psi of surface area may be used on unanchored piping where the manufacturer determines the condition exceeds the flexible joint rating without them. Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer.

2.4 MECHANICAL ANCHOR BOLTS

- A. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.5 ADHESIVE ANCHOR BOLTS

- A. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PIPING ISOLATION

- A. Horizontal Pipe Isolation: All pumped water, pumped condensate and refrigerant piping size 1-1/4 inch and larger within mechanical rooms and on pipe size 2 inch and larger outside

mechanical rooms shall be isolated. Outside equipment rooms this piping shall be isolated for the greater of 50 feet or 100 pipe diameters from externally isolated equipment. For the first 3 support locations from externally isolated equipment provide Type 30N hangers or Type SLF floor mounts with the same deflection as equipment isolators. All other piping within the equipment rooms shall be isolated with the same specification isolators with a 1" inch minimum deflection. Install piping hangers at regular intervals according the pipe hanger schedule. Where floor supports are required, provide sufficient spring capacity to absorb expansion and contraction of piping, and yet to permit piping to function as a floating system. Size hangers for 200 percent rated load. Coordinate selection of piping supports with equipment supports to accommodate expansion and contraction without creating excessive stresses at equipment connections.

- B. Pipe Riser Isolation: All vertical pipe risers 1-1/4 inch and larger, where specifically shown and detailed on riser drawings shall be fully supported by Type SW SLF isolators with brackets. Refer to details on Drawings. Steel spring deflection shall be 3/4 inch minimum. In locations where added deflection is required due to pipe expansion/contraction, the spring deflection shall be a minimum of 4 times the anticipated deflection change. Springs shall be selected to keep the riser in tension. Wall sleeves for take-offs from riser shall be sized for insulation O.D. plus two times the anticipated movement to prevent binding. Provide Type SWS wall sleeves. In addition to submittal data requirements previously outlined, riser diagrams and calculations shall be submitted for approval. Calculations must show anticipated expansion and contraction at each support point, initial and final loads on the building structure, and spring deflection changes. Submittal data shall include certification that the piping system has been examined for excessive stresses and that none will exist in the design proposed.

3.3 INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 Cast-in-Place Concrete.
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Locate isolation hangers as near the overhead support structure as possible.
- D. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.
- E. Install isolated inertia base frames and steel bases on isolator units as indicated so that a minimum of one (1) inch clearance below base will result when supported equipment has been installed and loaded for operation.
- F. Install flexible pipe connectors to equipment supported by vibration isolation. Provide line size flexible connectors.
- G. Comply with manufacturer's instructions for the installation and load application of vibration isolation materials and products. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation or shipment.
- H. Install cables so they do not bend across edges of adjacent equipment or building structure.

- I. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- J. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- K. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- L. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 - 5. Test to 90 percent of rated proof load of device.
 - 6. Measure isolator restraint clearance.
 - 7. Measure isolator deflection.
 - 8. Verify snubber minimum clearances.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

END OF SECTION 22 05 48

SECTION 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 22.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the owner or owner's representative.

1.3 RELATED WORK

- A. Division 1 - GENERAL REQUIREMENTS.
- B. Section 01 09 00 - GENERAL COMMISSIONING REQUIREMENTS.
- C. Section 01 33 00 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.4 SUMMARY

- A. This Section includes requirements for commissioning plumbing systems, subsystems and equipment. This Section supplements the general requirements specified in Section 01 91 00 General Commissioning Requirements.
- B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more specifics regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.5 DEFINITIONS

- A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.6 COMMISSIONED SYSTEMS

- A. Commissioning of a system or systems specified in Division 22 is part of the construction process. Documentation and testing of these systems, as well as training of the Owner's Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 and of Division 22, is required in cooperation with the Owner and the Commissioning Agent.
- B. The Plumbing systems commissioning will include the systems listed in Section 01 91 00 General Commissioning Requirements:

1.7 SUBMITTALS

- A. The commissioning process requires review of selected Submittals. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the OWNER prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.
- B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 CONSTRUCTION INSPECTIONS

- A. Commissioning of the Building Plumbing Systems will require inspection of individual elements of the Plumbing construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 91 00 and the Commissioning Plan to schedule inspections as required to support the commissioning process.

3.2 PRE-FUNCTIONAL CHECKLISTS

- A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the OWNER and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.3 CONTRACTORS TESTS

- A. Contractor tests as required by other sections of Division 22 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:

- A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

3.5 TRAINING OF OWNER PERSONNEL

- A. Training of the OWNER operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 91 00. The instruction shall be scheduled in coordination with the Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 22 Sections for additional Contractor training requirements.

END OF SECTION 22 08 00

SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS

1.3 SUMMARY

- A. Provide a complete domestic water piping system.
- B. Provide pressure gauge with all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, and leave in safe and proper operating condition all systems.
- C. All materials and equipment for the potable water system shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories.
 - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 - 3. Gauge: Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and manufacturer instruction.
 - 4. Domestic Water Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.7 EXTRA MATERIALS

- A. Furnish two (2) packing kits for each size valve and two (2) loose keys for outside hydrants.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

- A. Products and materials listed herein are for references of approved materials.
- B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

2.2 WATER PIPING, BELOW GRADE

- A. Copper Tubing: ASTM B88, Type K.
 - 1. Fittings: ASME B16.22 wrought copper and bronze.
 - 2. Joints: AWS A5.8, BCuP silver braze.
- B. PEX-a Tubing: ASTM F876/F877, AWWA C904
 - 1. Fittings: ASTM F1960 engineered polymer and lead-free brass.
 - 2. Joints: ASTM F1960 cold expansion with PEX reinforcing ring.

2.3 WATER PIPING, ABOVE GRADE

- A. Copper Tubing 6" and smaller: ASTM B88, Type L hard drawn.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints:
 - a. Solder, lead free, ASTM B32, 95-5TA (tin-antimony), or tin and silver, with melting range 430 to 535 degrees F. [Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.]
 - b. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - c. Appurtenances for Grooved-End Copper Tubing:
 - 1) Manufacturers: Subject to compliance with requirements, provide products from the following or approved equal:
 - a) Victaulic
 - 2) Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75 copper tube or ASTM B 584 bronze castings.
 - 3) Mechanical Couplings for Grooved-End Copper Tubing:
 - a) Copper-tube dimensions and design similar to AWWA C606.
 - b) Ferrous housing sections.
 - c) EPDM-rubber gaskets suitable for hot and cold water.
 - d) Bolts and nuts.
 - e) Minimum Pressure Rating: 300 psig.
 - 3. At the contractor's option, Press connection copper fittings manufactured by an approved manufacturer or approved equal will be acceptable. Building services piping -20 degrees to +250 degrees up to 200 PSI. Fittings shall comply with NSF-61, CSA, UPC. Seals shall be made of EPDM material and manufactured with an inboard bead design. The fittings shall include the Smart Connect feature to identify unpressed connections during system testing. All fittings shall be installed in accordance with the manufacturer's installation instructions and according to local plumbing and mechanical codes.
 - a. Approved manufacturer(s):
 - 1) Nibco

2) Viega

2.4 FLANGES, UNIONS, AND COUPLINGS

- A. Pipe Size two (2) inches and Smaller:
 - 1. Ferrous pipe: Class 150 malleable iron threaded unions.
 - 2. Copper tube and pipe: Class 150 bronze unions with soldered joints.

- B. Pipe Size 2-1/2 inches and Larger:
 - 1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets (Victaulic split ring flange is not allowed).
 - 2. Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.
 - 3. PEX-a tube and pipe: Class 150 ASME B16.5 flanges; ASTM F1960 joints.

2.5 GALVANIC PROTECTION

- A. Dissimilar piping material connections shall not be made without an approved dielectric union.

- B. Dielectric Connections:
 - 1. Two (2) inches and smaller union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier. Provide Watts Series LF3001A or an approved equal.
 - 2. 2-1/2 inches and larger, forged steel flanges, screwed neck, 1/16 inch thick preformed neoprene gasket.

2.6 VALVES

- A. General
 - 1. Valves shall be located to permit easy operation, replacement and repair. They shall be installed where shown on the Drawings, or as herein specified.
 - 2. Control valves shall be provided for the domestic hot and cold water supply to all risers and specific areas such as restrooms, fixture groups, shock absorbers, equipment, hose bibbs and wall hydrants, food service areas and building separations. Valves shall be located in back-of-house or service areas with access panels or above lay-in ceilings. No access panels will be permitted in public spaces with gypsum ceilings.

- B. Ball Valves:
 - 1. Manufacturers:
 - a. NIBCO INC.
 - b. Milwaukee.
 - c. Apollo.
 - d. Bray.
 - e. Kitz.
 - 2. Two (2) inches and Smaller: Nibco S/T-585-80-LF, full-port, MSS SP 110, Class 150, 600 psi CWP, silicon bronze, two piece body, chrome plated silicon bronze ball, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder or threaded ends. No Lead.
 - 3. Where piping is insulated, ball valves shall be equipped with two (2) inch extended handles of non-thermal conductive CPVC material that meets UL 2043 approved for inside air plenum. Also provide a protective sleeve that allows

operation of the valve without breaking the vapor seal or disturbing the insulation. Memory stops, which are fully adjustable after insulation is applied, shall be included.

4. Ball valves installed outdoors or in-ground shall have stainless steel handle.
5. Ball Valves for PEX-a Two (2) inches and smaller: NSF 359, Class 150, 250 psi CWP, forged brass, two piece body, brass ball, Teflon (PTFE) seats, blow-out proof stem, lever handle, ASTM F1960 ends. No Lead. Basis of design Uponor Lead-free Commercial Ball Valves.
6. Provide stem extensions of a non-thermal conducting material for valves in insulated lines to allow unobstructed operation.
7. Provide memory stops on all ball valves installed in domestic hot water return lines. Memory stops shall be adjustable after pipe insulation is applied.

C. Shut-off Valves:

1. Manufacturers:
 - a. NIBCO INC.
 - b. Milwaukee.
 - c. Apollo.
 - d. Bray.
 - e. Kitz.
2. Line Shut-Off Valves 2-1/2" to 3" where system operating pressure will not exceed 300 p.s.i.g. shall be 300 WOG LEAD-FREE ductile iron body with non-rising stem, ductile iron wheel handle, bronze stem and flange ends. Acceptable valves are Nibco F-619-RWS, or approved equivalent model by Kitz, Bray, Milwaukee, or Apollo.
3. Line Shut-Off Valves 4" and larger where system operating pressure will not exceed 300 p.s.i.g. shall be 300 CWP ductile iron body gate valve with non rising stem, resilient wedge, flange ends, EPDM liner and seal. Acceptable valves are NIBCO Model F-619-RWS/SON, or approved equal.
4. Provide stem extensions of a non-thermal conducting material for valves in insulated lines to allow unobstructed operation.

D. Swing Check Valves:

1. Manufacturers:
 - a. NIBCO INC.
 - b. Milwaukee.
 - c. Apollo.
 - d. Kitz.
2. Two (2) inches and Smaller: Nibco S-413-LF Series, class 125, MSS SP 80, silicon bronze body, stainless steel and PTFE disc, and soldered ends. No Lead.
3. 2-1/2 inches and Larger: NIBCO INC. F918-SS Series, MSS SP 71, cast iron body, stainless steel fitted, stainless steel disc, flanged ends. No Lead.

E. Balancing Valves (Hot Water Recirculation)

1. Balancing valves shall be venturi orifice type, bronze or brass body with brass or chrome ball, a minimum of two differential pressure read-out ports, 300 psi maximum working pressure. A compatible positive shutoff ball valve with memory stop is to be provided if not included with the balancing valve assembly.
2. Balancing valves shall be Flow Design Incorporated (FDI) model AC or MC or approved equal by ITT or Bell and Gossett.
3. Ball valves are not acceptable for balancing the hot water return system.

2.7 STRAINERS

- A. Manufacturer: NIBCO INC., Mueller Steam Specialty, or approved equal.
- B. Two (2) inches and Smaller: Threaded bronze body for 200 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen. NIBCO INC., 221 Series.
- C. 2-1/2 and Larger: Class 125, flanged iron body, Y pattern with 1/16-inch stainless steel perforated screen. NIBCO INC., F-721 Series.
- D. Lead Free.

2.8 GAGES AND TAPS

- A. Manufacturers: For portable water system (Lead Free)
 - 1. Weiss
 - 2. Marsh Bellofram
 - 3. Weksler
 - 4. Dwyer
- B. Gage: ASME B40.1, UL 404 with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.
 - 1. Case: Stainless steel.
 - 2. Bourdon Tube: Phosphor bronze.
 - 3. Dial Size: 4-1/2 diameter.
 - 4. Mid-Scale Accuracy: One (1) percent.
 - 5. Scale: Psi.
- C. Needle Valve: Brass, 1/4 inch NPT for minimum 300 psi.
- D. Ball Valve: Brass 1/4 inch NPT for 250 psi.
- E. Pulsation Damper: Pressure snubber, brass with 1/4 inch NPT connections.
- F. Siphon: Brass, 1/4 inch NPT angle or straight pattern.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection size, location, and invert are as indicated on Drawings.
- B. Establish elevations of buried piping with not less than two (2) feet of cover.

- C. Establish minimum separation from other services piping in accordance with code.
- D. Remove scale and dirt on inside of piping before assembly.
- E. Install pipe on prepared bedding.
- F. Route pipe in straight line.
- G. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- H. Do not use lead bearing solder materials.
- I. Pipe Cover and Backfilling:
 - 1. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in four (4) inches compacted layers to 12 inches minimum cover over top of jacket. Compact to 95 percent maximum density.
 - 2. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
 - 3. Do not use wheeled or tracked vehicles for tamping.
- J. Provide tracer wire for all piping routed below slab locate wire leads in accessible location for use in future line trouble shooting.

3.4 INSTALLATION - ABOVE GROUND PIPING

- A. Insulate all piping installed in exterior walls, above food service areas, and any area exposed to temperatures below 40 degrees Fahrenheit.
- B. Install non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Insulate all domestic hot water supply and return lines.
- D. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16.
- G. Provide expansion tank for each domestic water heater, install per manufacturer's recommendations.
- H. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 05 29.
- I. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Architect.
- J. Establish elevations of buried piping outside the building to obtain not less than one (1) foot of cover.
- K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

- L. Install water piping in accordance with ASME B31.9.
- M. Sleeve pipes passing through partitions, walls and floors.
- N. Install unions downstream of valves and at equipment or apparatus connections.
- O. Install valves with stems upright or horizontal, not inverted.
- P. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- Q. Install ball valves for shut-off and to isolate equipment at branch to each fixture bank and at each plumbing appliance or water heater.
- R. Provide check valves on discharge of all water circulating pumps.
- S. Install potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibs.
- T. Pipe relief from valves, back-flow preventers and drains to nearest floor drain.
- U. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to all equipment with solenoid valves.
- V. Route all domestic water piping inside building in climate controlled space not subject to freezing.
- W. Do not use lead bearing solder materials.
- X. In natatorium, including equipment rooms, all exposed plumbing piping shall be insulated and protected by a complete aluminum jacketing system. Refer to Section 23 07 16 for specification on jacketing. Provide color coded, printed pipe label 10' on center identifying pipe service type (gas, domestic water, storm water, etc.).
- Y. Provide chrome-plated floor and ceiling plates around pipes exposed to view when passing through walls, floors, partitions, or ceilings in finished areas. Size plates to fit pipe or insulation and lock in place.
- Z. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings, including the following.
- AA. Press-Connect Joints for Copper Tubing: Join copper tube and press-connect fittings with tools recommended by fitting manufacturer.
- BB. Pipe Joint Construction: PEX-a Connections: Install per manufacturer's recommendations. Use manufacturer-recommended cold-expansion tool for ASTM F 1960 connections.
- CC. Lead Free.

3.5 INSTALLATION - SERVICE CONNECTIONS

- A. At each incoming water service line provide approved reduced pressure back-flow preventer. Coordinate with division 23 to install gas flow meter provided by division 23 and install by this contractor.
- B. Provide a cast iron sleeve around service main to six (6) inches above floor and six (6) inches minimum below grade beam. Size for minimum of two (2) inches of loose batt insulation stuffing.
- C. Optionally, where building structural components permit, water service entrance may be composed of a single extended 90 degree fitting of fabricated 304 stainless steel tubing, maximum Working pressure of 175 psi with grooved-end connection on the outlet (building) side and a cast iron pipe size coupler on the underground (inlet) side.

3.6 INSTALLATION - BACKFLOW PREVENTERS

- A. Provide at each make up connection to a hot water boiler, cooling tower, chilled water system, kitchen equipment, and at each piece of equipment requiring a make-up connection.
- B. Provide at water supply to fire protection system.
- C. Provide a floor drain within six (6) feet of each backflow preventer.
- D. Backflow preventer shall be certified by Contractor.
- E. Lead Free.

3.7 INSTALLATION – PRESSURE GAGES

- A. Install pressure gages for each pump, locate taps before strainers and on suction and discharge of pump; pipe to gage.
- B. Install gage taps in piping with isolation valves.
- C. Install pressure gages at main water entry. Provide needle valve or ball valve to isolate each gage. Extend nipples to allow clearance from insulation.
- D. Install gage in piping to each inlet and outlet of water heater.
- E. Install gage in piping to each end of backflow preventer.
- F. Install gage in piping to each end of double check valves.
- G. Install gage in piping to each inlet and outlet of water softener.
- H. Install gage in piping to each inlet of water filter.
- I. Install gage in piping to each inlet of commercial dishwasher machine.

3.8 DOMESTIC HOT WATER SYSTEM BALANCING

- A. The test and balance contractor shall provide testing, adjusting and balancing of the hot water system, once the system is fully installed and operational. Preliminary and final reports shall be prepared and issued to the General Contractor, Architect and Engineer.
- B. Preparation of the hot water system for balancing:
 - 1. Confirm outlet temperature of the system at water heaters and/or storage tanks.
 - 2. Verify recirculation pump operation and rotation.
 - 3. Confirm/adjust setpoint of each individual riser balancing valve to flow a minimum of 0.5 gpm or as otherwise noted on the documents.
- C. The test and balance report shall indicate the following:
 - 1. Pressure, temperature and flow in gpm at the discharge side of each balancing valve referencing the valve tag number.
 - 2. Pressure, temperature and flow in gpm at the suction side of each recirculating pump.
- D. Copies of the final approved balancing report are to be included in the O and M manuals as noted in "Permits" under Part 1 of Section 22 05 00.

3.9 FIELD QUALITY CONTROL

- A. Pressure test all domestic water piping.
- B. After installation and prior to backfill or cover-up, rinse piping system of particulate contaminants, cap and subject to static water pressure of 125 psig for four (4) hours.
- C. Repair leaks and defects and re-test any portion of piping system that fails.
- D. Provide written test report including date and time of test, pass or fail indication, summary of remedial work required and date and time of each re-test.
- E. Installers for PEX-a piping shall have completed the applicable training courses per manufacturer's requirements.
- F. Cleaning of piping systems:
 - 1. General cleaning of piping systems: Purge pipe of construction debris and contamination before placing the systems in service. Provide and install temporary connections as required to clean, purge, and circulate.
 - 2. Install temporary strainers at the inlet of pumps and other equipment as necessary where permanent strainers are not indicated. Keep strainers in service until the equipment has been tested, then remove either entire strainer or straining element only.
 - 3. Phase One: Initial flushing of system.
 - a. Remove loose dirt, mill scale, weld beads, rust and other deleterious substance without damage to system components. Open valves, drains, vents and strainers at all system levels during flushing procedures. Flush until "potable water clear" and particles larger than 5 microns are removed.
 - b. Connect dead-end supply and return headers, even if not shown on the drawings, and provide terminal drains in bottom of pipe end caps or blind flanges.
 - 4. Phase Two: Cleaning of Piping Systems:

- a. Remove, without chemical or mechanical damage to any system component, adherent dirt (organic soil), oil, grease, (hydrocarbons), soldering flux, mill varnish, piping compounds, rust (iron oxide), and other deleterious substances not removed by initial flushing.
 - b. Flush system and replace with clean water.
 5. Phase Three: Final flushing and rinsing:
 - a. Flush and rinse until "potable water clear" and particles larger than 5 microns are removed. Operate valves to dislodge any debris in valve body. Dispose of water in approved manner.
 6. Submit status reports upon completion of each phase of work on each system.
- G. Branch Connections:
1. Pipe 2" and smaller. For threaded piping, use straight size reducing tee. When branch is small than header, a nipple and reducing coupling or swagged nipple may be used.
- H. 2-1/2" through 36". For welding piping, when branch size is the same as header size, use welding tee. Use Weld-o-let when branch is smaller than header. For threaded branch connections, use 3000 lb. full coupling or Thread-o-let welded to header.
- I. See section 220500 for additional requirements.

END OF SECTION 22 11 16

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS

1.3 SUMMARY

- A. Provide a complete sanitary drainage system.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories.
 - 2. Sanitary Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
- B. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of equipment and clean-outs.
- B. Operation and Maintenance Data: Submit frequency of treatment required for interceptors. Include spare parts lists, exploded assembly views for pumps and equipment.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with the plumbing code.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

- A. Products and materials listed herein are for references of approved materials.
- B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

2.2 SANITARY SEWER PIPING, BELOW GRADE

- A. PVC Pipe
 - 1. Provide a complete system of solid wall schedule 40 PVC DWV piping with solvent welded joints.
 - 2. Solvent welded joints shall conform to IAPMP installation standards IS-9.
 - 3. Provide tracer wire at all under slab piping and wire terminate at building exit. Wire to be 12AWG, green insulation, and copper conductor. Provide cast junction box flush with finished grade permanently labeled "Tracer Wire". Extend wire from exit point around all non-metallic piping to properly line, coordinate installation with Civil contractor.
 - 4. Pipe and fittings shall conform to ASTM D 1784, ASTM D 1785, ASTM D 2665, ASTM D 3311, and NPS standard 14 & 61.
- B. Cast Iron Pipe (Hub):
 - 1. ASTM – A 74, hub and spigot DWV pipe and fittings with neoprene compression gasket joints for all buried pipe. Cast iron soil pipe, fittings and hub gaskets shall be manufactured by Tyler Pipe, AB & I foundry or Charlotte Pipe and Foundry. All cast iron pipe and fittings shall be of the same manufacturer.
- C. Cast Iron Pipe (No Hub):
 - 1. ASTM A888 and CISPI 301, hub-less, service weight and marked with the collective trademark of the CISPI and listed by NSF International (first 15'-0" section of dishwasher waste grease waste pipe):
 - 2. Fittings: No hub cast iron fittings per CISPI 301 and ASTM A888.
 - 3. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies conforming to ASTM C564. Heavy duty couplings are required on no-hub systems at the base of stack and vertical to horizontal offsets and shall conform to the requirements of ASTM C1540 and shall be type 304 stainless steel shielded couplings with stainless steel worm gear clamps, 15 psi working pressure.
 - a. Acceptable Manufacturers: Ideal Tridon or Husky SD-4000.

2.3 SANITARY SEWER PIPING, ABOVE GRADE

- A. Manufacturers
 - 1. AB&I
 - 2. Charlotte Pipe and Foundry Co.
 - 3. Tyler Pipe/Soil Division
- B. Cast Iron Pipe: ASTM A888 and CISPI 301, hub-less, service weight and marked with the collective trademark of the CISPI and listed by NSF International.
 - 1. Fittings: No hub cast iron fittings per CISPI 301 and ASTM A888.
 - 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies conforming to ASTM C564. Heavy duty couplings are required on no-hub

systems at the base of stack and vertical to horizontal offsets and shall conform to the requirements of ASTM C1540 and shall be type 304 stainless steel shielded couplings with stainless steel worm gear clamps, 15 psi working pressure.

- a. Acceptable Manufacturers: Ideal Tridon or Husky SD-4000.
3. Transition coupling: No hub cast iron pipe to PVC use Husky SD 4200 transition coupling.

2.4 VENT PIPING, ABOVE GRADE

- A. Manufacturers
 1. AB&I
 2. Charlotte Pipe and Foundry Co.
 3. Tyler Pipe/Soil Division
- B. Cast Iron Pipe: ASTM A888 and CISPI 301, hub-less, service weight and marked with the collective trademark of the CISPI and listed by NSF International.
 1. Fittings: No hub cast iron fittings per CISPI 301 and ASTM A888.
 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies conforming to ASTM C564. Heavy duty couplings are required on no-hub systems at the base of stack and vertical to horizontal offsets and shall conform to the requirements of ASTM C1540 and shall be type 304 stainless steel shielded couplings with stainless steel worm gear clamps, 15 psi working pressure.
 - a. Acceptable Manufacturers: Ideal Tridon, Tyler Wide Body or Husky HD-2000.

2.5 VENT PIPING, BELOW GRADE

- A. Use same as Sanitary Sewer Piping, Below Grade.

PART 3 - EXECUTION

3.1 FLOOR DRAINS

- A. Provide floor drain, including sanitary waste and vent piping, where indicated on drawings and at each toilet room containing two (2) or more water closets or a combination of one (1) water closet and one (1) urinal.
- B. Coordinate the exact location of all floor drains with Architectural Drawings prior to rough-in. Ensure drains are located at low points(s) of floor slope.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Coordinate the exact location of all floor drains with architectural drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.
- C. Remove scale and dirt, on inside and outside, before assembly.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection size, location, and invert as indicated on Drawings.
- B. Establish minimum separation from other services piping in accordance with code.
- C. Remove scale and dirt on inside of piping before assembly.
- D. Install with a uniform slope of not less than 1/4 of an inch per foot.
- E. Install pipe on prepared bedding of bank sand, minimum of 2" depth on bottom of trench up to centerline of pipe.
- F. Route pipe in straight line.
- G. Excavation:
 - 1. Excavate trenches for underground piping to the required depth to ensure two (2) foot minimum coverage over piping.
 - 2. Cut the bottom of the trench or excavation to uniform grade.
 - 3. Lay out alignment of pipe trenches to avoid obstructions. Assure that proposed route of pipe will not interfere with building foundation before any cutting is begun. Should interference be found, contact the Architect/Engineer before proceeding.
- H. Pipe Cover and Backfilling:
 - 1. Backfill shall not be placed until the work has been inspected, tested, and approved. Complete backfill to the surface of natural ground or to the lines and grades shown on drawings. Except where special materials are requested, use suitable friable soils from other excavation as backfill material. Do not use peat, silt, muck, debris or other organic materials. Deposit backfill in uniform layers and compact each layer as specified in Division 2.
 - 2. Compacting Backfill. Place material in uniform layers of prescribed maximum thickness and wet or dry the material to optimum moisture content. Compact with power-driven tampers to the prescribed density. Place regular backfill in eight (8) inch maximum layers, loose measure. Compact to not less than 95% of maximum soil density as determined by ASTM D-698 Standard Proctor.
 - 3. PVC-piping shall be installed per the requirements of ASTM D 2321, which details the trench width per pipe size, bedding depth, backfill and compaction, as well as other factors. Calculating maximum burial depths for flexible piping requires the use of external loading software, additional information and free software is available at www.uni-bell.org.
 - 4. Restoration. Compact backfill, where trenching or excavation is required in improved areas such as pavements, walks, and similar areas, to a condition equal to the adjacent undisturbed earth, and restore surface of the area to the condition existing prior to trenching or excavating operation.
- I. Disposal of excess material:
 - 1. Remove excess excavation material or material unsuitable for backfill. Excess material can be spread on grade, or shall be removed from site as directed by Owner/Architect.
- J. Provide tracer wire for all piping routed below slab locate wire leads in accessible location for use in future line trouble shooting.

3.4 INSTALLATION - ABOVE GROUND PIPING

- A. Establish invert elevations, slopes for drainage to 1/8 inch per foot (one (1) percent) minimum. Maintain gradients.
- B. Provide and installed cleanout as required by code and local AHJ.
- C. Furnish and install cleanouts in soil and waste lines as required by Code and/or job conditions, as shown on the Drawings and as follows: At or near the end of each branch and main drainage line, horizontal lines at intervals as required by code. All cleanouts shall be readily accessible, with plugs easily removable for cleanout lines. Cleanouts at the base of vertical piping shall be held within 2'-0" from finished floor unless otherwise indicated.
- D. Install a floor clean out according to the following;
 - 1. Not more than 40' apart in all horizontal drain lines.
 - 2. At each change of direction greater than 45 Deg.
 - 3. At the base of each waste or soil stack.
 - 4. Install floor cleanouts at elevation to accommodate finished floor.
 - 5. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearances at cleanout for snaking drainage system.
 - 6. Provide Wye cleanouts with long sweeps turned up to elevated floor conditions for cleanout openings at floor drain waist lines.
- E. Install a wall cleanout according to the following:
 - 1. Install a wall cleanout at every sanitary piping within wet wall chase for all urinals. Wall cleanout shall be flush with exterior side of wall
 - 2. Provide full size wall cleanouts at end of run and on soil stack at ganged toilets where pipes penetrate the slab including water closets, lavatories and EDF's.
 - 3.
- F. Install a exterior cleanout according to the following:
 - 1. Encase exterior cleanouts in concrete flush with grade.
 - 2. Provide double cleanouts where building sanitary sewer system and civil sewage system intersect.
 - 3.
- G. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- H. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- I. Install piping to maintain headroom. Do not spread piping, conserve space.
- J. Group piping whenever practical at common elevations.
- K. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- L. Provide clearance in hangers and from structure and other equipment for installation of insulation.
- M. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Architect.

- N. Install piping penetrating roofed areas to maintain integrity of roof assembly.
- O. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- P. Burred ends of all pipe and tubing shall be reamed to the bore of the pipe or tube and all chips shall be removed before installation.
- Q. Install bell and spigot pipe with bell end upstream.
- R. Sleeve pipes passing through partitions, walls and floors.
- S. Support cast iron drainage piping at every joint.
- T. Water test all piping per code.
- U. Insulate all above slab horizontal sanitary waste piping carrying air-conditioning condensate with fiberglass insulation with jacket from floor drain, including traps, all the way to change in direction to vertical.
- V. Slope all vent piping to allow for drainage.
- W. Provide and install a floor sink next to each HVAC air handling unit, pump, expansion tank, and every piece of HVAC equipment requiring condensate removal in every mechanical room.
- X. Drainage-waste-vent copper pipe and fittings for waste stub-outs for all fixture locations.
- Y. PVC-piping is a combustible material per ASTM E 136 and shall not be installed in return air plenums unless it is fire wrapped to meet all the requirements of ASTM E 84 test protocol with a flame spread index of 25 and a developed smoke spread of 50 or less.

3.5 RODDING SEWERS

- A. All sanitary soil and waste lines, both in the building and out, shall be rodded out after completions of the installation.
- B. This Work shall be done, as part of the contract, to make certain that all lines are clear, and any obstruction that may be discovered shall be removed immediately. Rodding shall be accomplished by utilizing a rotary cutter, which shall be full size of pipe being cleaned. Rodding operations shall be witnessed by Owner's field representative. Submit a certificate of completion to owner.

3.6 FIELD QUALITY CONTROL

- A. Separate trenches for water lines, sanitary, storm, and gas piping.
- B. Piping shall be labeled along entire length; indicating size, class, material specification, manufacturers name, and country of origin.
- C. Piping and fittings resting on ground is unacceptable. Keep products covered. Provide temporary end caps and closures on piping and fittings.
- D. Foreign pipe and fittings unacceptable.

- E. Prior to cover up water pipe, sanitary pipe, and gas piping shall be pressure tested. Tests shall be witnessed by consultant and owner. Notify owner 48 hours prior to test. Test shall be witnessed by client plumbing technician.
- F. The inside of all sanitary lines shall be video recorded with a camera and witnessed by owner to first outside manhole. Provide tape and/or DVD upon closeout of project. If any obstructions are found they shall be removed and the line shall be videoed again to show the blockage has been cleared.
- G. For additions and renovations, use camera to locate routing of underslab lines.
- H. Upon completion of the sanitary piping system, the contractor shall notify engineer and owner to observe a smoke test of the system. Smoke testing shall be performed on sanitary piping system twice during construction.

END OF SECTION 22 13 16

SECTION 22 13 21 - ACID WASTE AND VENT SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS

1.2 PLUMBING SYSTEMS DESIGN CRITERIA AND SCOPE OF WORK

A. SYSTEMS

- 1. Systems to be provided under the Plumbing design section shall be as listed below. The connection point for all systems from the site utilities shall be at 5'-0" from the exterior of the building unless specifically otherwise noted.
 - a. Acid waste and vent piping systems.
 - b. Acid neutralization tanks.

B. DESIGN STANDARDS

- 1. Plumbing systems shall be designed and installed in accordance with the requirements of the following codes, standards and design guides:
 - a. The International Plumbing Code, 2012 Edition, with most current State of Texas Amendments
 - b. The International Building Code, 2012 Edition, with most current State of Texas Amendments
 - c. Americans with Disabilities Act (ADA)
 - d. American Society of Plumbing Engineers (ASPE) Data Books
 - e. National Fire Protection Association (NFPA) Standards
 - 1) NFPA 30 - Flammable and Combustible Liquids Code
 - 2) NFPA 58 - Liquefied Petroleum Gases
 - f. Plumbing Drainage Institute (PDI)
 - g. Underwriters Laboratories Inc. (UL)
 - h. National Sanitation Foundation (NSF)
 - i. Local and State Fire Marshal requirements
 - j. Local Building and Inspection Department requirements
 - k. Local Health Department requirements

1.3 GENERAL REQUIREMENTS

- A. Division 1, General Requirements and Supplementary Conditions, are hereby made a part of this section as fully as if repeated herein.

- B. The scope of work required by this section of the specifications consists of furnishing all materials, labor, supervision, equipment, appurtenances, accessories, connections, permits and services to perform all plumbing work, complete and placed into approved operating condition, including all tests and adjustments, in strict accordance with these specifications and the Contract Drawings.
- C. The principal work under this section shall include, but not be limited to the following systems and equipment:
 - 1. The Contractor shall furnish and install acid waste and vent piping and dilution basins as indicated on the drawings and/or included in this division of these specifications.
 - 2. Underground acid waste and vent piping including mains, branches, traps, connections to fixture and drains, and connections to stacks, piping to dilution tank; dilution tank(s) and piping connections from tank to designated outfall structure.
- D. The drawings and these specifications are complimentary each to the other, and any labor, or material called for by either, whether or not by both, shall be furnished and installed. The Contractor shall notify the Architect/Engineer of any discrepancies between the drawings and specifications regarding labor or materials prior to submitting bid.
- E. The drawings are diagrammatic in nature and indicate the various systems and piping required. All offsets, fittings, valves, devices and accessories which may be required are to be provided under this Contract. The plumbing subcontractor shall examine the entire set of Contract Documents and carefully investigate the structural and finish conditions affecting all his work and shall arrange such work accordingly for the complete satisfactory operation of all systems, providing such fittings, traps, valves, devices and accessories as may be required to meet such conditions. Particular attention shall be taken to avoid foundations, footing and other structural elements furnished under other sections of the specifications. Any adaptations, modifications, or additions are the responsibility of and shall be borne by this subcontractor and shall be approved by the Engineer before execution. All openings, blockouts or sleeves required for the execution of this subcontract are the responsibility of this subcontractor to coordinate.

1.4 RELATED WORK SPECIFIED ELSEWHERE

- A. Excavation and backfill for installation of the specified systems shall be done by this subcontractor.
- B. Core drilling, masonry work and painting incidental to the installation of the specified systems shall be included in the scope of work of this subcontractor.

1.5 REFERENCES

- A. Codes, Ordinances and Permits
 - 1. All work performed under this section of the Specifications shall conform to all codes, ordinances, and regulations of the City, County, State and/or other

authorities having jurisdiction. All work shall conform to the 2000 Standard Plumbing Code with all local amendments as a minimum.

2. This subcontractor shall give proper authorities all requisite notices, file all required plans relative to the work specified herein with proper authorities, and secure and pay for all permits, licenses and certificates relating to his work.
3. If code or other requirements exceed the provisions shown on the Contract Documents, the Engineer shall be notified in writing. Where requirements of the Contract Documents exceed code requirements, work shall be furnished and installed in accordance with the Contract Documents. Any work done contrary to these requirements shall be removed and replaced at the Contractor's expense.

1.6 SUBMITTALS

A. Shop Drawings and Catalog Data

1. The Contractor shall prepare, submit, and obtain Engineer's review of manufacturers' submittals on the following equipment and systems prior to ordering, purchasing, or installation of any equipment or materials, and within 30 days from date of contract award. All required submittals shall be transmitted simultaneously in hard ring binders with the associated specification section and the item submitted clearly identified. Partial submittals will be returned without review unless previously agreed to by the Engineer.
 - a. Acid waste and vent piping.
 - b. Acid neutralization tank
2. All shop drawing approvals required by any code or enforcement authority, insurance underwriter, etc. shall be obtained prior to being submitted to the Engineer.
3. Review of shop drawings by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc. Such coordination shall be clearly indicated on the shop drawings.
4. Shop drawings shall clearly indicate selection of model numbers, sizes, dimensions, electrical characteristics, etc. of the proposed equipment. Any deviations from specified equipment shall be clearly indicated on the submittal.

1.7 EQUIPMENT, MATERIAL BID BASIS

- A. Manufacturers' names, model numbers, etc. as specified on the drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.
- B. Unless "approved equal" is specifically stated, bids shall be based on equipment named in specifications or on drawings as "base" products.
- C. Alternate "approved equal" items listed shall conform to specified base items and shall be substantially equal in quality, size, weight, construction and capacities. The alternate equipment and materials shall be submitted as full equivalent to the equipment and

materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question. The Engineer shall consider the use of the alternate equipment based on the supportive documentation and other information available to him, and shall approve or disapprove any alternates. The decision of the Engineer shall in all cases be final.

1.8 EXAMINATION OF PREMISES

- A. Prior to the ordering or purchasing of any plumbing equipment or materials or the layout or installation of any work, the Contractor shall examine the premises and verify any and all of the existing conditions under which he will be required to operate, or that will in any manner affect the work under this Contract.

1.9 EXISTING SERVICES

- A. If existing active services are encountered that require relocation, notify the Architect and relocate as directed. Do not prevent or disturb operation of active services that are to remain.

1.10 COORDINATION OF TRADES

- A. The plumbing subcontractor shall give full cooperation to other trades, and shall furnish all information necessary to permit the work of all trades to be installed satisfactorily and with least possible interference or delay.
- B. Piping and other plumbing equipment shall not be installed without first coordinating the installation of same with other trades. This subcontractor, at his own expense, shall relocate all uncoordinated piping and other plumbing equipment installed should they interfere with the proper installation and mounting of electrical, HVAC equipment, ceilings and other architectural or structural finishes.
- C. This subcontractor shall coordinate the elevations of all piping and equipment above ceilings and in exposed areas with the work of all other disciplines prior to installation.
- D. In areas where more than one trade is required to use common openings in beams, joists, chases, shafts and sleeves for the passage of conduits, raceways, piping, ductwork and other materials, this subcontractor must coordinate the positions of all piping and equipment to be furnished under this section so that all items including the materials and equipment of other trades may be accommodated within the space available.
- E. This subcontractor shall confirm that work installed under this section does not interfere with the clearances required for finished columns, pilasters, partitions, walls or other architectural or structural elements as shown on the Contract Documents.
- F. Plumbing work that is installed under this Contract which interferes with the architectural design or building structure shall be removed and relocated as required at no additional cost to the Contract.

1.11 OBTAINING AND GIVING INFORMATION

- A. Obtain detailed information from all manufacturers as to the proper method of installing and connecting same. Obtain all required information necessary to facilitate and complete the plumbing installation.
- B. Coordinate the shape, size and position of all openings required for materials and equipment under this section and give full information to other trades sufficiently in advance to allow proper access requirements. Provide all sleeves and supports necessary to complete the work specified under this section.
- C. In case of failure on the part of this subcontractor to give proper information as noted above, all necessary cutting and patching will be performed at this subcontractor's expense.
- D. The information to be furnished by this subcontractor shall include sleeve openings (sizes and locations) and all other pertinent information relative to the plumbing installation. This subcontractor shall also furnish to other trades the dimensions and weights of all major pieces of mechanical equipment, and schedule with other trades the clearances that will be required throughout the building to allow for the passage of same through the building to their required installation locations.

1.12 OPERATING INSTRUCTIONS

- A. This subcontractor shall give detailed instructions for a period of not less than one-half days to the responsible personnel designated by the Owner in the operation and maintenance of all equipment furnished under this Contract. A letter containing the name of the person or persons to whom the instructions were given and the dates of instruction period shall be submitted to the Engineer in the as-built submittal.
- B. Prior to final acceptance by the Owner, this subcontractor shall submit a complete as-built submittal to the Engineer for review, three (3) sets of operating and instructional manuals, spare parts lists, drawings, wiring diagrams, trouble shooting data, manufacturer's bulletins, and other pertinent data on all equipment furnished under this Contract. Each set shall be enclosed in a suitable hard cover binder.
- C. A complete set of reproducible as-built drawings shall be provided indicating the location of all concealed piping dimensionally located from a minimum of two column lines or major building structures. Drawings shall be a minimum of 1/8" scale.
- D. Provide name, address and telephone numbers of the manufacturer's representative and service company for each piece of equipment installed in the as-built submittal package.

1.13 GUARANTEE

- A. Guarantee for all work furnished and/or installed under this section shall be as specified in Division 1 or a minimum of one (1) year from final acceptance.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Products and materials listed herein are for references of approved materials.
- B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

2.2 PIPING SYSTEMS

- A. General
 - 1. The various piping systems are classified as follows, and materials of construction shall be as specified unless otherwise noted on drawings.
- B. Underground Pipe and Fittings
 - 1. Pipe sizes 1-1/2" to 6": Polypropylene, Schedule 40, DWV type ASTM F-1412, with recessed drainage fittings, ASTM "D" 4101 and joints conforming to ASTM-2657.
 - a. Joints shall be mechanical type with heavy bituminous coating on exposed metal parts.
 - b. Joints shall be electric heat fusion type.
 - 2. Pipe sizes 1-1/2" to 6": ChemDrain® Chlorinated Polyvinyl Chloride (CPVC-cwd) schedule 40, non-pressure DWV type conforming to ASTM F2618.
 - a. Joints shall be solvent cemented per ASTM F2618.
 - 3. Provide tracer wire at all underslab piping and wire terminate at building exit. Wire to be 12AWG, green insulation, and copper conductor. Provide cast junction box flush with finished grade permanently labeled "Tracer Wire". Extend wire from exit point around all non-metallic piping to properly line, coordinate installation with Civil contractor.
- C. Aboveground Pipe and Fittings
 - 1. Pipe sizes 1-1/2" to 4": Polyvinylidene Fluoride (PVDF), flame retardant, schedule 40, DWV type, with recessed drainage fittings, ASTM "D" 4101 and ASTM-2657.
 - a. Joints shall be mechanical type.
 - b. Joints shall be electric heat fusion type.
 - 2. Pipe sizes 1-1/2" to 4": Polypropylene Fluoride (PP), flame retardant, schedule 40, DWV type, with recessed drainage fittings, ASTM "D" 4101 and ASTM-2657.
 - a. Joints shall be mechanical type.
 - b. Joints shall be electric heat fusion type.
 - c. Pipe to be fire wrapped in return air plenum.
 - 3. Pipe sizes 1-1/2" to 4": ChemDrain Chlorinated Polyvinyl Chloride (CPVC-cwd), schedule 40, non-pressure DWV type conforming to ASTM F-2618.
 - a. Joints shall be solvent cemented per ASTM F2618.
 - 4. Glass Pipe: ASTM C1053

- a. Fittings: ASTM C1053.
 - b. Joints: Stainless steel compression couplings with tetra-fluoroethylene seal ring.
 - c. Manufacturer: O-I/Schott Process Systems, Inc., "KIMAX".
- D. Floor Drains
- 1. Corrosion resistant drain with sediment bucket and fiber-filled grate, Polyvinylidene Fluoride (PVDF), ASTM D4101, socket fusion or mechanical joint connection, Orion model AWFSTD or approved equal.
- E. Floor Cleanout
- 1. Corrosion resistant floor cleanout with countersunk plug, ASTM-D-4101, round nickel bronze cover, AWCO (acid waste cleanout) cast in cover, Orion model FCO-SQ or approved equal.
- F. Manufacturers
- 1. Provide acid waste and vent piping and dilution tanks from one of the following:
 - a. George Fischer Sloane
 - b. Zurn Industries
 - c. Charlotte Pipe
 - d. Spears Mfg.
 - e. IPEX
 - f. Equal and owner approved
- G. Acid Waste Drainage Piping Materials and Products
- 1. Provide piping materials and factory fabricated piping products of sizes, types, pressure ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in chemical drainage piping systems.
 - 2. Where more than one type of material or product is indicated, selection is Installer's option, however, systems of piping must remain consistent in the type of materials and fittings utilized.
 - 3. The Acid Dilution Basin shall be as indicated on the plumbing drawings.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS

- A. Waste, Vent and Indirect Waste Piping - General
- 1. Pipes shall be plumb and parallel to building walls, beams and columns unless otherwise indicated. All horizontal lines are to be evenly pitched and properly secured with iron or steel hangers, unless noted otherwise. A pitch of 1/4 inch per lineal foot shall be maintained on all soil, and waste lines, wherever possible. Where long runs of piping require less pitch due to space restrictions, a less pitch shall be allowed on main lines 4 inches and over in size, but in no event should any pipeline have a slope less than 1/8 inch per foot.

2. All soil and waste pipes shall be extended out full size through the roof or connected to a common vent as shown on the drawings.
3. The main ventilation stacks shall run parallel to the soil pipe stacks and shall connect to the vent continuation of the soil stack at least 3 feet above the rim of the highest plumbing fixtures on the stack. Vent stacks shall also be connected at the base or horizontal offset of the soil stack through a Y and 1/8 bend or an upright Y fittings. Offsets in vent pipe shall be made with 45 degree fittings wherever possible. Horizontal vent lines shall pitch toward a waste line.
4. Piping is to be run straight and plumb and all offsets shall be made at an angle of not less than 45 degrees.
5. Fire wrap non rating piping in return air plenum as required. Re section 22 05 29 for additional requirements.

3.2 TESTING OF PIPING SYSTEMS

A. General

1. All piping systems shall be subjected, before being insulated or concealed, to testing with water or air as noted and shall hold tight at the pressure head stated for the time interval required without adding air or water. While any system is being tested required head or pressure shall be maintained until all joints are inspected.
2. All tests shall be witnessed by the inspector having jurisdiction and the Owner's Representative, with 48 hours minimum notice given these authorities.
3. All equipment, material, labor and testing mediums required for testing any of the various systems or any part thereof shall be furnished by this subcontractor.
4. All connected equipment, accessories, etc. shall be isolated from piping systems prior to testing.

B. Acid Waste Piping Systems

1. Water test shall be applied to these drainage systems either in their entirety or in sections as required, after rough piping has been installed. If the system is tested in sections, each opening shall be tightly closed except the highest opening in the section under test. All sections shall be tested with a minimum of 10 feet head of water. In testing successive sections at least the upper 10 feet of the next preceding section shall be tested so that no joint of piping in the building except the uppermost 10 feet of the system shall be submitted to a test of less than a 10 foot of head water. The water shall be kept in the system for at least 30 minutes before inspection starts; the system shall then be made tight at all points.
2. Any points of the drainage systems to be tested with air instead of water shall be made by attaching an air compressor testing apparatus to any suitable opening and after closing all other inlets or outlets, forcing air into the system until there is a minimum gauge pressure of 5 psi. This pressure shall be held without the introduction of additional air for a period of at least 30 minutes.
3. Exterior connections shall be tested as part of the interior systems.

C. Defective Work

1. If inspection or tests show defects, such defective work or material shall be replaced and inspection and tests shall be repeated. All repairs to piping shall be made with new material. Caulking of screwed joints or holes is not acceptable.

D. Additional Tests

1. Provide all additional tests such as smoke or pressure tests as required by the regulations or as directed by authorities making the inspection.
2. Provide for any repeated test as directed by the Owner's Representative, to make all systems tight as required.
3. Visual inspections of joints, valves, etc. shall be made as directed by the Engineer.

3.3 EXCAVATION AND BACKFILL

- A. The Contractor shall do all necessary excavations for all piping, equipment and apparatus under this section and shall backfill trenches by filling and tamping in not more than 6" layers after pipes have been installed, tested and approved. Care shall be taken not to excavate below depth necessary. If excessive excavation is made or pipes are installed in filled areas, fill soil shall be tamped to compaction as specified under the Division 2 specifications. Provide a layer of sand at least 6" deep under all plastic pipe installed in soil. Bell holes shall be excavated to ensure that the sewer pipe rests for its entire length upon a solid trench bottom.
- B. Provide tracer wire for all piping routed below slab locate wire leads in accessible location for use in future line trouble shooting.

3.4 FIXTURE CONNECTIONS AND SUPPORTS

- A. Wall fixtures shall be hung by means of wall hangers supported by at least four (4) 3/8" lag bolts and expansion shields.

3.5 SLEEVES

- A. Furnish and install pipe sleeves around all piping passing through masonry walls, floors, beams, etc. Sleeves shall be of such diameter as to allow pipe to pass through easily and permit expansion and contraction of pipe. Where pipes are insulated, the sleeves shall be of such diameter as to allow the insulated pipe to pass through easily. The sleeves shall be placed before the pouring of concrete and before construction of walls. Sleeves for vertical risers shall extend a minimum of 1" above the floor slab. Sleeves to outside walls below grade shall be caulked or provided with expansion type mechanical seals as required to make them waterproof.

3.6 INSTALLATION OF UNIONS

- A. Unions shall be located as shown on plans and as required by equipment so piping and equipment can be easily dismantled. Unions shall not be installed in any location where they are not readily accessible.

3.7 TRAPS

- A. All fixtures, drains, etc. shall be provided with traps, unless specifically shown or specified otherwise. Traps shall be set in an upright position, level and true, and shall be vented as shown and required. All exposed traps shall be provided with cleanout plugs.

3.8 CLEANOUT INSTALLATION

- A. Furnish and install cleanouts in soil and waste lines as required by Code and/or job conditions, as shown on the drawings and as follows: At or near the end of each branch and main drainage line, horizontal lines at intervals as required by code. All cleanouts shall be readily accessible, with plugs easily removable for cleanout lines. Cleanouts at the base of vertical piping shall be held within 2'-0" from finished floor unless otherwise indicated.
- B. Install a floor clean out according to the following;
 - 1. Not more than 40' apart in all horizontal drain lines.
 - 2. At each change of direction greater than 45 Deg.
 - 3. At the base of each waste or soil stack.
 - 4. Install floor cleanouts at elevation to accommodate finished floor.
 - 5. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearances at cleanout for snaking drainage system.
 - 6. Provide Wye cleanouts with long sweeps turned up to elevated floor conditions for cleanout openings at floor drain waist lines.
- C. Install a wall cleanout according to the following:
 - 1. Install a wall cleanout at every sanitary piping within wet wall chase for all urinals. Wall cleanout shall be flush with exterior side of wall
- D. Install a exterior cleanout according to the following:
 - 1. Encase exterior cleanouts in concrete flush with grade.
 - 2. Provide double cleanouts where building sanitary sewer system and civil sewage system intersect.

3.9 FLASHING INSTALLATION

- A. All pipes passing through roofs shall be flashed in an approved manner. Flashing shall be watertight.
- B. Roof connections shall meet the approval of the manufacturer of roofing material and shall comply with roof bond requirements.

3.10 EQUIPMENT AND MATERIAL PROTECTION

- A. During construction all equipment shall be properly protected against damage, defacing and freezing with shipping cartons, plastic sheeting, shipping covers.
- B. All open ends of piping and equipment shall be sealed with nipples and caps, plugs, test plugs until connection to system is made.

3.11 SPACE REQUIREMENTS

- A. Piping, apparatus and equipment shall fit into the space provided in the building or within the property and shall be installed at such time and in such manner as to avoid damage to the

building structure or property as required by the job progress. Equipment, apparatus and accessories requiring normal servicing or maintenance shall be made easily accessible.

END OF SECTION 22 13 21

SECTION 22 14 13 - STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS

1.2 SUMMARY

- A. Provide a complete storm drainage piping system.
- B. Section Includes:
 - 1. Storm Piping Below Grade
 - 2. Storm (Including Overflow) Piping Above Grade

1.3 SUBMITTALS

- A. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories.
 - 2. Storm Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
- B. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Products and materials listed herein are for references of approved materials.
- B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

2.2 STORM WATER PIPING, BELOW GRADE

- A. Cast Iron Pipe: ASTM A74 service weight.
 - 1. Fittings: No hub cast iron fittings per CISPI 301 and ASTM A888.
 - 2. Joints: ASTM C564 and ASTM C1563, neoprene gasket system or lead and oakum.
- B. PVC Pipe
 - 1. Provide a complete system of solid wall schedule 40 PVC DWV piping with solvent welded joints.
 - 2. Provide tracer wire at all underslab piping and wire terminate at building exit. Wire to be 12AWG, green insulation, and copper conductor. Provide cast junction box flush with finished grade permanently labeled "Tracer Wire". Extend wire from exit point around all non-metallic piping to properly line, coordinate installation with Civil contractor.
- C. Contractor Option: Provide a complete system of schedule 40 PVC with solvent welded joints.
- D. Foam core PVC piping is not acceptable for any drainage system.

2.3 STORM WATER PIPING, ABOVE GRADE

- A. Cast Iron Pipe: ASTM A888 and CISPI 301, hub-less, service weight and marked with the collective trademark of the CISPI and listed by NSF International.
 - 1. Fittings: No hub cast iron fittings per CISPI 301 and ASTM A888.
 - 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies conforming to ASTM C564. Heavy duty couplings are required on no-hub systems at the base of stack and vertical to horizontal offsets and shall conform to the requirements of ASTM C1540 and shall be type 304 stainless steel shielded couplings with stainless steel worm gear clamps, 15 psi working pressure.
 - a. Acceptable Manufacturers: Ideal Tridon or Husky HD-4000.
 - 3. Transition coupling: No hub cast iron pipe to PVC use Husky SD 4200 transition coupling.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection size, location, and invert are as indicated on Drawings.
- B. Establish elevations of buried piping with not less than two (2) feet of cover.
- C. Establish minimum separation from other services piping in accordance with code.

- D. Remove scale and dirt on inside of piping before assembly.
- E. Install pipe with uniform slope of not less than 1/8 of an inch per foot.
- F. Install pipe on prepared bedding of bank sand, minimum of 2" depth on bottom of trench up to centerline of pipe.
- G. Route pipe in straight line.
- H. Pipe Cover and Backfilling:
 - 1. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in four (4) inches compacted layers to 12 inches minimum cover over top of pipe.
 - 2. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
 - 3. Do not use wheeled or tracked vehicles for tamping.
- I. Provide tracer wire for all piping routed below slab locate wire leads in accessible location for use in future line trouble shooting.

3.3 INSTALLATION - ABOVE GROUND PIPING

- A. Establish invert elevations, slopes for drainage 1/8 inch per foot (one (1) percent) minimum. Maintain gradients.
- B. Provide and installed cleanout as required by code and local AHJ.
- C. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearance at cleanout for snaking drainage system.
- D. Furnish and install cleanouts in soil and waste lines as required by Code and/or job conditions, as shown on the Drawings and as follows: At or near the end of each branch and main drainage line, horizontal lines at intervals as required by code. All cleanouts shall be readily accessible, with plugs easily removable for cleanout lines. Cleanouts at the base of vertical piping shall be held within 2'-0" from finished floor unless otherwise indicated.
- E. Install a floor clean out according to the following;
 - 1. Not more than 40' apart in all horizontal drain lines.
 - 2. Install floor cleanouts at elevation to accommodate finished floor.
 - 3. At each change of direction greater than 45 Deg.
 - 4. At the base of each waste or soil stack.
 - 5. Install floor cleanouts at elevation to accommodate finished floor.
 - 6. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearances at cleanout for snaking drainage system.
- F. Install a wall cleanout according to the following:
 - 1. Install a wall cleanout at every sanitary piping within wet wall chase for all urinals. Wall cleanout shall be flush with exterior side of wall.
- G. Install a exterior cleanout according to the following:

1. Encase exterior cleanouts in concrete flush with grade.
 2. Provide double cleanouts where building sanitary sewer system and civil sewage system intersect.
- H. Provide Wye cleanouts with long sweeps turned up to elevated floor conditions for cleanout openings at floor drain waist lines
- I. Install non-conducting dielectric connections wherever jointing dissimilar metals.
- J. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- K. Install piping to maintain headroom. Group piping to conserve space.
- L. Group piping whenever practical at common elevations.
- M. Support cast iron drainage piping at every joint.
- N. Provide bracing at horizontal pipe and fittings larger than 4 inches in size. Pipe and fittings shall be suitably braced to prevent horizontal movement at every branch opening or change of direction by use of braces, blocks, rodding, or other suitable method as required to prevent movement or joint separation.
- O. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- P. Provide clearance in hangers and from structure and other equipment for installation of insulation.
- Q. Install piping penetrating roofed areas to maintain integrity of roof assembly.
- R. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- S. Install bell and spigot pipe with bell end upstream.
- T. Sleeve pipes passing through partitions, walls and floors. Refer to Section 22 05 29.
- U. Provide heavy-duty clamps, fittings and gaskets at no-hub connections to all roof and overflow drains then transition to bell and spigot piping system.
- V. Insulate all horizontal storm and overflow drain piping with fiberglass insulation with service jacket. For exposed locations provide rigid insulation with rigid jacket. Insulate from roof drain body, past first elbow all the way to change to vertical direction, including y-fittings.

3.4 RODDING SEWERS

- A. All storm lines, both in the building and out, shall be rodded out after completion of the installation.
- B. This Work shall be done, as part of the contract, to make certain that all lines are clear, and any obstruction that may be discovered shall be removed immediately. Rodding shall be accomplished by utilizing a rotary cutter, which shall be full size of pipe being

cleaned. Rodding operations shall be witnessed by Owner's field representative. Submit a certificate of completion to owner.

END OF SECTION 22 14 13

SECTION 22 20 23 - GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS

1.2 SUMMARY

- A. Provide a complete natural gas piping system to all gas-burning appliances and all natural connectors.
- B. This section covers the complete first class natural gas system installation, within and to five (5) feet beyond building perimeter unless noted otherwise on Contract Drawings, including but not limited to piping, regulators, unions, valves, installation, testing and other normal parts that make the systems complete, operable, code compliant and acceptable to the authorities having jurisdiction.

1.3 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - 1. 2015 Edition of the International Fuel Gas Code.
 - 2. Latest Edition of NFPA 54, National Fuel Gas Code.
 - 3. Minimum Safety Standards for Natural Gas, 49 Code of Federal Regulations (CFR) Part 192, as Required by Title 16 of the Texas Administration Code § 8.70.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories.
 - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 - 3. Piping Specialties: Submit manufacturers catalog information including capacity, rough-in requirements, and service sizes for the following:
 - a. Strainers.

- b. Natural gas pressure regulators.
- c. Natural gas pressure relief valves.
- d. Tape form pipe coating.

- B. Test Reports: Indicate results of piping system pressure test.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of valves, piping system, and system components.
- B. Operation and Maintenance Data: Submit for valves and gas pressure regulators installation instructions, spare parts lists, and exploded assembly views.

1.6 QUALITY ASSURANCE

- A. All materials, equipment and Work shall meet or exceed all applicable federal, state and local requirements and conform to codes and ordinances of authorities having jurisdiction.
- B. Valves: Manufacturer's name, size, standards compliance and pressure rating clearly marked on outside of valve body.
- C. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
- D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.
- E. Installer Qualifications: Company specializing in performing the Work of this Section with minimum three (3) years documented experience. Installation of natural gas systems shall be performed by individuals licensed by the Texas State Board of Plumbing Examiners as a Journeyman or Master Plumber. All installation shall be supervised by a licensed Master Plumber. All testing shall be performed by a licensed Journeyman or Master Plumber. Welders shall be certified in accordance with ASME Section 9.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation. Furnish temporary protective coating on cast iron and steel valves.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.9 EXTRA MATERIALS

- A. Furnish two packing kits for each type and size valve.

PART 2 - PRODUCTS

2.2 MANUFACTURERS

- A. Products and materials listed herein are for references of approved materials.
- B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

2.3 NATURAL GAS PIPING, BELOW GRADE

- A. Steel Pipe: ASTM A53 Schedule 40 black.
 - 1. Fittings: ASTM A234/A234M forged steel welding type or ANSI LC-4/CSA 6.32 press-connect type (Viega MegaPressG, NIBCO BenchPressG).
 - 2. Joints: ASME B31.9, welded or ANSI LC-4/CSA 6.32, press-connect.
 - 3. Jacket: AWWA C105 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.
- B. Contractor Option: Provide Underground Gas Polyethylene (PE), SDR-11, ASTM D2513 pipe and fittings with heat fusion socket joints.
 - 1. Polyethylene pipe and fitting materials shall be compatible and by same manufacturer to ensure uniform melting and a proper bond. Fabricated fittings shall not be used.
 - 2. Provide connection between buried plastic gas service piping and metallic riser in accordance with the gas code. Provide metallic riser consisting of HDPE fused coating on steel pipe for connection to above ground building distribution piping. Underground horizontal metallic portion of riser shall be at least twenty four inches in length before connecting to the plastic service pipe. An approved transition fitting or adaptor meeting design pressure rating and plastic pipe manufacturers recommendations shall be used where the plastic joins the metallic riser.

2.4 NATURAL GAS PIPING, ABOVE GRADE (OUTDOOR)

- A. Piping 1½ inches and smaller shall be seamless Schedule 40 black steel, ASTM A106 or ASTM A53 Type "S", Grade A or B, with Class 150 black malleable iron threaded fittings conforming to ASME B16.3.
- B. Piping 2 inches and larger shall be Type "S" seamless or Type "E" electric resistance welded Schedule 40 black steel, ASTM A53, Grade A or B, with Schedule 40 wrought carbon steel fittings, ASTM A 234 and butt weld joints.
- C. Provide factory-applied, three-layer coating of epoxy, adhesive, and PE or field applied primer and epoxy paint coating on all pipe and fittings. Field applied coating is restricted to fittings and short sections of pipe necessarily stripped for threading or welding. Field coating shall be manufactured by Amercoat Type 240 or approved equal and applied in accordance with manufacturer's recommendations. Galvanizing shall not be considered adequate protection.

2.5 NATURAL GAS PIPING, ABOVE GRADE (INDOOR)

- A. Steel Pipe: ASTM A53 Schedule 40 black.
 - 1. Fittings: ASME B16.3, malleable iron, ANSI LC-4/CSA 6.32 press-connect (Viega MegaPressG, NIBCO BenchPressG), or ASTM A234/A234M forged steel welding type.
 - 2. Joints: NFPA 54, threaded or press-connected through 2" max size or welded to ASME B31.9 above 2" size.
 - 3. EXCEPTIONS:
 - a. All exposed piping 1½ inches and smaller located within areas utilized as return air plenums shall have welded joints with Schedule 40 socket welded forged steel fittings conforming to ASME B16.11.
 - b. All exposed piping 1½ inches and smaller serving laboratories from main natural gas riser to each emergency shut-off valve shall have welded joints with Schedule 40 socket welded forged steel fittings conforming to ASME B16.11.

2.6 UNIONS AND COUPLINGS

- A. Ferrous pipe: 150 psi malleable iron threaded connections.
- B. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.7 VALVES

- A. Manufacturers:
 - 1. Apollo.
 - 2. NIBCO.
 - 3. Milwaukee.
 - 4. Watts.
 - 5. Kitz.
 - 6. Homestead Valve.
- B. Ball Valves:
 - 1. 1/4 inch to 2-1/2 inch, MSS SP 110, 250 psi, two piece, threaded ends, bronze body, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, full port. Nibco T-585-70-UL.
 - 2. 3 to 4 inch, MSS SP 110, 250 psi, two piece, threaded ends, brass body, stainless steel ball, reinforced teflon seats, blow-out proof stem, lever handle, UL listed for flammable liquids and LPG, Full port. Nibco T-FP-600A (CSA, UL, FM).
 - 3. 3 inch and larger, MSS-SP-78, Type IV, Class 125, ASME/ANSI B16.38, 200 psi, lubricated plug valves with flanged or threaded ends. Bodies, plugs and bonnets shall be made from Gray Iron castings, ASTM A-126, Class B. Homestead Valve series 600 (CSA, UL, FM).

2.8 STRAINERS

- A. Manufacturers:
 - 1. O.C. Keckley Company or approved equal.
- B. Two (2) inch and Smaller: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.
- C. 2-1/2 inch to four (4) inch: Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.
- D. Five (5) inch and Larger: Flanged iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

2.9 NATURAL GAS PRESSURE REGULATORS

- A. Manufacturers:
 - 1. BelGas.
 - 2. Itron.
 - 3. Honeywell.
 - 4. Sensus.
 - 5. Maxitrol.
 - 6. Fisher.
- B. Product Description: Spring loaded, general purpose, self-operating service regulator including internal relief type diaphragm assembly and vent valve. Diaphragm case can be rotated 360 degrees in relation to body.
 - 1. Temperatures: minus 20 degrees Fahrenheit to 150 degrees Fahrenheit.
 - 2. Body: Steel.
 - 3. Spring case, lower diaphragm casing, union ring, seat ring and disk holder: Aluminum.
 - 4. Disk, diaphragm, and O-ring: Nitrile.
 - 5. Maximum inlet pressure: 150 psig
 - 6. Furnish sizes two (2) inches and smaller with threaded ends. Furnish sizes 2-1/2 inches and larger with flanged ends.

2.10 NATURAL GAS PRESSURE RELIEF VALVES

- A. Manufacturers:
 - 1. Fisher 289H, or approved equal.
- B. Product Description: Spring loaded type relief valve.
 - 1. Body: Aluminum.
 - 2. Diaphragm: Nitrile.
 - 3. Orifice: Brass.
 - 4. Maximum operating temperature: 150 degrees Fahrenheit.
 - 5. Inlet Connections: Threaded.

6. Outlet or Vent Connection: Same size as inlet connection.

2.11 UNDERGROUND PIPE MARKERS

- A. Plastic Ribbon Tape: Bright colored, continuously printed, minimum six (6) inches wide by four (4) mil thick, manufactured for direct burial service.

2.12 PROTECTIVE COATING

- A. Underground steel service entry piping shall be furnished with factory applied plastic coating and field coating at joints conforming to AWWA Standard C-203. All valves, fittings, and joints in underground piping shall be field coated using a heat-applied coal tar enamel tape, using two coats of heavy mastic, using "Scotchwrap," "CT Tapecoat" or "X-Tru-Tape." Field coating shall extend over mill wrapping a minimum of 4 inches. Damaged coating shall be repaired as specified for valves, fittings, and joints.

2.13 EMERGENCY SHUT-OFF VALVE

- A. Kitchen.
1. The main gas supply to kitchen equipment shall be provided with an automatic solenoid valve with manual reset lever. The valve shall be interconnected with the hood fire suppression system to shut down gas supply to all kitchen equipment.
 2. The valve shall be energized to open, closed when de-energized with manual reset. The required voltage shall be coordinated with the electrical contractor. The valve shall carry a UL Listing.
 3. The emergency shutoff valve is to be provided with manual shutoff valves and unions on each side and located in a surface mount steel cabinet with flush solid metal door. The cabinet is to be located as shown on the drawings with the top of cabinet flush with finished ceiling. The cabinet shall be Potter Roemer 1000 series or approved equal.
 4. The emergency shutoff valve is to be provided with manual shutoff valves and unions on each side and located in a surface mount steel cabinet with flush solid metal door. The cabinet is to be located as shown on the drawings with the top of cabinet flush with finished ceiling. The cabinet shall be Potter Roemer 1000 series or approved equal.
 5. Valves 3/4"-2-1/2" in size shall be ASCO 8044 series.
- B. Laboratory Classrooms – See related section 22 30 00.

2.14 LABORATORY NATURAL GAS PIPING

- A. All natural gas piping serving labs from main natural gas riser shall be routed exposed to view below ceiling and painted in accordance with Division 09. (Delete this if is not required on school project).
- B. Install emergency gas shut-off valve in each line serving individual laboratory rooms. Locate (Emergency) shut-off actuator within lab area adjacent to each room exit at 54 inches above finished floor. Location of emergency shut-off shall be accessible to occupants for shutting off the natural gas supply under emergency conditions and comply with Texas Accessibility Standards Accessible Elements and Space requirements.
- C. The emergency shutoff valve is to be provided with manual shutoff valves and unions on each side and located in a surface mount steel cabinet with flush solid metal door. The

cabinet is to be located as shown on the drawings with the top of cabinet flush with finished ceiling. The cabinet shall be BLC Lab Controls or approved equal.

- D. Gas piping joints shall be welded from main natural gas riser to each emergency shut-off valve. Piping from the emergency shutoff valve to the outlets shall be assembled with threaded fittings provided all joints are exposed to view or within the confines of laboratory furniture.
- E. Install flexible stainless steel appliance/equipment connector at each fume hood and biological safety cabinet requiring natural gas service. Connectors shall not be concealed within or extended through wall, floor or partition and shall be located entirely in the same room as the connected equipment. Provide an accessible shut-off valve not less than the nominal size of the equipment connector, immediately ahead of the connector.

PART 3 - EXECUTION

3.2 EXAMINATION

- A. Verify excavations are to required grade, dry, and not over-excavated.

3.3 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Install plastic ribbon tape continuous over top of pipe buried six (6) inches below finish grade, above pipe line.

3.4 INSTALLATION - BURIED PIPING SYSTEMS

- A. Install natural gas piping in accordance with NFPA 54.
- B. Establish minimum separation of gas pipe from other services, piping in accordance with code.
- C. Install continuous jacket or tape.
- D. Install gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure regulators. Gas service distribution piping to have initial minimum pressure of 5 psi. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.
- E. Install Work in accordance with Gas Company standards.
- F. Pressure test natural gas piping in accordance with NFPA 54. Pressure test prior to backfill, minimum 50 psi for 24 hours.
- G. Provide pipe sleeve as required for gas pipe routing under slab or in conceal space.
- H. Provide tracer wire for all piping routed below slab locate wire leads in accessible location for use in future line trouble shooting.

3.5 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

- A. Install natural gas piping in accordance with NFPA 54.
- B. Provide rigid appliance connections for each gas-burning appliance in accordance with code.
- C. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- D. Provide an accessible, approved shut-off valve within three (3) feet of each gas appliance. Install such that appliance can be maintained and removed without removal of the shutoff valve.
- E. Install gas pressure regulator vent full size opening on regulator and terminate outdoors.
- F. Provide new gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure of 5 psi. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.
- G. Install service pipe and set gas meters in accordance with Gas Company regulations. Coordinate with division 23 to install gas flow meter provided by division 23 and install by this contractor.
- H. Gas piping installed in plenums and chases shall be welded.
- I. In natatorium, including equipment rooms, all exposed plumbing piping shall be insulated and protected by a complete aluminum jacketing system. Refer to Section 15083 for specification on jacketing. Provide color coded, printed pipe label 10' on center identifying pipe service type (gas, domestic water, storm water, etc.).
- J. Provide shut-off valves on both sides of all gas regulators for isolation of gas regulators.
- K. Provide a manual shut off valve on the appliance gas supply line in addition to the Kitchen Ansul unit automatic shut off.
- L. Provide a gas valve manifold to isolate kitchen gas appliances individually at one location.
- M. Provide separate gas valves on each fixture in labs.
- N. Provide a gas isolation valve on the lab controller unit.
- O. Install a test port of each side of all natural gas pressure regulators.
- P. Perform a pressure test of all replaced natural gas piping.
- Q. Gas piping on roof shall be supported at appropriate intervals to prevent sagging. Spacing shall be determined by the roof type and loading. No piping shall rest directly on the roof.
- R. All supports shall be manufactured for the purpose of supporting pipe. Wood blocks are not an acceptable means of pipe support.

3.6 FIELD QUALITY CONTROL

- A. Pressure test natural gas piping in accordance with NFPA 54. Pressure test prior to backfill, minimum 50 psi for 24 hours.

- B. Defective joints or piping shall be replaced as required and the system shall then be re-tested.

END OF SECTION 22 20 23

SECTION 22 30 00 - PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS

1.2 SUMMARY

- A. Provide a complete installation for each equipment type listed in this section.
- B. Section Includes:
 - 1. COMMERCIAL GAS FIRED WATER HEATERS
 - 2. COMMERCIAL, GRID-TYPE, COPPER FINNED-TUBE, NATURAL GAS WATER HEATER
 - 3. COMMERCIAL NATURAL GAS DOMESTIC WATER HEATER
 - 4. COMMERCIAL (TANKLESS) GAS FIRED WATER HEATERS
 - 5. COMMERCIAL ELECTRIC WATER HEATERS
 - 6. COMMERCIAL (TANKLESS) ELECTRIC WATER HEATERS
 - 7. VACUUM RELIEF VALVES
 - 8. IN-LINE CIRCULATORS
 - 9. T & P RELIEF VALVES
 - 10. DIAPHRAGM-TYPE EXPANSION TANKS
 - 11. GARBAGE DISPOSAL
 - 12. GREASE TRAP (Gravity)
 - 13. GREASE TRAP (Hydro)
 - 14. GREASE TRAP (Automatic Grease Interceptor – Three comp sink)
 - 15. SCALE PREVENTION FLUID DYNAMICS
 - 16. SCALE PREVENTION SYSTEM (PS-1)
 - 17. ELEVATOR SUMP PUMP (ESP-1) - Standard
 - 18. ELEVATOR SUMP PUMP (ESP-1) With Oil-Minder Control System
 - 19. ELEVATOR SUMP PUMP (ESP-1) – Standard With Oil/Water Separator
 - 20. SOLIDS INTERCEPTOR
 - 21. SUBMERSIBLE, QUICK-DISCONNECT, DOUBLE-SEAL EFFLUENT PUMPS
 - 22. SEWAGE-PUMP BASINS AND BASIN COVERS
 - 23. ACID DILUTION BASIN
 - 24. ACID DILUTION TRAP
 - 25. LINT INTERCEPTOR – LT-1 (Central System up to 20 GPM)
 - 26. LINT INTERCEPTOR – LT-2 (Central System 30 to 50 GPM)
 - 27. LINT INTERCEPTOR – LT-3 (Drain Trough)
 - 28. LINT INTERCEPTOR – LT-4 (Concrete Drain Trough)
 - 29. SAMPLING WELL
 - 30. DRY WELL
 - 31. BACKFLOW PREVENTERS

32. WATER PRESSURE REGULATING VALVES
33. WATER HAMMER ARRESTORS
34. THERMOSTATIC MIXING VALVES
35. SOLENOID VALVES
36. INLINE WATER SERVICE FILTER
37. FLOW METER
38. TEMPERATURE INSTRUMENTS

1.3 SUBMITTALS

- A. Product Data: Submit complete manufacturer's specification pages for each piece of equipment. Submit dimensioned drawings of water heaters indicating components and connections to other equipment and piping. Indicate pump type, capacity and power requirements. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Submit electrical characteristics and connection locations.
- B. Manufacturer's Installation Instructions: Submit mounting and support requirements.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Accept all equipment on site in original labeled cartons. Inspect for damage.
- B. Protect heat exchangers and tanks with temporary inlet and outlet caps. Maintain caps in place until installation.

1.5 EXTRA MATERIALS

- A. Furnish two pump seals.

PART 2 - PRODUCTS

2.1 COMMERCIAL GAS FIRE TUBE WATER HEATERS GWH-X:

- A. Manufacturers: (The model numbers of heaters shall be among those listed as a certified model with the TCEQ).
 1. Sellers Engineering Company - Immersion Fired
 2. Patterson-Kelley Company - Scale Free or approved equal.
- B. Water heater shall be a one pass or two pass, horizontal immersion type, built to comply with Section IV of the ASME Code for 125 lbs. per square inch design pressure. Water heater shall combine scheduled recovery and storage capacity in one packaged unit.
- C. The water heater shall be approved as a unit by Underwriters Laboratory.
- D. Heat exchangers shall be installed in the rear half of the tubes.
- E. The water heater shall have straight two (2) inch O.D. tubes. Tubes shall be seamless copper over a steel tube each attached to tube sheets by roller expanding and beading.

- F. Tank shall be a welded design. Gasketed openings shall be limited to a maximum of five 3-1/2 inches x 4-1/2 inches handholds on all vessels and one 11 inches x 15 inches manhole on 60 inches and larger diameter vessels. The tank shall have an epoxy glass lining with two (2) magnesium anodes.
- G. The water heater shall be factory insulated with two (2) inch fiberglass and covered with a steel jacket.
- H. The entire burner assembly shall be hinged mounted requiring only disconnecting gas unions for complete access to burner components and front tube and sheet. Either an explosion relief door or bolted door shall be provided to give access to rear tube sheet.
- I. The entire water heater, base and other components shall be painted prior to shipment using a hard finish enamel.
- J. All trim items shall be mounted, piped, and wired. Loose items will not be accepted.
- K. Water heater trim items shall include the following; 4-1/2 inches temperature gauge, low water cutoff with manual reset and ASME safety valve(s) sized for input.
- L. Natural Gas Burner:
 - 1. The gas burner shall consist of a premix type gas-air burner assembly, runner pilots, and one main burner for each fire tube.
 - 2. Main gas train shall include the main pressure regulator, main gas shutoff cock, dual motorized safety shutoff valves, normally open vent valve, high and low gas pressure switches, manual test cock and gas pressure adjustment valve. Regulators shall be sized to handle 5 lb. entering gas.
 - 3. Pilot gas train shall include a pilot gas cock, regulator and solenoid gas valves. Regulator shall be sized to handle 5 lb. entering gas.
 - 4. Gas train shall conform to requirements of Industrial Risk Insurers (IRI).
 - 5. Draft equipment shall include a direct drive, forced draft blower with a combustion air switch. Dampers shall provide for both primary and secondary air adjustments.
- M. Controls:
 - 1. Each unit shall have a control cabinet with burner on/off switch, motor starter, flame safeguard programmer, factory wired control transformer, fuses, wiring diagram and six indicator lights with engraved labels.
 - 2. Lights shall indicate low water, limits, call for heat, pilot, main burner and flame failure.
 - 3. Flame safeguard shall be a Honeywell 7800 with keyboard display module with reset button, providing a safety shutdown within three (3) seconds in the event of flame failure.
 - 4. Power supply for the water heater shall be 480 volts, 3 phase, 60 cycle with control voltage being supplied from a 115/1/60 control transformer. (Coordinate with electrical for exact requirements.)
 - 5. The sequence of operation for call for heat by the temperature controls shall be as follows: water level and limits shall be checked for safety and the blower motor shall start. Once the air supply is proven, the burner shall be prepurged for 30 seconds. After the pilot is proved within ten (10) seconds the main gas valve shall open. When the heat demand is satisfied gas valves shall close and a 15 second post purge of the burner shall complete the cycle.
 - 6. The water heater shall be provided with Honeywell L4006 operating limit and high limit temperature controls.
 - 7. Provide dry contacts for shut down command from CO monitor.

N. Warranties and Tests:

1. The water heater shall be warranted to be free from defects in material and workmanship under normal use and service. This manufacturer shall replace or repair any component part originally supplied with the water heater that becomes defective during the first 18 months from date of shipment.
2. The Epoxy-Glass lined pressure vessel shall be warranted for a period of ten (10) years from date of shipment covering the shell, heads, stays and copper clad tubes, against leakage. Refractories, if any, shall be provided with a ten (10) year non-prorated labor and materials warranty.
3. The burner assembly shall be warranted for a period of five (5) years from date of shipment. The manufacturer shall replace any burner assembly material or impellers that become defective during the warranty period.
4. The water heater shall be shipped as a complete packaged requiring only connections of vent, drains, hot water supply and cold-water inlet, electrical and fuel. Loose items will not be accepted.
5. The completely piped and wired packaged water heater shall receive a full factory test to check construction, operation, efficiency and function for all controls. All factory tests may be witnessed by the Engineer at their request.
6. The water heater shall be guaranteed to operate at a minimum fuel-to-water efficiency of 82 percent.
7. After the water heater is installed and ready in all respects for firing, the water heater shall be started up by the manufacturer's field representative.
8. Water heater's NOx emissions shall not exceed 30 PPM when referenced at three (3) percent O₂. Water heaters must have a certification of compliance as required under Title 30, Texas Administrative Code, Chapter 117 of the Texas Commission on Environmental Quality (TCEQ).

O. Capacities:

1. GHW-X (X = as scheduled):
 - a. Located in hot water boiler room, gallon per hour recovery at 100-degree rise.
 - b. Water storage as scheduled.
 - c. Provide regulator for 5 lb. gas service pressure.

P. Accessories:

1. Provide neutralization drain tank as required.
2. Provide single point power connection as scheduled.
3. Provide integral heat traps.

2.2 COMMERCIAL, GRID-TYPE, COPPER FINNED-TUBE, NATURAL GAS WATER HEATER

A. Acceptable Manufacturers:

1. RBI
2. Lochinvar
3. Patterson Kelley Co.

- B. Water heaters shall be CSA design certified and shall not release any condensate during operation. Water heaters shall be designed for operation with natural or propane gas and have a CSA certified input rating as noted on the drawings, and a thermal efficiency rating up to 83.4%.

- C. The water heater(s) shall be ASME inspected and stamped and National Board registered for 160 psi working pressure and 210° F maximum allowable temperature, complete with a Manufacturer's Data Report.
- D. Service Access: The water heaters shall be provided with access covers for easily accessing all serviceable components. The water heaters shall not be manufactured with large enclosures, which are difficult to remove and reinstall. All accesses must seal completely as not to disrupt the sealed combustion process. All gas train components and blower motor must be accessible and able to adjust without the removal of covers or cabinet components.
- E. Indicating Lights: Each water heater shall include a diagnostic control panel indicating power on, operator, high limit, low water, low air, trial for ignition, main burner, flame failure, and inlet/outlet temperatures incorporated into the water heater. Access to the controls shall be through a control access door leaving diagnostic panel intact and not disrupted.
- F. COMPONENTS
 1. Combustion Chamber: The combustion chamber shall be constructed of stainless steel. An access door shall be provided for ease of service and inspection of the heat exchanger. Chamber shall be air-cooled and not require additional insulation.
 2. Heat Exchanger: The heat exchanger shall be inspected and bear the A.S.M.E. Section IV seal of approval. The heat exchanger shall be a four pass heat exchanger with a maximum working pressure of 160 psi. The heat exchanger's vertical design shall provide equal amounts of heat transfer throughout the entire heating surface. Each heat exchanger shall have copper tubes, with an integral copper finned tube of 7/8" I.D., .064" minimum wall thickness, 7 fins per inch, with a fin height of 3/8". Each end of the water tubes shall be strength rolled into the header. The heat exchanger shall be gasketless. Each individual tube can be re-tubed without the disturbance of the surrounding tubes. A pressure relief valve of 125 lb/sq. in. shall be equipped with the water heater and factory mounted. The headers shall be of bronze construction only, cast iron shall not be acceptable.
 3. Jacket: 18 gauge galvanized steel with factory applied baked enamel.
 4. Gas Burner: The burner shall be constructed of low alloy steel and nickel-plated. The burner flame shall burn vertically and be of the power type with a forced draft fan. Burner shall fire to produce a full 360-degree flame pattern to provide equal distribution of heat throughout the entire heat exchanger. The burner shall be easily removed for maintenance without the disruption of any other major component of the water heater. A window view port shall be provided for visual inspection of the flame during firing.
 5. Ignition Components: Turbo Pilot™ proven spark to pilot ignition system hardware shall consist of an Alumina ceramic insulated ignition electrodes and UV sensing tube permanently arranged to ensure proper ignition electrode and UV alignment. Electrodes must be capable of removal while leaving the burner intact. Hot surface ignition systems of any type will not be accepted. Turbo Pilot™ will produce a stable and robust fire of 6,000 BTU's and will operate at minimum gas pressures of 1.5" W.C. and maximum pressures of 5.5" W.C. The Gas Regulating valve supplied with the pilot has a full adjustment within these parameters.
 6. Rated Capacity: The water heater shall be capable of operating at rated capacity with pressures as low as 6" W.C. at the inlet to the burner pressure regulator.
 7. The burner shall be capable of 85% efficiency without exceeding a NOx reading above 10ppm.
 8. The burner and gas train shall be provided with the following trim and features:

- a. Burner Firing: On/off
- b. Burner Firing: 2 Stage (750-1950)
- c. Burner Ignition: Intermittent spark
- d. Safety Controls: Energize ignition, limit time for establishing flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, and allow gas valve to open.
- e. Flue Gas Collector: Enclosed combustion chamber with integral combustion air blower and single venting connection.
- f. Gas Train: Manual gas valves (2), redundant main gas valves (solenoid/diaphragm, motorized), firing valve, 'B' valve, pilot gas pressure regulator, and automatic pilot gas valve. All components to be factory mounted.
- g. Safety Devices: Optional high/low gas pressure switches, air flow switch, and blocked flue detection switch. All safeties to be factory mounted.

G. WATER HEATER TRIM

1. Safety Relief Valve: ASME rated, factory set to protect water heater and piping as per schedule/drawings.
2. Gauge: Combination water pressure and temperature shipped loose for field installation. Inlet/ Outlet temperature gauges to be an integral part of the front water heater control panel to allow for consistent easy monitoring of temperatures factory mounted and wired.
3. Flow Switch: Prevent burner operation when water falls below a safe level or when water flow is low. Flow switch shall be factory mounted. Provision for installation of a low water cut off shall be provided.
4. Operating Controls: Water heaters shall be provided with a Honeywell RM7800 series digital flame safeguard. The flame safeguard shall be capable of prepurge cycles.
5. Operating Temperature Control: Shall be a manual probe type controller adjustable from 120°F to 240°F, 49°C to 116°C. Control shall be factory mounted and sense the inlet temperature of the water heater through a dry well.
6. High Limit: Temperature control with manual reset limits boiler water temperature in series with the operating control. High limit shall be factory mounted and sense the outlet temperature of the water heater through a dry well.
7. PROVIDE THE FOLLOWING STANDARD TRIM:
 - a. Bronze headers
 - b. Low air pressure switch
 - c. Blocked flue detection switch
 - d. Flow switch (factory mounted and wired)
 - e. Operating aquastat
 - f. Manual reset high limit
 - g. Air inlet filter
 - h. Inlet/outlet thermometers (factory mounted and wired)
 - i. FM and CSD-1 gas train
8. PROVIDE THE FOLLOWING JOB SPECIFIC TRIM AND FEATURES:
 - a. All bronze circulator provided by the manufacturer (shipped loose)
 - b. FM or IRI controls and gas train
 - c. Cupro-nickel heat exchanger
 - d. Probe type low water cut off, manual reset (shipped loose)
 - e. Diagnostic keyboard display for RM7800 series control
 - f. CSD-1 controls
 - g. Temperature/pressure gauge
 - h. Barometric damper
 - i. Motorized gas valves

H. MOTORS

1. Refer to Division 22 Section "Motors" for factory installed motors.
 2. Water Heater Blower Motor: Open drip-proof motors where satisfactorily housed or remotely located during operation. Blower motor shall be externally mounted for ease of service. There shall be no requirement to remove covers or gas train components to remove the blower motor. Blower motor shall not exceed 3/4 HP and not require more than 12 amps
- I. SOURCE QUALITY CONTROL
1. Test and inspect water heaters according to the ASME Boiler and Pressure Vessel Code, Section IV. Water heaters shall be test fired in the factory with a report attached permanently to the exterior cabinet of the water heater for field reference.
- J. Warranty Period: Manufacturer's standard, but not less than 5 years from date of Substantial Completion on the heat exchanger. Warranty shall be non-prorated and not limited to thermal shock. Additional 21 year thermal shock warranty on heat exchanger.
- K. The water heater(s) flue connection, combustion air opening, gas connection, water connections and electrical connections shall be located on the rear.
- L. The primary heat exchanger shall have accessible water heater drain valves with hose bibs to drain the water section of the primary heat exchanger.
- M. The water heater(s) shall be equipped with a 100 percent safety shutdown. Provide dry contacts for shut down command from CO monitor.
- N. The water heater(s) shall have a firing/leak test valve and pressure test valve as required.
- O. Gas control trains shall a redundant safety shut-off feature, main gas regulation, shut-off cock and plugged pressure tapping to meet the requirements of ANSI Z21.10.3/CSA 4.3.
- P. The water heater(s) shall be equipped with a PID modulating temperature controller with LCD display that incorporates an adjustable energy-saving pump control relay and is factory mounted and wired to improve system efficiency; three water sensors included.
- Q. Water sensors shall be shipped loose for field-installation by installing contractor. Inlet/Outlet sensors are factory-installed. Tank sensor is loose.
- R. The water heater(s) shall meet safety standards for direct vent equipment as noted by the local codes.
- S. The water heater(s) shall be completely assembled, wired, and fire-tested prior to shipment from the factory.
- T. The water heater(s) shall be furnished with the sales order, ASME Manufacturer's Data Report, inspection sheet, wiring diagram, rating plate and Installation and Operating Manual.
- U. Must comply with:
1. Local, State, and national codes, laws, regulations and ordinances
 2. Manufacturer's installation instructions, including required service clearances and venting guidelines.
 3. Manufacturer's representative to verify proper and complete installation.
- V. Start-up shall be performed by factory-trained personnel.

- W. Test during operation and adjust if necessary:
 - 1. Safeties
 - 2. Operating Controls
 - 3. Static and full load gas supply pressure
 - 4. Gas manifold and blower air pressure
 - 5. Amp draw of blower
 - 6. Shut down command from BAS or CO panel
- X. Submit copy of start-up report to Architect and Engineer.
- Y. Provide factory-authorized service representative to train maintenance personnel on procedures and schedules related to start-up, shut-down, troubleshooting, servicing, and preventive maintenance.
- Z. Schedule training at least seven days in advance.
- AA. Capacities:
 - 1. GHW-X (X = as scheduled):
 - a. Located in hot water boiler room, gallon per hour recovery at 100-degree rise.
 - b. Water storage as scheduled.
 - c. Provide regulator for 5 lb. gas service pressure.
- BB. Accessories:
 - 1. Provide neutralization drain tank as required.
 - 2. Provide single point power connection as scheduled.
 - 3. Provide integral heat traps.

2.3 COMMERCIAL NATURAL GAS DOMESTIC WATER HEATER (Min 95% EFF)

- A. Furnish and install condensing, low NOx, modulating natural gas-fired domestic water heaters with a minimum thermal efficiency of 95% when tested to ANSI Z21.10.3 with the standby loss, and all other requirements of latest edition of ASHRAE 90.1b. The unit shall be NSF 61 standard tested and compliant for drinking water use. The dimensions, capacities, natural gas requirements and electrical characteristics of the water heater shall be as scheduled on the Contract Drawings and as outlined herein. This Specification describes minimum quality and performance requirements. Variations of system components by the individual referenced manufacturers are acceptable for installation in this project provided they meet or exceed all of the requirements scheduled on Contract Drawings, indicated herein and fit properly in the space provided.
- B. Gas water heater(s) shall be equipped with a powered gas burner with electronic flame safeguard, intermittent electronic ignition, main and pilot automatic gas valves, redundant solenoid gas valve, gas pressure regulator, diaphragm switch for proof of boiler operation, and flame inspection port. Maximum gas supply pressure to heater(s) shall be 13" W.C., and ASME working pressure shall be 160 psi. Water heater(s) shall have the followings:
 - 1. Modulating gas burner that automatically adjusts the input based on demand.
 - 2. Powered anodes that are non-sacrificial and maintenance free.
 - 3. Have seamless glass-lined steel tank construction, with glass lining applied to all water-side surfaces after the tank has been assembled and welded.

4. Have a down-fired power burner designed for precise mixing of air and gas for optimum efficiency, requiring no special calibration on start-up.
 5. Be approved for 0" clearance to combustibles
- C. The control shall be an integrated solid-state temperature and ignition control device with integral diagnostics, graphic user interface, fault history display, and shall have digital temperature readout and other components shall include manual-reset high-temperature limit control, upper and lower thermostats, combination temperature and pressure gauge, low-water cutoff, ASME-rated temperature and pressure relief valve, drain valve and draft regulator. Control compartment door shall be hinged for easy access.
1. All models are design certified by Underwriters Laboratories (UL), Inc., according to ANSI Z21.10.3 standards governing storage type water heaters.
 2. Meet the thermal efficiency and standby loss requirements of the U. S. Department of Energy and current edition ASHRAE/IES 90.1. Complies with SCAQMD Rule 1146.2 and other air quality management districts with similar requirements for low NOx emissions.
- D. The heater(s) shall meet or exceed current standard or ASHRAE/IESNA 90.1-1999 for recovery efficiency and standby loss. The tank shall have a 15 year warranty against failure as outlined in the written warranty. Professional start-up service shall be included.
- E. Tank will be welded utilizing joint designs to minimize volume of weld deposit and heat input. All heat affected zones (HAZ) shall be processed after welding to ensure the HAZ corrosion resistance is consistent with the mill condition base metal chemical composition. Weld procedures (amperage, volts, welding speed, filler metals and shielding gases) utilized shall result in a narrow range of austenite-ferrite microstructure content consistent with phase balanced objectives for welds, HAZ and the base metal.
- F. Tank, combustion chamber and fire tubes will be constructed from phase-balanced austenitic and ferritic duplex steel with a chemical structure containing a minimum of 21% chromium to prevent corrosion and mill certified per ASTM A 923 Methods A to ensure that the product is free of detrimental chemical precipitation that affects corrosion resistance. The material selected shall be tested and certified to pass stress chloride cracking test protocols as defined in ISO 3651-2 and ASTM G123 - 00(2005) "Standard Test Method for Evaluating Stress-Corrosion Cracking of Stainless Alloys with Different Nickel Content in Boiling Acidified Sodium Chloride Solution."
- G. Water heater(s) shall be capable for remote monitoring, leak detection and fault alert. Provide dry contacts for shut down command from CO monitor.
- H. Capacities: GHW-X (X = as scheduled); Water storage as scheduled; Located in hot water boiler room, gallon per hour recovery at 100-degree rise.
1. Accessories:
 - a. Provide regulator for 5 lb. gas service pressure.
 - b. Provide single point power connection as scheduled.
 - c. Provide neutralization drain kit as required.
 - d. Provide Concentric vent kit as required.
 - e. Provide integral heat traps.

- f. Provide drain pan.
- 2. Water heaters with full rated input between 199,000 and 300,000 BTU will operate at a minimum 95.3% thermal efficiency at full firing rate when tested to the ANSI Z21.10.3 thermal efficiency test protocol (DOE 10 CFR 431).
- 3. Water heaters with full rated input between 399,000 and 600,000 BTU will operate at a minimum 96% thermal efficiency at full firing rate when tested to the ANSI Z21.10.3 thermal efficiency test protocol (DOE 10 CFR 431)
- 4. Manufacturers: RBI, & PVI.

2.4 COMMERCIAL NATURAL GAS DOMESTIC WATER HEATER (Min 95% EFF)

- I. Manufacturers:
 - 1. AO Smith,
 - 2. Rheem
 - 3. State
- J. Furnish and install condensing, low NOx, modulating natural gas-fired domestic water heaters with a minimum thermal efficiency of 95% when tested to ANSI Z21.10.3 with the standby loss, and all other requirements of latest edition of ASHRAE 90.1b. The unit shall be NSF 61 standard tested and compliant for drinking water use. The dimensions, capacities, natural gas requirements and electrical characteristics of the water heater shall be as scheduled on the Contract Drawings and as outlined herein. This Specification describes minimum quality and performance requirements. Variations of system components by the individual referenced manufacturers are acceptable for installation in this project provided they meet or exceed all of the requirements scheduled on Contract Drawings, indicated herein and fit properly in the space provided.
- K. Gas water heater(s) shall be equipped with a powered gas burner with electronic flame safeguard, intermittent electronic ignition, main and pilot automatic gas valves, redundant solenoid gas valve, gas pressure regulator, diaphragm switch for proof of boiler operation, and flame inspection port. Maximum gas supply pressure to heater(s) shall be 13" W.C., and ASME working pressure shall be 160 psi. Water heater(s) shall have the followings:
 - 1. Modulating gas burner that automatically adjusts the input based on demand.
 - 2. Powered anodes that are non-sacrificial and maintenance free.
 - 3. Have seamless glass-lined steel tank construction, with glass lining applied to all water-side surfaces after the tank has been assembled and welded.
 - 4. Have a down-fired power burner designed for precise mixing of air and gas for optimum efficiency, requiring no special calibration on start-up
 - 5. Be approved for 0" clearance to combustibles.
- L. The control shall be an integrated solid-state temperature and ignition control device with integral diagnostics, graphic user interface, fault history display, and shall have digital temperature readout and other components shall include manual-reset high-temperature limit control, upper and lower thermostats, combination temperature and pressure gauge, low-water cutoff, ASME-rated temperature and pressure relief valve, drain valve and draft regulator. Control compartment door shall be hinged for easy access.
 - 1. All models are design certified by Underwriters Laboratories (UL), Inc., according to ANSI Z21.10.3 standards governing storage type water heaters.
 - 2. Meet the thermal efficiency and standby loss requirements of the U. S. Department of Energy and current edition ASHRAE/IES 90.1. Complies with SCAQMD Rule 1146.2 and other air quality management districts with similar requirements for low NOx emissions.

- M. The heater(s) shall meet or exceed current standard or ASHRAE/IESNA 90.1 for recovery efficiency and standby loss. The tank shall have a 10-year warranty against failure as outlined in the written warranty. Professional start-up service shall be included.
- N. The tank shall be glass lined with alkaline borosilicate composition and fused to the steel by firing at 1600°F and shall be insulated with fiberglass insulation. The heater will also be equipped with multiple anodes for cathodic protection. Heater(s) shall be equipped with 1-1/2" NPT water inlet and outlet openings, and two 3" handhole cleanouts. The heater(s) shall be constructed on accordance with ASME code, and the entire unit listed by Underwriters Laboratories.
- O. Water heater(s) shall capable for remote monitoring, leak detection and fault alert. Provide dry contacts for shut down command from CO monitor.
- P. Capacities: GHW-X (X = as scheduled); Water storage as scheduled; Located in hot water boiler room, gallon per hour recovery at 100-degree rise.
 - 1. Accessories:
 - a. Provide regulator for 5 lb. gas service pressure.
 - b. Provide single point power connection as scheduled.
 - c. Provide neutralization drain kit as required.
 - d. Provide Concentric vent kit as required.
 - e. Provide integral heat traps.
 - f. Provide drain pan.
 - 2. 120K-250K BTU Input: For Standard Power Venting: Water heater(s) shall be suitable for power venting using a 4" diameter pipe for a total distance of (120 ft.) equivalent feet of vent piping. For Power Direct Venting: Water heater(s) shall be suitable for power direct venting using a 4"-diameter pipe for a total distance of (120 ft.) equivalent feet of vent piping and (120 ft.) equivalent feet of intake air piping.
 - 3. 300K - 500K BTU Input: For Standard Power Venting: Water heater(s) shall be suitable for standard power venting using a (6") diameter pipe for a total distance of (120 ft.) equivalent feet of vent piping. For Power Direct Venting: Water heater(s) shall be suitable for power direct venting using a (6") diameter pipe for a total distance of (120 ft.) equivalent feet of vent piping and (120 ft.) equivalent feet of intake air piping.

2.4 COMMERCIAL (TANKLESS) GAS FIRED WATER HEATERS:

- A. Accepted Manufacturers:
 - a. Rinnai
 - b. Rheem
 - c. A.O. Smith
- B. The water heater shall be approved as a unit by Underwriters Laboratory.
- C. Ultra-Low NOx gas tankless water heaters with condensing technology featuring up to 0.95 Uniform Energy Factor (UEF) which lowers operating costs and is environmentally friendly.
- D. The entire water heater, base and other components shall be painted prior to shipment using a hard finish enamel.

- E. All trim items shall be mounted, piped, and wired. Loose items will not be accepted.
- F. Water heater trim items shall include the following; 4-1/2 inches temperature gauge, low water cutoff with manual reset and ASME safety valve(s) sized for input.
- G. The indoor heater(s) shall be vented with 3" or 4" diameter schedule 40 PVC, CPVC, ABS, or Category IV vent pipe with a length not to exceed 70 ft. (equivalent) for 3" vent or 100 ft. (equivalent) for 4" vent, terminating horizontally or vertically. The intake pipe may use material such as PVC, ABS, aluminum, or Category IV pipe and cannot exceed 70 ft. (equivalent) for 3" vent or 100 ft. (equivalent) for 4" vent. The outdoor heater(s) shall be constructed with an integral exhaust vent on the front of the heater.
- H. The water heater(s) shall use a commercial-grade copper, fin tube primary heat exchanger with quick release brass or bronze waterways. The secondary heat exchanger shall be constructed from stainless steel 316L. The heater(s) shall be controlled by an on-board solid-state printed circuit board which uses the following factory installed components: thermistors to monitor water temperature and exhaust temperature; a flow sensor to measure flow rate; a flame sensor to monitor combustion; an Air-Fuel Ratio Rod to measure and adjust air input in order to maintain optimal combustion efficiency. The heater also consists of in-line fusing and surge absorbers for electrical surge protection, an electronic spark igniter, aluminized stainless steel burners, hi-limit temperature switches to monitor water and exhaust temperatures, modulating gas valve, dual freeze protection that will automatically fire the heater (indoor model only) and use heating blocks to protect the heat exchanger, and an overheat cutoff fuse.
- I. The heater models are design certified by CSA according to ANSI Z21.10.3 · CSA 4.3, ENERGY STAR® qualified, has a minimum uniform energy factor of 0.93, meets the energy efficiency requirements of the U. S. Department of Energy and ASHRAE 90.1, complies with SCAQMD Rule 1146.2 and other air quality districts with similar requirements for low NOx emissions of 14 ng/J or 20 ppm, and shall be certified to NSF 5 standards.
- J. Safety Features:
 - 1. Air-Fuel Ratio (AFR) Sensor.
 - 2. Exhaust & Water Temperature Safety Control.
 - 3. Overheat Cut-Off Fuse.
- K. Warranties:
 - 1. 6-year limited warranty on heat exchanger in commercial applications.
 - 2. 5-year limited warranty on all parts.
- L. Capacities:
 - 1. GHW-X (X = as scheduled):
 - a. Provide regulator for 5 lb . gas service pressure as needed.
 - b. Provide single point 120V.
 - c. Provide neutralization drain kit as required.
 - d. Model: Noritz N-0841MC or as scheduled.

2.5 COMMERCIAL ELECTRIC WATER HEATERS (EWH-x)

- A. Manufacturers:
 - 1. A.O. Smith.
 - 2. Rudd.
 - 3. State.
 - 4. Rheem.

5. All electric point-of-use storage tank type water heaters provided within this project shall be the product of one manufacturer.
- B. Furnish and install a Factory-assembled and wired, electric, vertical storage domestic hot water heaters with dimensions, capacities and electrical characteristics as scheduled on the Contract Drawings and as outlined herein. This Specification describes minimum quality and performance requirements. Variations of system components by the individual referenced manufacturers are acceptable for installation in this project provided they meet or exceed all of the requirements indicated herein, are compatible with the electrical service provided and fit properly in the allocated space.
- C. Water heater(s) shall have the UL seal of certification and be factory equipped with an ASME rated temperature and pressure relief valve. Water heater(s) shall be constructed in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section IV Part HLW. Tank(s) shall have a coating of high temperature porcelain enamel and furnished with two (2) magnesium anode rods rigidly supported. Water heater(s) shall meet or exceed the standby loss requirements of ASHRAE. Tank(s) shall have a working pressure of 160 psi and shall be completely assembled.
- D. Tank: Shall be insulated with 2-1/2" of rigid polyurethane foam insulation or with minimum two (2) inches glass fiber polyurethane encased in corrosion-resistant steel jacket; baked-on enamel finish.
- E. Controls: Equip with diagnostic panel utilizing light emitting diodes. Each LED will correspond to the number and location of the heating elements and monitor their on-off function. Automatic immersion water thermostat; externally adjustable temperature range from 60 to 180 degrees Fahrenheit, flanged or screw-in nichrome elements, high temperature limit thermostat. Water heater(s) shall be provided with internal power circuit fusing, control circuit fusing, magnetic contactors, 120-volt control circuit transformer and immersion thermostat(s) with manual reset high limit control.
- F. Water heater(s) shall capable for remote monitoring, Controls, leak detection and fault alert.
- G. The heater(s) shall meet or exceed current standard or ASHRAE/IESNA 90.1 for recovery efficiency and standby loss. The tank shall have a 10-year warranty against failure as outlined in the written warranty. Professional start-up service shall be included.
- H. Capacity:
 1. Storage capacity: 10 gal or as indicated.
 2. Heating element size: 3 kW or as indicated.
 3. Number of heating elements: 1 or as indicated.
 4. Minimum recovery rate: (as indicated) gph with 100 degrees Fahrenheit temperature rise.
 5. Maximum working pressure: 160 psig.
 6. Provide integral heat traps.
 7. Provide drain pan.
- I. Accessories: Brass water connections and dip tube, drain valve, magnesium anode, and ASME rated temperature and pressure relief valve.

2.6 COMMERCIAL (TANKLESS) ELECTRIC WATER HEATERS

- A. Manufacturers:
 1. Stiebel Eltron

2. EEMAX
 3. Bosch
 4. Chronomite
 5. Bradford White
- B. Type: Point of use electric water heater.
- C. IWH-1:
1. Tankless Water Heater have a micro processing temperature control capable of maintaining outlet temperature of +/- 1-degree Fahrenheit accuracy, Chronomite M-30L/277, with 8.4 kW, 277 V, and 30A to heat 1.0 GPM @ a temperature rise of 57 degrees F. Unit shall be UL-Listed. Element shall be replaceable cartridge insert. Unit shall have replaceable filter in the inlet connector. Element shall be iron free, Nickel Chrome material. Heater shall be fitted with 1/2" pipe compression nuts (5/8" OD) or 3/8" sleeves, to eliminate need for soldering. Maximum operating pressure of 150 PSI. Hot water storage tanks prohibited.
- D. IWH-2
1. Tankless Water Heater have a micro processing temperature control capable of maintaining outlet temperature of +/- 1-degree Fahrenheit accuracy, Chronomite SR-15L/277, with 4.1 kW, 277 V, and 15A to heat 0.8 GPM @ a temperature rise of 35 degrees F. Unit shall be UL-Listed. Element shall be replaceable cartridge insert. Unit shall have replaceable filter in the inlet connector. Element shall be iron free, Nickel Chrome material. Heater shall be fitted with 1/2" pipe compression nuts (5/8" OD) or 3/8" sleeves, to eliminate need for soldering. Maximum operating pressure of 150 PSI. Hot water storage tanks prohibited.
- E. IWH-3
1. Heater shall have three heating modules. Elements shall be replaceable cartridge inserts. Unit shall have a replaceable filter in the inlet connector. Elements shall be iron free nickel-chrome wire. Heater shall be fitted with compression nuts and sleeves to eliminate need for soldering. Maximum operating pressure of 150 psi. Hot water storage tanks prohibited. Units shall be Eemax EX280T3 or approved equal. 240V/28kW/120A.

2.7 VACUUM RELIEF VALVES

- A. Construction shall be bronze body with silicone disc having a dry guide which is located out of the water. Unit shall open at less than 1/2" vacuum and be suitable for use within a system having a maximum water pressure of 200 psi and a maximum temperature of 250°F. Vacuum relief valves shall be in compliance with the appropriate requirements of ANSI Z21.22.
- B. Vacuum relief valves shall be manufactured by Watts Regulator, Wilkins or Conbraco.

2.8 IN-LINE CIRCULATORS

- A. Manufacturers:
1. Bell and Gossett
 2. Taco
 3. Aurora
 4. Armstrong
 5. Grundfos

- B. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 80 psig, 150 psig maximum working pressure.
- C. Casing: Cast iron, with flanged pump connections.
- D. Impeller: Cast bronze, dynamically balanced and keyed on shaft.
- E. Bearings: Two, oil lubricated bronze sleeve, integral thrust collar.
- F. Seal: Carbon rotating against stationary ceramic seat, 212 degrees Fahrenheit maximum continuous operating temperature.
- G. Drive: Flexible coupling.
- H. CP-1, 1/6 HP or as scheduled and fitted with remote heat sensing aqua-stat and timer.
- I. Aqua-stat: Honeywell – Model L4006A1009 (100 – 240 degree range) or approved equal by Johnson Controls and Dayton.
- J. Timer: Armstrong – Model 810233-130 or approved equal by Taco, Bell and Gossett, Grundfos, or Intermatic

2.9 T & P RELIEF VALVES

- A. Manufacturers: Watts Industries or approved equal.
- B. Temperature and Pressure Relief:
 - 1. ANSI Z21.22 certified, bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees Fahrenheit, capacity ASME Section IV certified and labeled.
- C. Vacuum Relief Valves:
 - 1. Watts N36 Lead Free Series.

2.10 DIAPHRAGM-TYPE EXPANSION TANKS

- A. Manufacturers: Bell & Gosset PT Series or approved equal.
- B. Construction: Welded steel, tested and stamped in accordance with ASME Section VIII; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.
- C. Accessories: Pressure gage and air-charging fitting, tank drain; pre-charge to 12 psig.
- D. Provide separate support to structure for expansion tank

2.11 GARBAGE DISPOSAL

- A. Insinkerator Model 444, 120V, 3/4 HP, provide all trim and accessories for City approved installation.

2.12 GREASE TRAP

- A. Manufacturers:
 - 1. Park GT-Series. (GT)

2. Oldcastle
 3. Lindsay
 4. Jensen
- B. Concrete: Class 1 concrete with design strength of 4500 PSI at 28 days. Unit is a monolithic construction at floor, first stage of wall and baffle with sectional riser to required depth. (Monolithic baffle required; slide-in type is not acceptable.)
- C. Reinforcement: Grade 60 reinforced with steel rebar conforming to ASTM A615 on required centers or equal.
- D. C.I. Castings: Manhole frames, covers or grates are manufactured of grey cast iron conforming to ASTM A48-76 Class 30. Manhole shall be nominal 24-inch diameter and be traffic duty and gas-tight access covers.
- E. Provide an approved sampling well connection.

2.13 GREASE TRAP –

- A. Manufacturer:
1. Schier - Series. (GT)
 2. HGI
 3. Proceptor (Zurn)
 4. Mifab
- B. The Basin™ grease interceptor shall be lifetime guaranteed and seamless, rotationally molded polyethylene. Interceptor shall be furnished for above or below grade installation. Interceptor shall be certified to ASME A112.14.3 (type C) and CSA B481.1, with field adjustable riser system, built-in flow control, built-in test caps and three outlet options. Cover shall provide water/gas-tight seal and have minimum 16,000 lbs. load capacity.
- C. Performance: The inlet diffuser splits influent into three paths, creating laminar flow and utilizing the entire liquid volume of the tank for efficient grease separation. The calibrated openings greatly reduce effluent turbulence. The effluent enters the main chamber without disturbing the existing grease or sediment layers.
- D. Manhole frames, covers or grates are manufactured of grey cast iron conforming to ASTM A48-76 Class 30. Manhole shall be nominal 24-inch diameter and be traffic duty and gas-tight access covers.
- E. Provide an approved sampling well connection.

2.14 GREASE TRAP (Automatic Grease Interceptors)

- A. Manufactures:
1. Highland Tank AGI-Series. (GT)
 2. Grease Guardian
 3. Zurn
- B. Steel: 16 gauge fully welded 304 stainless steel or carbon steel that meets ASTM specifications. Beginning with the inspection of raw materials and throughout the manufacturing process, rigorous testing and documentation procedures assure compliance with the most stringent industry standards.

- C. Fabrication: carbon steel and stainless-steel fabrication plates are formed, fitted and welded creating an impermeable interceptor of superior strength. Lap joints with an overlap provide superior "ribbed" construction. Steel baffles and bulkheads are added to create multiple compartments for fluid treatment, pump and storage options. Flat-fanged heads are standard, as are continuous exterior welds on all joints.
- D. Listings and Standards: PC, UPC and state plumbing codes. Designed and constructed in accordance with Underwriters' Laboratories, Inc. UL 430 Standard conforms to PDI G101 and certified to ASME A112.14.3 & 14.4. APMO Research and Testing, Inc. Certificate of Listing (UPC).
- E. Limited Warranty: 1 year
- F. Provide an approved sampling well connection.

2.15 SCALE PREVENTION FLUID DYNAMICS

- A. Provide an industry proven catalytic solution for scale prevention method by using a chemical free connector between equipment and point of use.
- B. Consists of a non-sacrificial lead-free catalytic core made from a special alloy housed within a non-reactive stainless steel (304) tube Approved manufacturers.
 - 1. Natural Sof.
 - 2. Fluid Dynamics.
- C. Provide connection to the followings.
 - 1. Hot water heater serving the kitchen area.
 - 2. Dishwasher.
 - 3. Ice Maker.
 - 4. Cooking Equipment.
- D. Coordinate with food service supplier for equipment hookup.

2.16 SCALE PREVENTION SYSTEM (PS-1)

- A. A Watts OneFlow scale prevention system shall be installed on the main water service pipe just after it enters the building, but after other whole building water safety devices (backflow preventers or pressure reducing valves), to effectively address water hardness concerns. A system may also be installed further downstream to protect specific equipment or areas within a plumbing system. The system shall be plumbed with a bypass valve to allow isolation of tank(s) and to allow the bypass of untreated water in the event that service or media replacement be necessary. The installation area should be suitable in size for the tank(s) to be serviced without encumbrance and sit upright on a flat level surface. The system must operate in an upflow manner and not require additional water to backwash, flush, or regenerate once put into service. The system must be installed in parallel with CPVC manifold to meet peak flow rate requirements.
- B. Capacities:
 - 1. pH = 6.5 to 8.5
 - 2. Hardness (max.) = 75 grains
 - 3. Water Pressure = 15psi to 100psi
 - 4. Temperature = 40F to 110F
 - 5. Watts OneFlow Model OF1465-50

2.20 ART ROOM SINK PLASTER TRAP

- A. Manufacturer: Jay R. Smith 8714 Series.
- B. Construction: Fabricated Steel Body and Cast-Iron Cover with Galvanized Sub-Coat with White Duco Finish Inside and Outside and Stainless-Steel Perforated Bucket.
- C. Coordinate installation with Architectural casework installer, allow adequate room for bucket removal.

2.21 ELEVATOR SUMP PUMP (ESP-1) - Standard

- A. General: Submersible type, complete with manual switch and magnetic starter.
- B. Pump; Cast iron, bronze fitted, with stainless steel shaft. Oil-less sleeve guide bearings, semi-open impeller, expansion joints at discharge column.
- C. Motor: Constructed to operate continuously without overheating while submerged, built-in automatic reset thermal protection, cord length as required.
- D. High Water Alarm: Provide high water alarm assembly consisting of Mercoid #41 alarm switch in basin and 24-volt transformer with six (6) inch bell, auxiliary alarm contacts, and silence button in a NEMA II panel located as indicated on drawings. Provide engraved lamacoid plate on panel face lettered.
- E. Characteristics: Sump Pump

GPM	50
Head in Feet	20
Minimum Horsepower	1/2
Maximum RPM	1750
Voltage / Phase	Ref: Electrical
Manufacturer	Aurora
- F. Manufacturer: Aurora as indicated or comparable model by Gould, Stancor, Pacific, Hydromatic Paco.

2.22 ELEVATOR SUMP PUMP (ESP-1) With Oil-Minder Control System

- A. General: Submersible type, complete with manual switch and magnetic starter. Complete pump and Oil-Minder control system for each elevator pit, as shown on the drawings. The system shall be capable of pumping water automatically to the sewer and diverting oil to a storage container and shall include the oil diverting TV option. The Oil-Minder System shall be capable of sensing oil floating on the top of the water, emulsified in solution or solid oil and prevent the pump from discharging this oil into the sewer or storm drain.
- B. Pump; shall have a semi-open non-clogging Vortex impeller and shall be designed for floor mounting complete with support legs.
- C. Motor: Constructed to operate continuously without overheating while submerged, built-in automatic reset thermal protection, cord length as required. The motor housing and fastening bolts shall be constructed of 304 Stainless Steel and the mechanical seals shall be housed in a separate oil-filled compartment.

- D. Control Panel: Built and tested to meet UL508 standards and shall be housed in a gasketed NEMA 4X electrical enclosure with a wiring terminal strip for field wiring to the J-Box in the hoistway. The control panel shall have a combination manual reset/push to test switch for motor overload with both automatic, manual reset and control diagnostics.
- E. Control System:
1. Provide a local audible alarm with silence switch. Provide individual dry contacts for warning of conditions A, & B, C D, & E and panel mounted audible alarm with LED indicator lights for Power, Oil Detected and High-water level. The dry contacts shall be normally open and shall activate under the following conditions.
 - a. The presence of oil in the sump when the pump is signaled to run
 - b. High liquid level in the sump
 - c. High amps or a locked rotor motor condition
 - d. Loss of electrical power to the panel
 - e. Pump activation/pump run
 2. Provide individual dry contacts and wire to the BMS for remote monitoring of Oil Detected and Diverted High Water Alarm. Pump Run, Loss of Power & Locked Rotor/overload.
- F. Characteristics: Sump Pump
- | | |
|--------------------|-----------------------|
| GPM | 50 |
| Head in Feet | 30 |
| Minimum Horsepower | 1/2 |
| Maximum RPM | 1750 |
| Voltage / Phase | Ref: Electrical |
| Manufacturer | Stancor – SE-50-TV-RP |
- G. Accessories: 55 gallons storage as shown on the plans with a complete with a removable plain top cover having no connections. The installing contractor shall field install all of the connections on the top drum cover with pipe sizes as shown or required. Furnish and install a drum high fluid level alarm panel, NEMA 4 enclosure, 115/1/60 power, complete with weighted float switch with 20 feet of cord and a cord grip for mounting to the drum top. The cord shall be both **waterproof** and **Oil Resistant**.
- H. Manufacturer: Stancor as indicated or comparable model by Aurora, Gould, Pacific, Hydromatic Paco.

2.23 ELEVATOR SUMP PUMP (ESP-1) – Standard With Oil/Water Separator

- A. General: Submersible type, complete with manual switch and magnetic starter.
- B. Pump; Cast iron, bronze fitted, with stainless steel shaft. Oil-less sleeve guide bearings, semi-open impeller, expansion joints at discharge column.
- C. Motor: Constructed to operate continuously without overheating while submerged, built-in automatic reset thermal protection, cord length as required.
- D. Control System: The control System consists of float sensors and a single panel (Nema 4X weatherproof) that is wall mounted near the elevator shaft. The control panel has 3 principal operations:
1. Operate the sump pump, on/off depending on shaft water levels, has “Hand Off-Auto” Switch, a pump, a “Pump Run” light, and an aux contact for a BAS System.
 2. Indicates “Sump High Level” light & horn, a “Silence” button, and an aux contact for a BAS System.

3. Indicates "High Oil Level" of the separator, in the event of a high accumulation of oil in the separator, the panel has a "Separator High Level" light & horn, a "Silence" button, and an aux contact for a BAS System.

- E. Characteristics: Sump Pump
- | | |
|--------------------|---------------------------------------|
| GPM | 50 |
| Head in Feet | 20 |
| Minimum Horsepower | 1/2 |
| Maximum RPM | 1750 |
| Voltage / Phase | Ref: Electrical |
| Manufacturer | Aurora, Pacific, Stancor, Paco, Gould |
- F. Accessories: Park ELV-050- ES floor mounted Oil/Water Separator.
- G. Manufacturer: Chicago as indicated or comparable model by Aurora, Stancor, Pacific, Hydromatic Paco, Park.

2.25 ACID DILUTION BASIN

- A. Manufacturer: Parks Model ANT, or Koch Knight LLC.
- B. Construction:
1. Concrete: Class 1 concrete with design strength of 4500 PSI at 28 days. Unit is of monolithic construction at floor and first stage of wall with sectional riser to required depth.
 2. Reinforcement: Grade 60 reinforced with steel rebar conforming to ASTM A615 on required centers or equal.
 3. C.I. Castings: Manhole frames, covers or grates are manufactured of grey cast iron conforming to ASTM A48-76 Class 30. Manhole shall have 24 inch inside diameter and be traffic duty and gas-tight access covers.
 4. Engineering Data: Neutralization tank to be structurally and hydraulically engineered conforming to The Plumbing Code.
- C. Lining:
1. Interior shall be lined with H. D. Polypropylene, minimum 3/16" thick.
 2. Exterior shall be coated with Bitumastic vapor barrier.
- D. Fill: Chemical rock of 1" to 3" diameter with calcium carbonate equivalent in excess of 90%.
- E. Provide an approved sampling well connection.

2.26 ACID DILUTION TRAP

- A. Manufacturer: Striem, Zurn, Spears, Orion.
- B. Capacity: 2 gallons
- C. Construction:
1. Tanks can be manufactured from polypropylene resin conforming to ASTM D-4101. These tanks can be used at temperatures up to 212°F in continuous service and in areas of high chemical concentration. Polypropylene tanks are translucent.

2. Tank lids can be bolted or welded. Maintenance access ports can be polypropylene threaded plugs or bolted manways. All fittings and penetrations are polypropylene and are located according to the specification.
 3. Engineering Data: Neutralization tank to be structurally and hydraulically engineered conforming to Uniform Plumbing Code.
- D. Fill: Chemical rock of 1" to 3" diameter with calcium carbonate equivalent in excess of 85%.

2.27 LINT INTERCEPTOR – LT-1 (Central System up to 20 GPM)

- A. Manufacturers:
1. Jay R. Smith 8910 Series.
 2. Zurn Z-1185.
 3. Josam 61805.
 4. Mifab - MI-LINT.
 5. Watts - LI-800
- B. Capacity: 20 GPM
- C. Construction:
1. Fabricated Steel with Gray Duco Coating and Stainless-Steel Primary and Secondary Lint Screens, 3/16" Diamond Plate Cover (Secured & Gasketed) and Threaded Inlet and Outlet.
 2. Provide flanges, connections and extensions as required by field installation conditions

2.28 LINT INTERCEPTOR – LT-2 (Central System 30 to 50 GPM)

- A. Manufacturers:
1. Jay R. Smith 8910 Series.
 2. Zurn Z-1185.
 3. Josam 61805.
 4. Mifab – LiL-L.
 5. Watts - LI-803
 6. Rockford – RLSW
- B. Capacity: 30 - 50 GPM
- C. Construction:
1. Fabricated Steel with Gray Duco Coating and Stainless-Steel Primary and Secondary Lint Screens, 3/16" Diamond Plate Cover (Secured & Gasketed) and Threaded Inlet and Outlet.
 2. Provide flanges, connections and extensions as required by field installation conditions.

2.29 LINT INTERCEPTOR – LT-3 (Drain Trough)

- A. Manufacturers:
1. Jay R. Smith SQ-9-3615.
 2. H-M Company – Drain Trough.
 3. High Mark Manufacturing, Inc. – OPL Drain trough.
- B. Trough Capacity: 45 - 130 Gallons or as indicated on drawings.

- C. Construction:
 - 1. Fabricated Steel with Gray Duco Coating or Polypropylene and Stainless-Steel Primary and Secondary Lint Screens, 3/16" Diamond Plate Cover (Secured & Gasketed) and Threaded Inlet and Outlet.
 - 2. Provide flanges, connections and extensions as required by field installation conditions

2.30 LINT INTERCEPTOR – LT-4 (Concrete Drain Trough)

- A. Manufacturers:
 - 1. H-M Company – Lint Baskets.
- B. Trough Capacity: 45 - 130 Gallons or as indicated on drawings.
- C. Construction:
 - 1. Concrete trough with Stainless-Steel Lint Baskets and Threaded Inlet and Outlet.
 - 2. Provide flanges, connections and extensions as required by field installation conditions

2.31 SAMPLING WELL

- A. Manufacturer: Manufacturer: Parks Model SWB, Old Castle, or Jensen Precast..
- B. Construction:
 - 1. Concrete: Class 1 concrete with design strength of 4500 PSI at 28 days. Unit is of monolithic construction at floor and first stage of wall with sectional riser to required depth.
 - 2. C.I. Castings: Manhole frames, covers or grates are manufactured of grey cast iron conforming to ASTM A48 Class 30. Manhole shall have 15 inch inside diameter and be traffic duty AASHTO H-20 and gas-tight access covers.

2.32 DRY WELL

- A. Manufacturer: Oldcastle, Wieser Concrete, Columbia Precast, or Harris Precast
- B. Capacity:
 - 1. 24" Dia. x 24" (50 gallon)
 - 2. 30" Dia. x 30" (80 gallon)
 - 3. 36" Dia" x 36" (150 gallon)
 - 4. 48" Dia. x 30" (220 gallon)
 - 5. 48" Dia. x 42" (320 gallon)
 - 6. 48" Dia. x 54" (400 gallon)
 - 7. 48" Dia. x 66" (500 gallon)
- C. Construction:
 - 8. Concrete: ASTM C478 concrete with design strength of 5000 PSI at 28 days. Unit is of monolithic construction at floor and first stage of wall with sectional riser to required depth. Bottom shall have opening center of base.
 - 9. C.I. Castings: Manhole frames, covers or grates are manufactured of grey cast iron conforming to ASTM -C478. All manhole joints sealed with mastic or rubber gasket.

2.33 BACKFLOW PREVENTERS

- A. Reduced Pressure Backflow Preventers

1. Comply with ASSE 1013.
 2. Bronze body, with bronze internal parts and stainless-steel springs.
 3. Two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve opening under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.
 4. Manufacturers:
 - a. Febco 825Y.
 - b. Hersey FRP II
 - c. Wilkins 975.
 - d. Watts Series LF909, or approved equal
- B. Double Check Valve Assemblies:
1. Comply with ASSE 1012.
 2. Bronze body with corrosion resistant internal parts and stainless-steel springs; two independently operating check valves with intermediate atmospheric vent.
 3. Dual Check Valve with Atmospheric Vent shall be installed at referenced cross-connections. Valve shall feature stainless steel and rubber internals protected by an integral strainer. Primary check shall be rubber to rubber seated, backed by the secondary check with rubber to metal seating.
 4. Manufacturers:
 - a. Febco 815.
 - b. Hersey BCP
 - c. Wilkins 760.
 - d. Watts Series 9D or approved equal.
- C. Dual Check Valves:
1. Comply with ANSI/NSF Standard 18, Manual Food and Beverage Dispensing Equipment. (ASSE 1022 Approved Dual Check Valve).
 2. Body and adapters are of 316 stainless steel construction and all rubber components comply with FDA food additive regulations.
 3. All materials in contact with the potable water are in compliance with the requirements of the Safe Drinking Water Act, Public Law 93-523, National Interim Primary Drinking Water Regulations.
 4. Manufacturers:
 - a. Wilkins 740.
 - b. Watts Model SD-2/9BD, or approved equal
- D. Lead Free

2.34 WATER PRESSURE REGULATING VALVES

- A. Low to Moderate Flow Systems (Less Than 70 GPM) and Individual Equipment
1. Sizes 1/2" through 2"
 2. All bronze body
 3. 0.25% maximum weighted average lead content
 4. Integral stainless-steel strainer screen
 5. Built-in bypass check valve
 6. FDA approved elastomers
 7. Renewable seat
 8. Union end connection
 9. Rated for water temperature up to 180°F and minimum 300 psi inlet pressure. Provide model with inlet pressure rating, reduced pressure range and factory preset outlet pressure as scheduled on Contract Drawings.
 10. Manufactured by Wilkins Series 600XL or approved equal by Watts

- B. Large Demand Systems
 - 1. Sizes 1-1/4" through 2 - ASTM B62 bronze body
 - 2. Sizes 2-1/2" and larger - ASTM A536 ductile iron body
 - 3. Pressure reducing pilot control
 - 4. Stainless steel disc guide, seat and bearing cover
 - 5. Stainless steel stem, nut and spring
 - 6. FDA approved Nylon reinforced Buna-N rubber diaphragm
 - 7. Provide model(s) with size, temperature range, inlet pressure rating, reduced pressure range, outlet pressure and options as scheduled on Contract Drawings.
 - 8. Cla-Val Company Series 90 or approved equal by Watts

2.35 WATER HAMMER ARRESTORS

- A. Manufacturers: Watts Series LF15M2 Series or approved equal.
- B. ANSI A112.26.1; copper construction, piston type sized in accordance with PDI WH-201.
- C. Pre-charged suitable for operation in temperature range 33 to 180 degrees Fahrenheit and maximum 150 psi working pressure.
- D. Access Panel: Acorn Model 8292 or approved equal.
- E. Lead Free.

2.36 THERMOSTATIC MIXING VALVES:

- A. Manufacturers:
 - 1. Leonard.
 - 2. Acorn controls.
 - 3. Power.
 - 4. Bradley.
 - 5. Zurn/Wilkins.
- B. Certified to ASSE Standard 1017, ASSE 1070, and meets the anti-scald requirements of ASSE Standard 1016.
- C. Valve: Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.
- D. Capacity:
 - 1. TMV-1: Flow capacity between 0.35 gpm Min. and 4 gpm Max. at 5 psi pressure drop. Lead Free.
 - a. Model:
 - (1) Lawler 1070 Series
 - (2) Leonard – 170-LF
 - (3) Acorn controls - ST70CP-38
 - (4) Power - LFLM495
 - (5) Zurn/Wilkins – ZW3870XLT-4P
 - 2. TMV-2: 3 gpm Min. and 14 gpm Max. at 5 psi pressure drop. Lead Free
 - a. Model:
 - (1) Lawler 66-25
 - (2) Leonard – LV-186-982-LF-STSTL-REC.
 - (3) Acorn controls – SFMV Series
 - (4) Power – ETV200
 - (5) Bradley – TMV-25

3. TMV-3: 3 gpm Min. and 30 gpm Max. at 5 psi pressure drop. Lead Free
 - a. Model:
 - (1) Lawler 66-80
 - (2) Leonard – LV-186-983-LF-STSTL-REC.
 - (3) Acorn controls – SFMV Series
 - (4) Power – ETV200
 - (5) Bradley – TMV-80
- E. Accessories:
 1. Check valve on inlets.
 2. Volume control shut-off valve on outlet.
 3. Stem thermometer on outlet.
 4. Strainer stop checks on inlets.
- F. Cabinet: 16 gage stainless steel, for recessed mounting with keyed lock.
- G. Mechanical Rooms: Omit cabinet, surface mount.
- H. Mount:
 1. TMV-1 in piping under lavatory/sink/etc.
 2. TMV-2 in wall mounted stainless steel cabinet.
 3. TMV-3 in wall mounted stainless steel cabinet
- I. Lead Free.

2.37 SOLENOID VALVES

- A. ASCO Series Next Generation
- B. Provide at each kitchen cooking hood and at each science lab prep room and demo table where for automatic gas supply shut-off.
- C. Coordinate electrical connections with Division 26.

2.38 INLINE AUTOMATIC WATER FILTER

- A. A 10 to 25 micron Water filter to be provided on the main cold-water line (Amiad SAF series).
- B. The SAF series are automatic filters, with a self-cleaning mechanism driven by an electric motor. The SAF filters are designed to work with various types of screens in filtration degrees from 800 to 10 micron. The ABF series is available in inlet/outlet diameters of full size as incoming water service.
- C. Controller shall be Electro-Mechanical Relay and Timer. The self-cleaning cycle begins under any one of the following conditions:
 1. Receiving a signal from the Pressure Differential Switch.
 2. Time interval parameter set at the control board.
 3. Manual Start.
- D. Power:
 1. 460/3/60
 2. Coordinate electrical connections with Division 26.

2.39 FLOW METER

- A. Water meter
1. Provide clamp-on ultrasonic water flow meter at the main water point of entry or as indicated on plan.
 2. Provide Onicon F-4300 meter with the followings.
 - a. Accuracy +/- 1.0% of reading from 1.6 ft/s to 20 ft/s
 - b. Repeatability +/- 0.25 % of reading
 - c. Bi-directional flow range of 1.6 to 40 ft/s
 - d. Process pipe-wall temperature: 32°F to 140°F
 - e. Power supply: 120VAC , 60 Hz, 10 VA max. .(provide transformer as needed)
 - f. Output signals:
 - (1) 4-20 mA DC current output
 - (2) Pulse (configurable)
 - (3) Relay (configurable)
 - g. Digital communications: RS-232, RS-485, Modbus RTU
 - h. Materials:
 - (1) Enclosure NEMA 4X
 - (2) Transducers IP68 (Encapsulated)
 - i. Standard cable length: 25 ft (9 m), Maximum cable length: 100 ft (30 m)
 3. Acceptable Manufacturers:
 - a. Sierra
 - b. Siemens
 - c. Dynasonics
 - d. Onicon
- B. Natural/Propane gas meter
1. Provide insert mass flow meter at the main water point of entry or as indicated on plan.
 2. Provide Onicon F-5500 meter with the followings.
 - a. Accuracy +/- 0.5% of reading from 0.16 ft/s to 20 ft/s
 - b. Repeatability +/- 0.25 % of reading
 - c. Bi-directional flow range of 0.16 to 40 ft/s
 - d. Process pipe-wall temperature: 32°F to 140°F
 - e. Input power: 12-28 VDC, 6 W min.
 - f. Power supply: 120VAC , 60 Hz, 10 VA max.(provide transformer as needed)
 - g. Output signals:
 - (1) 4-20 mA DC current output
 - (2) Pulse (configurable)
 - (3) Relay (configurable)
 - h. Digital communications: RS-232, RS-485, Modbus RTU
 - i. Materials:
 - (1) Enclosure NEMA 4X
 - (2) Transducers IP68 (Encapsulated)
 - j. Standard cable length: 15 ft (9 m), Maximum cable length: 100 ft (30 m)
 3. Acceptable Manufacturers:
 - a. Sierra
 - b. Thermal Instrument Co.
 - c. Dynasonics
 - d. Onicon
- C. Blowdown meter
1. Provide 2" stainless steel water flow meter with pulse output at the cooling tower blow down line or as indicated on plan.
 2. Provide PRM # WM200SSVX meter with the followings.

- a. Accuracy +/- 5.0% of transitional flow and +/- 2.0% normal flow
 - b. Process pipe-wall temperature: 32°F to 104°F
 - c. Flow range: 2-100 GPM.
 - d. Output signals:
 - (1) Pulse (configurable)
 - e. Materials:
 - (1) 304 Stainless steel
 - (2) Seal: Viton
 - f. Standard cable length: 10 ft (9 m), Maximum cable length
3. Acceptable Manufacturers:
- a. Stenner
 - b. EKM
 - c. Carlon Meter
 - d. PRM
- D. Warranty
1. Products are warranted to be free from defects in material and workmanship and will be repaired or replaced at no charge to the owner, provided return or rejection of product is made within a reasonable period but no longer than one (1) year for calibration and non-calibration defects, from date of delivery

2.40 TEMPERATURE INSTRUMENTS

- A. Manufacturer: Terice, Taylor, Marsh, Weksler, Marshalltown, Weiss, or Miljoco.
- B. Thermometer Wells.
1. Brass or type 300 stainless steel. Machined bar stock, 1-piece construction.
 2. Where installed in insulated piping or vessels, provide with extension neck to match insulation thickness.
 3. Provide metal-to-metal contact with bulb chamber for maximum sensitivity.
 4. Wells shall be sized to extend a minimum of 50% into pipe

2.41 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Coordinate required voltage, wire size and over current device size with electrical drawings. Contractor shall provide all electrical connections per manufacturer's installation instructions.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install equipment on concrete housekeeping pad, minimum 4 inches high and six (6) inches larger than water heater base on each side. Refer to Section 03 30 00
- B. Install water heater with the followings.
1. Maintain manufacturer's recommended clearances around and over water heaters.
 2. Connect natural gas piping in accordance with NFPA 54.
 3. Provide water heater pan beneath all water heaters with 3/4-inch drain to nearest floor sink.

4. Connect natural gas piping to water heater, full size of water heater gas train inlet. Arrange piping with clearances for burner removal and service.
5. Install the following piping accessories.
 - a. On supply:
 - (1) Thermometer well and thermometer.
 - (2) Strainer.
 - (3) Pressure gage.
 - (4) Shutoff valve.
 - (5) Diaphragm-type expansion tank
 - b. On return:
 - (1) Thermometer well and thermometer.
 - (2) Pressure gage.
 - (3) Shutoff valve.
6. Install the following piping accessories on natural gas piping connections.
 - a. Strainer.
 - b. Pressure gage.
 - c. Shutoff valve.
 - d. Pressure reducing valve.
7. Install discharge piping from relief valves and drain valves to nearest floor drain.
8. Install circulator and diaphragm expansion tank on water heater.
9. Install water heater trim and accessories furnished loose for field mounting.
10. Install electrical devices furnished loose for field mounting.
11. Install control wiring between water heater control panel and field mounted control devices.
12. On gas-fired equipment connect flue to water heater outlet, full size of outlet.
13. Provide factory start-up and demonstration, including operating instructions for all gas-fired water heaters. Schedule training sessions with Architect and Owner's representative. Provide certification letter from manufacturer indicating water heater is installed in accordance with manufacturer's instructions.

- C. Circulating Pump Installation: Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
1. Install the following piping accessories.
 - a. On supply:
 - (1) Pressure gage.
 - (2) Shutoff valve.
 - (3) Check valve.
 - b. On return:
 - (1) Thermometer well and thermometer.
 - (2) Timer.
 - (3) Pressure gage.
 - (4) Shutoff valve.
- D. Water softener: Install system components according to manufacturer's published recommendations and pipe as indicated on Drawings. Care shall be exercised in fabricating plumbing lines to avoid all cross connections eliminate the possibility of water contamination.
1. Provide and install double check valve assembly backflow prevention on the potable water line serving the water softener downstream of all potable water connections serving any other outlets or equipment.
 2. Backflow preventers shall be duplexed where located within lines serving in-patient areas, critical research areas, and/or any area or equipment where uninterrupted (twenty-four hour) water service is required.
 3. Provide a physical air gap of at least two times the diameter of the softener equipment drain piping discharging into a floor drain/sink receptor.
 4. Provide for the service of a competent supervising agent from the water softener manufacturer to inspect the completed installation, start the water softening system in operation and acquaint the operators with the proper operation and maintenance of the equipment.
- E. Backflow Preventers and Vacuum Breakers.
1. Isolate all non-potable water requirements from the building domestic water system with backflow prevention device manufactured and certified for the particular application.
 2. Pipe relief from backflow preventer indirectly to drain of sufficient size to evacuate maximum flow discharge.

3. Backflow preventers shall be duplexed full-size where located within domestic water lines serving in-patient areas, critical research areas, and/or any area or equipment where un-interruptible (24 hour) water service is required.
 4. Test ports shall not be located more than 72 inches above finished floor or permanent platform.
 5. Do not install vacuum breakers or backflow preventers above equipment, above ceilings, concealed within walls, or areas where water leakage can cause damage.
 6. Install a strainer immediately upstream of each vacuum breaker and backflow preventer.
- F. Water Hammer Arrestors (Hydraulic Shock Absorbers).
1. Provide hydraulic shock absorbers in cold and hot water supply lines to each fixture branch, battery of fixtures and at each automatic, solenoid-operated or quick-closing valve serving equipment.
 2. Locate and size hydraulic shock absorbers in accordance with PDI-WH-201 Standard and manufacturer's published recommendations.
 3. Install hydraulic shock absorbers with clearances to allow inspection, removal and replacement. Provide access panels where required.
- G. Water Pressure Regulating Valves.
1. Provide isolation valve, strainer and pressure gauge immediately upstream of each pressure regulating valve.
 2. Provide pressure gauge and isolation valve immediately downstream of each pressure regulating valve.
 3. Installation shall allow sufficient access to and space around components for adjustments and servicing.
 4. Provide services of a direct factory representative for start-up service, inspection and necessary adjustments for all large demand regulators
- H. Grease traps shall be cleaned and pumped prior to substantial completion. Interior joints shall be properly sealed.
- I. Install diaphragm-type expansion tank on cold water supply line.
- J. Install flow meter on cold water supply line and gas line at point of entry. Coordinate with div. 23 (BAS) for signal output and div. 26 for power requirements.
- K. Sewer and Sump pump Discharge Piping:
1. Factory or field fabricated, galvanized, ASTM A53/A 53M, Schedule 40, steel pipe with ASME B16.1, Class125, cast-iron flange and flanged fittings or ASME B16.4, Class 125, gray iron threaded fittings.

2. Underground piping shall be Copper Tubing: ASTM B88, Type K. Fittings: ASME B16.22 wrought copper and bronze. Joints: AWS A5.8, BCuP silver braze.

END OF SECTION 22 30 00

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS

1.2 SUMMARY

- A. Provide a complete system of plumbing fixtures and trim.
- B. All materials and equipment for the potable water system shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.

1.3 SUBMITTALS

- A. Product Data: Submit catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- B. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Accept fixtures on site in factory packaging. Inspect for damage.
- B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.5 EXTRA MATERIALS

- A. Furnish two sets of faucet washers flush valve service kits lavatory supply fittings shower heads toilet seats.

PART 2 - PRODUCTS

2.1 FLUSH VALVE WATER CLOSETS

- A. Fixture Manufacturers:
 - 1. Zurn
 - 2. Or approved as equal.

- B. Fixture Trim Manufacturers:
1. Church
 2. Sloan Valve Co.
 3. Zurn Industries.
- C. WC-1: ASME A112.19.2M; wall hung, siphon jet vitreous china closet bowl, with elongated rim, 1-1/2 inch top back spud, china bolt caps. Provide as indicated on plumbing fixture schedule.
1. Wall Mounted: American Standard 3351.101.020
 2. Or as indicated on schedules.
 3. Trim : (Type x)
- D. WC-2: Same as WC-1, except mounted at ADA/TAS height for appropriate age group.
1. Wall Mounted: American Standard 3351.101.020
 2. Or as indicated on schedules.
 3. Trim : (Type x)
 4. Provide flush valve stem offset as required.
- E. Trim:
1. Sensor Operated Flush Valve (Type A): ASME A112.18.1; exposed chrome plate, diaphragm type with battery operated solenoid operator, infrared sensor and over-ride button in plate chrome cover, 2" offset flush connection, vandal resistant stop cap and vacuum breaker maximum 1.28 gallon. Sloan Model 8111-1.28 or provide as indicated on plumbing fixture schedule.
 2. Sensor Operated Flush Valve (Type B): ASME A112.18.1; exposed chrome plated, diaphragm type with 24V transformer, solenoid operator, infrared sensor and manual over-ride button in chrome plated cover, 2" offset flush connection, integral screwdriver stop with vandal resistant stop and vacuum breaker, maximum 1.28 gallon flush volume. Sloan 111 ESS Hardwired-1.28 DFB-TMO-HW or provide as indicated on plumbing fixture schedule.
 3. Exposed Flush Valve (Type C): ASME A112.18.1; exposed chrome plated, diaphragm type with non-hold open handle, escutcheon, seat bumper, 2" offset flush connection, integral screwdriver stop and vacuum breaker; maximum 1.28 gallon. Sloan Model Royal or Zurn AV Series or Sloan 111-1.28 (standard), Sloan 115-1.28 DFB (ADA) or provide as indicated on plumbing fixture schedule
- F. Seat: White/Black plastic, open front, extended back, self-sustaining hinge, stainless steel mounting hardware, brass bolts, with without cover. Manufacturer: Bemis, Beneke, Olsonite, and Church. Bemis 1655SSCT or provide as indicated on plumbing fixture schedule.
- G. Wall Mounted Carrier: ASME A112.6.1; adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers. Jay R. Smith 200 series carriers, or equal by zurn and watts.

2.2 CHILD TYPE WALL MOUNTED WATER CLOSETS

- A. WC-3 (Child Care): ASME A112.19.2M: Elongated wall mount, ADA accessible vitreous china closet bowl, with elongated rim, 1-1/2 inch top back spud, china bolt caps.
1. Child Care: Wall Mounted: American Standard 3351.101.020 or provide as indicated on plumbing fixture schedule.
 2. Trim : (Type x)
- B. Trim:
1. Sensor Operated Flush Valve (Type A): ASME A112.18.1; exposed chrome plate, diaphragm type with battery operated solenoid operator, infrared sensor and over-ride button in plate chrome cover, 2" offset flush connection, vandal resistant stop cap and vacuum breaker maximum 1.28 gallon. Sloan Model 8111-1.28 or provide as indicated on plumbing fixture schedule.
 2. Exposed Flush Valve (Type B): ASME A112.18.1; exposed chrome plated, diaphragm type with non-hold open handle, escutcheon, seat bumper, 2" offset flush connection, integral screwdriver stop and vacuum breaker; maximum 1.28 gallon. Sloan Model Royal or Zurn AV Series or Sloan 111-1.28 (standard), Sloan 115-1.28 DFB (ADA) or provide as indicated on plumbing fixture schedule.
 3. Exposed Flush Valve (Type C): ASME A112.18.1; exposed chrome plated, diaphragm type with non-hold open handle, escutcheon, seat bumper, 2" offset flush connection, integral screwdriver stop and vacuum breaker; maximum 1.28 gallon. Zurn AV Series or Sloan Royal 115-1.28 or provide as indicated on plumbing fixture schedule.
 4. Concealed Valve (Type D): ASME A112.18.1; Concealed, rough brass closet flushometer, metal direct acting, non-hold open push button with triple seal handle packing, vacuum breaker, chrome plated exposed flushometer parts and 1.28 gpf. Sloan Model 150 – 1.28 gpf or provide as indicated on plumbing fixture schedule.
- C. Seat: White plastic, open front, extended back, self-sustaining hinge, stainless steel mounting hardware, brass bolts, with without cover. Manufacturer: Bemis, Beneke, Olsonite, and Church. Olsonite Model 126CAMT or provide as indicated on plumbing fixture schedule.
- D. Wall Mounted Carrier: ASME A112.6.1; adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers. Jay R. Smith 200 series carriers, or equal by zurn and watts

2.3 TANK TYPE WATER CLOSETS

- A. Fixture Manufacturers:
1. American Standard.
 2. Briggs Industries, Inc.
 3. Kohler Co.
 4. Zurn.
- B. Fixture Trim Manufacturers:
1. Bemis

2. Beneke
 3. Church
 4. American Standard.
 5. Kohler Co.
- C. WC-4A (Right Hand) - Bowl: ASME A112.19.2M; floor mounted, siphon jet, vitreous china, 16.5 inches high or 18 inches high for ADA Applications close-coupled closet combination with regular rim, insulated vitreous china closet tank with fittings and lever flushing valve, bolt caps vandal proof cover locking device. Provide Kohler K-3615 "Gabrielle" or as indicated on plumbing fixture schedule.
- D. WC-4B (Right Hand w/flushmate) - Bowl: ASME A112.19.2M; floor mounted, siphon jet, vitreous china, 16.5 inches high or 18 inches high for ADA Applications close-coupled closet combination with regular rim, insulated vitreous china closet tank with fittings and lever flushing valve, bolt caps vandal proof cover locking device. Provide Kohler K-3519 "Highline" or as indicated on plumbing fixture schedule.
- E. WC-4C (Left Hand w/flushmate) - Bowl: ASME A112.19.2M; floor mounted, siphon jet, vitreous china, 16.5 inches high or 18 inches high for ADA Applications close-coupled closet combination with regular rim, insulated vitreous china closet tank with fittings and lever flushing valve, bolt caps vandal proof cover locking device. Provide Kohler K-3519-RA "Highline" or as indicated on plumbing fixture schedule.
- F. Seat: White plastic black, open front, extended back, self-sustaining hinge, brass bolts, with without cover. Bemis Model.

2.4 CHILD TYPE FLOOR MOUNTED WATER CLOSETS

- A. Fixture Manufacturers:
1. American Standard Plumbing
 2. Briggs Industries, Inc.
 3. Kohler Co.
- B. Fixture Trim Manufacturers:
1. Bemis
 2. Beneke
 3. Church
 4. American Standard.
 5. Kohler Co.
- C. WC-5 (Child Care): ASME A112.19.2M: Elongated floor mount, ADA accessible vitreous china closet bowl, with elongated rim, 1-1/2 inch top back spud, china bolt caps. American Standard 2282.010.
- D. Trim:

1. Sensor Operated Flush Valve (Type A): ASME A112.18.1; exposed chrome plate, diaphragm type with battery operated solenoid operator, infrared sensor and over-ride button in plate chrome cover, 2" offset flush connection, vandal resistant stop cap and vacuum breaker maximum 1.28 gallon. Sloan Model 8111-1.28 or provide as indicated on plumbing fixture schedule.
 2. Exposed Flush Valve (Type B): ASME A112.18.1; exposed chrome plated, diaphragm type with non-hold open handle, escutcheon, seat bumper, 2" offset flush connection, integral screwdriver stop and vacuum breaker; maximum 1.28 gallon. Sloan Model Royal or Zurn AV Series or Sloan 111-1.28 (standard), Sloan 115-1.28 DFB (ADA) or provide as indicated on plumbing fixture schedule.
 3. Exposed Flush Valve (Type C): ASME A112.18.1; exposed chrome plated, diaphragm type with non-hold open handle, escutcheon, seat bumper, 2" offset flush connection, integral screwdriver stop and vacuum breaker; maximum 1.28 gallon. Zurn AV Series or Sloan Royal 115-1.28 or provide as indicated on plumbing fixture schedule.
 4. Concealed Valve (Type D): ASME A112.18.1; Concealed, rough brass closet flushometer, metal direct acting, non-hold open push button with triple seal handle packing, vacuum breaker, chrome plated exposed flushometer parts and 1.28 gpf. Sloan Model 150 – 1.28 gpf or provide as indicated on plumbing fixture schedule.
- E. Seat: White plastic, open front, extended back, self-sustaining hinge, stainless steel mounting hardware, brass bolts, with without cover. Manufacturer: Bemis, Beneke, Olsonite, and Church. Olsonite Model 126CAMT or provide as indicated on plumbing fixture schedule.

2.5 WALL HUNG URINALS

- A. Fixture Manufacturers:
1. Zurn.
 2. Or approved as equal.
- B. Fixture Trim Manufacturers:
1. Sloan.
 2. Zurn.
 3. American Standard.
- C. All urinal flush valves shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.
- D. U-1: ASME A112.19.2M; vitreous china, wall hung, elongated rim integral trap, removable stainless steel strainer, 3/4 inch top spud, provide chair carrier as required. American Standard Pintbrook Model 6002.001 or provide as indicated on plumbing fixture schedule.
1. Trim : (Type x)
- E. U-2: Same as U-1, except mounted at ADA/TAS height for appropriate age group.
1. Trim : (Type x)

- F. Trim:
1. Sensor Operated Flush Valve (Type A): ASME A112.18.1; exposed chrome plate, diaphragm type with battery operated solenoid operator, infrared sensor and over-ride button in plate chrome cover, vandal resistant stop cap and vacuum breaker maximum 1 pint. Sloan Model G2 OPTIMA PLUS 8186-0.5 Series or provide as indicated on plumbing fixture schedule.
 2. Sensor Operated Flush Valve (Type B): ASME A112.18.1; exposed chrome plated, diaphragm type with 24V transformer, solenoid operator, infrared sensor and manual over-ride button in chrome plated cover, integral screwdriver stop with vandal resistant stop and vacuum breaker, maximum one (1) pint flush volume. Sloan Model 186 ES-S or provide as indicated on plumbing fixture schedule.
 3. Exposed Flush Valve (Type C): ASME A112.18.1; exposed chrome plated, diaphragm type with non-hold open handle, escutcheon, integral screwdriver stop with vandal resistant stop cap, vacuum breaker; maximum one (1) pint flush volume. Sloan Model Royal, or Zurn AV series. Sloan Flushometer 186-0.125 DBP or provide as indicated on plumbing fixture schedule.
- G. Wall Mounted Carrier: ASME A112.6.1; cast iron and steel frame with rectangular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs. Provide bottom bearing plate. Jay R. Smith figure 0637, or equal by Zurn and watts or provide as indicated on plumbing fixture schedule.

2.6 LAVATORIES

- A. Fixture Manufacturers:
1. American Standard Plumbing.
 2. Kohler Co
 3. Zurn.
- B. Fixture Trim Manufacturers:
1. Sloan
 2. T & S Brass.
 3. Chicago.
 4. Speakman.
- C. Supply Fittings Manufacturers:
1. Chicago.
 2. McGuire.
 3. Brasscraft.
 4. Zurn.
- D. All lavatory faucets and trim shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.

- E. L-1, Vitreous China Wall Hung Basin: ASME A112.19.2M; American Standard 0355.012 vitreous china wall hung lavatory 21 x 18 inch minimum, with four (4) inch high back, 3 deck holes, rectangular basin with splash lip, front overflow, and soap depression. Provide floor mounted carrier for correct lavatory type. Provide as indicated on plumbing fixture schedule.
1. Trim : (Type x)
- F. L-2, Vitreous China Wall Hung Basin: ASME A112.19.2M; American Standard 0356.421 vitreous china wall hung lavatory 21 x 18 inch minimum, with four (4) inch high back, single deck hole, rectangular basin with splash lip, front overflow, and soap depression. Provide floor mounted carrier for correct lavatory type. Provide as indicated on plumbing fixture schedule.
1. Trim : (Type x)
- G. L-3, Vitreous China Counter Top Basin: ASME A112.19.2M; vitreous china self-rimming counter top lavatory, 20 x 17 inches with drillings on four (4) inch centers, front overflow, soap depression, seal of putty, caulking, or concealed vinyl gasket. (Oval) American Standard 0476.028 or provide as indicated on plumbing fixture schedule.
1. Trim : (Type x)
- H. L-4, Under-counter Lavatory: ASME A112.19.2M; vitreous china, unglazed rim for under counter mount with rear overflow, 19-1/4" x 14-1/4" inches with drillings on eight (8) inch centers. American Standard 0496.221 or provide as indicated on plumbing fixture schedule.
1. Trim : (Type x)
- I. L-5 (Child Care), Vitreous China Wall Hung Basin: ASME A112.19.2M; American Standard 0355.012 vitreous china wall hung lavatory 21-1/4" x 18-18", with four (4) inch high back, rectangular basin with splash lip, front overflow, and soap depression. Single temperature water only. Provide floor mounted carrier for correct lavatory type. Provide as indicated on plumbing fixture schedule.
1. Trim: ASME A112.18.1, chrome plated brass spout, metering valve cartridge, supply fitting with open grid strainer, water economy aerator with maximum 0.5 gpm flow, ADA compliant. Chicago Faucet Co. 857-E2805-665PSHAB, or equivalent by T&S Brass. Supply Fitting deck mounted single hole bubbler / drinking fountain, Chrome plated brass spout, supply fitting with open grid strainer, water economy aerator with maximum 0.74 gpm flow, ADA compliant. Chicago Faucet 748-244ABCP Series, or equivalent by T&S Brass, and American Standard.
- J. L-6, ADA and TAS compliant fixture at utilization height for age group. Provide fixture that complies with ADA and TAS regulations based on mounting height indicated on architectural drawings. Provide ADA and TAS approved trim. American Standard 0955.XXXEC. Provide floor mounted carrier for correct lavatory type. Provide as indicated on plumbing fixture schedule.
1. Trim: ASME A112.18.1 (Type A2); chrome plated brass spout, metering valve cartridge, supply fitting with open grid strainer, water economy aerator with maximum 0.5 gpm flow, ADA compliant. Chicago Faucet Co. 404-HZ665ABCP Series, or equivalent by T&S Brass, and or provide as indicated on plumbing fixture schedule.
- K. L-7, Pedestal Basin: ASME A112.19.2M; vitreous china pedestal lavatory with integral rear splash rim, 20 x 18 inches with drillings on eight (8) inch centers, front overflow, steel hanger. American Standard 0445.100 or provide as indicated on plumbing fixture schedule.

1. Supply Fitting: ASME A112.18.1 (Type J1); chrome plated brass spout, supply fitting with open grid strainer, water economy aerator with 0.5 gpm flow, 4 inch wrist blade handle. ADA compliant. Chicago Faucet 201-AGN8AE2805FAB, or equivalent by T&S Brass, or provide as indicated on plumbing fixture schedule.
- L. Trims:
1. Supply Fitting: ASME A112.18.1 (Type A1); chrome plated brass spout, metering valve cartridge, supply fitting with open grid strainer, water economy aerator with maximum 0.5 gpm flow, ADA compliant. Chicago Faucet Co. Series, or equivalent by T&S Brass, and American Standard. Chicago 802-VE2805-665ABCP or provide as indicated on plumbing fixture schedule.
 2. Supply Fitting: ASME A112.18.1 (Type B); chrome plated brass spout, supply fitting with open grid strainer, water economy aerator with maximum 0.5 gpm flow, ADA compliant. Chicago Faucet Co. Series, or equivalent by T&S Brass, and American Standard. Chicago Mechanical Faucet 420-E2805ABCP or provide as indicated on plumbing fixture schedule.
 3. Supply Fitting: ASME A112.18.1 (Type C1); chrome plated brass spout, supply fitting with open grid strainer, battery operated sensor faucet with water economy aerator with maximum 0.5 gpm flow, ADA compliant. Sloan Model EBF-650 or provide as indicated on plumbing fixture schedule.
 4. Supply Fitting: ASME A112.18.1 (Type C2); chrome plated brass spout, supply fitting with open grid strainer, battery operated sensor faucet with water economy aerator with 0.5 gpm flow, ADA compliant. Chicago Faucets Model EQ-C12A-12ABCP or provide as indicated on plumbing fixture schedule.
 5. Supply Fitting: ASME A112.18.1 (Type C3); chrome plated brass spout, supply fitting with open grid strainer, battery operated sensor faucet with water economy aerator with maximum 0.5 gpm flow, ADA compliant. Chicago Faucet 116.606.AB.1 Series or provide as indicated on plumbing fixture schedule.
 6. Supply Fitting: ASME A112.18.1 (Type C4); chrome plated brass spout, supply fitting with open grid strainer, 24V transformer sensor faucet with water economy aerator with maximum 0.5 gpm flow, ADA compliant. Chicago Faucet 116.706.AB.1 Series or provide as indicated on plumbing fixture schedule.
 7. Supply Fitting: ASME A112.18.1 (Type D1) ; chrome plated brass spout, supply fitting with open grid strainer, 24V transformer sensor faucet with water economy aerator with maximum 0.5 gpm flow, ADA compliant. Sloan Model ETF-600-8-B-BDM or provide as indicated on plumbing fixture schedule.
 8. Supply Fitting: ASME A112.18.1 (Type D2); chrome plated brass spout, supply fitting with open grid strainer, 24V transformer sensor faucet with water economy aerator with 0.5 gpm flow, ADA compliant. Chicago Faucets Model EQ-A-12A-52ABCP or provide as indicated on plumbing schedule.
 9. Supply Fitting: ASME A112.18.1 (Type D3); chrome plated brass spout, supply fitting with open grid strainer, 24V transformer sensor faucet with water economy aerator with maximum 0.5 gpm flow, single supply for temperature Chicago Faucets EQ-A13A-51ABCP and or provide as indicated on plumbing fixture schedule.

10. Supply Fitting: ASME A112.18.1 (Type D4); chrome plated brass spout, supply fitting with open grid strainer, 24V transformer sensor faucet with water economy aerator with maximum .5 gpm flow, dual supply for temperature Chicago Faucets EQ-A13A-52ABBN ADA compliant or provide as indicated on plumbing fixture schedule.
11. Supply Fitting: ASME A112.18.1 (Type E1); chrome plated brass spout, quantum compression operating cartridge, supply fitting with open grid strainer, water economy aerator with 0.5 gpm flow, ADA compliant. Chicago Faucet Co. Series, or equivalent by T&S Brass, and American Standard. Chicago Faucet 895-317E2805-5ABCP.
12. Supply Fitting: ASME A112.18.1 (Type E2); chrome plated brass spout, quantum compression operating cartridge, supply fitting with open grid strainer, water economy aerator with 1.0 gpm flow, ADA compliant. Chicago Faucet Co. Series, or equivalent by T&S Brass, and American Standard. Chicago Faucet 895-317E65VRGD1AB.
13. Supply Fitting: ASME A112.18.1 (Type E3); chrome plated brass spout, quantum compression operating cartridge, supply fitting with open grid strainer, water economy aerator with 1.5 gpm flow, ADA compliant. Chicago Faucet Co. Series, or equivalent by T&S Brass, and American Standard. Chicago Faucet 895-317E35ABCP.
14. Supply Fitting: ASME A112.18.1 (Type E4); chrome plated brass spout, quantum compression operating cartridge, supply fitting with open grid strainer, water economy aerator with 2.2 gpm flow, ADA compliant. Chicago Faucet Co. Series, or equivalent by T&S Brass, and American Standard. Chicago Faucet 895-317E29ABCP.
15. Supply Fitting: ASME A112.18.1 (Type F1); chrome plated brass spout, metering valve cartridge, supply fitting with open grid strainer, water economy aerator with 0.5 gpm flow, ADA compliant. Chicago Faucet Co. Series, or equivalent by T&S Brass, and American Standard. Chicago Faucets Model 807-E2805-665PSHAB or provide as indicated on plumbing fixture schedule.
16. Supply Fitting: ASME A112.18.1 (Type F2); chrome plated brass spout, metering valve cartridge, supply fitting with open grid strainer, water economy aerator with 0.5 gpm flow, ADA compliant. Chicago Faucet Co. Series, or equivalent by T&S Brass, and American Standard. Chicago Faucets Model 857-E2805-665PSHAB or provide as indicated on plumbing fixture schedule
17. Supply Fitting: ASME A112.18.1 (Type H); chrome plated brass spout, metering valve cartridge, supply fitting with open grid strainer, water economy aerator with 0.5 gpm flow, ADA compliant. Chicago Faucet Co. Series, or equivalent by T&S Brass, and American Standard. Chicago Faucets Model 333-E2805-665PSHAB or provide as indicated on plumbing fixture schedule.
18. Supply Fitting: ASME A112.18.1 (Type I); chrome plated brass spout, supply fitting with open grid strainer, water economy aerator with 0.5 gpm flow, ADA compliant. Chicago Faucet 3510-E2805AB Series, or equivalent by T&S Brass, and or provide as indicated on plumbing fixture schedule.
19. Supply Fitting: ASME A112.18.1 (Type J1); chrome plated brass spout, supply fitting with open grid strainer, water economy aerator with 0.5 gpm flow, 4 inch

wrist blade handle. ADA compliant. Chicago Faucet 201-G8AE2805F317AB, or equivalent by T&S Brass, or provide as indicated on plumbing fixture schedule.

- M. Accessories:
1. Chrome plated 17 gage brass P-trap with clean-out plug and arm with escutcheon.
 2. Chrome plated 17 gage open grid P. O. plug.
 3. Removable key stops.
 4. Flexible supplies.
 5. Trap and waste insulated and offset to meet ADA compliance.
 6. Tempering valve – Power LFe480 series, Acorn, or Leonard.
- N. Floor Mounted Carrier: ASME A112.6.1; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded studs for fixture hanger, concealed arm supports, bearing plate and studs. Jay R. Smith 710 Series, or equal by Zurn and watts.

2.7 SINKS

- A. Fixture Manufacturers:
1. Elkay Mfg.
 2. American standard
 3. Advance Tabco
- B. Fixture Trim Manufacturers:
1. Chicago Faucet Co.
 2. T & S Brass
- C. Supply Fittings Manufacturers:
1. Chicago.
 2. Zurn.
- D. All sink faucets and trim shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.
- E. SK-1: Single Compartment Bowl: ASME A112.19.3; 19-1/2 x 19-1/2" x 6-1/2 inch outside dimensions, 18 gage thick, Type 304 stainless steel. Self-rimming and undercoated, with 1-1/2 inch chromed brass stainless steel drain, ledge back drilled for trim. Elkay Model LRADQ191965PD or provide as indicated on plumbing fixture schedule.
1. Trim: ASME A112.18.1 (Type J1); chrome plated brass supply with rigid spout, 4" vandal proof wrist blade, water economy aerator with 0.5 gpm. Mechanical faucet deck mounted 8" fixed Center, dual supply for hot and cold water service Chicago Faucets Model 201-AGN8AE2805-F-317CP, or equivalent by T&S Brass and American Standard or provide as indicated on plumbing fixture schedule.

2. Trim: ASME A112.18.1 (Type J2): chrome plated brass supply with rigid spout, 4" vandal proof wrist blade, water economy aerator with 1.0 gpm. Mechanical faucet deck mounted 8" fixed Center, dual supply for hot and cold water service Chicago Faucets Model 201-G8AE26-F-317AB, or equivalent by T&S Brass and American Standard or provide as indicated on plumbing fixture schedule.
 3. Trim: ASME A112.18.1 (Type J3): chrome plated brass supply with rigid spout, 4" vandal proof wrist blade, water economy aerator with 1.5 gpm. Mechanical faucet deck mounted 8" fixed Center, dual supply for hot and cold water service Chicago Faucets Model 201-AGN8AE35-317CP, or equivalent by T&S Brass and American Standard or provide as indicated on plumbing fixture schedule.
 4. Trim: ASME A112.18.1 (Type K1); chrome plated brass supply with rigid spout, vandal proof water economy aerator with maximum 1.5 gpm flow, four (4) inch wrist blade handles and quarter turn ceramic disc cartridges. Chicago Faucet Model 1100-L9E35-317ABCP, or equivalent by T&S Brass and or provide as indicated on plumbing fixture schedule.
- F. SK-2: Double Compartment Bowl: ASME A112.19.3; 33 x 19-1/2 x 6-1/2 inch outside dimensions 18 gage thick, Type 304 stainless steel. Self-rimming and undercoated, with 1-1/2 inch chromed brass stainless steel drains 3-1/2 inch crumb cups and tailpieces, ledge back drilled for trim. Elkay Model LRADQ331965PD or provide as indicated on plumbing fixture schedule.
1. Trim: ASME A112.18.1 (Type J1): chrome plated brass supply with rigid spout, 4" vandal proof wrist blade, water economy aerator with 0.5 gpm. Mechanical faucet deck mounted 8" fixed Center, dual supply for hot and cold water service Chicago Faucets Model 201-AGN8AE2805-F-317CP, or equivalent by T&S Brass and American Standard.
 2. Trim: ASME A112.18.1 (Type J2): chrome plated brass supply with rigid spout, 4" vandal proof wrist blade, water economy aerator with 1.0 gpm. Mechanical faucet deck mounted 8" fixed Center, dual supply for hot and cold water service Chicago Faucets Model 201-AGN8AE26-F-317CP, or equivalent by T&S Brass and American Standard or provide as indicated on plumbing fixture schedule.
 3. Trim: ASME A112.18.1 (Type J3): chrome plated brass supply with rigid spout, 4" vandal proof wrist blade, water economy aerator with 1.5 gpm. Mechanical faucet deck mounted 8" fixed Center, dual supply for hot and cold water service Chicago Faucets Model 201-AGN8AE35-317CP, or equivalent by T&S Brass and American Standard or provide as indicated on plumbing fixture schedule.
 4. Trim: ASME A112.18.1 (Type K1); chrome plated brass supply with rigid spout, vandal proof water economy aerator with maximum 1.5 gpm flow, four (4) inch wrist blade handles and quarter turn ceramic disc cartridges. Chicago Faucet Model 1100-L9E35-317ABCP, or equivalent by T&S Brass and or provide as indicated on plumbing fixture schedule.
- G. SK-3: Single Compartment Bowl: ASME A112.19.3; 25" x 21-1/4" x 6-1/2" outside dimensions, 18 gage thick, Type 304 stainless steel. Self-rimming and undercoated, with 1-1/2 inch chromed brass stainless steel drain, ledge back drilled for trim. Elkay Model LRADQ252165PD or provide as indicated on plumbing fixture schedule.
1. Trim: ASME A112.18.1 (Type J1): chrome plated brass supply with rigid spout, vandal proof water economy aerator with 0.5 gpm flow, 8" fixed center, 4" vandal proof Wrist blade Chicago Faucet Model 201-G8AE2805F317AB, or equivalent by T&S Brass and or provide as indicated on plumbing fixture schedule.

2. Trim: ASME A112.18.1 (Type J2): chrome plated brass supply with rigid spout, 4" vandal proof wrist blade, water economy aerator with 1.0 gpm. Mechanical faucet deck mounted 8" fixed Center, dual supply for hot and cold water service Chicago Faucets Model 201-AGN8AE26-F-317CP, or equivalent by T&S Brass and American Standard or provide as indicated on plumbing fixture schedule.
 3. Trim: ASME A112.18.1 (Type J3): chrome plated brass supply with rigid spout, 4" vandal proof wrist blade, water economy aerator with 1.5 gpm. Mechanical faucet deck mounted 8" fixed Center, dual supply for hot and cold water service Chicago Faucets Model 201-AGN8AE35-317CP, or equivalent by T&S Brass and American Standard or provide as indicated on plumbing fixture schedule.
 4. Trim: ASME A112.18.1 (Type K1); chrome plated brass supply with rigid spout, vandal proof water economy aerator with maximum 1.5 gpm flow, four (4) inch wrist blade handles and quarter turn ceramic disc cartridges. Chicago Faucet Model 1100-L9E35-317ABCP, or equivalent by T&S Brass and or provide as indicated on plumbing fixture schedule.
- H. SK-4: Single Compartment Bowl: ASME A112.19.3; 16-3/4" x 15-1/2" x 6" outside dimensions, 20 gauge, Type 304 stainless steel with a buffed satin finish, center drain. Elkay Model CHS1716C or provide as indicated on plumbing fixture schedule.
1. Trim: (Type L1) ASME A112.18.1; 8" centerset wall mount faucet with 4" Gooseneck Spout 2" Lever handles 1/2" offset inlets. Vandal resistant aerator standard with 1.5 gpm, chromo plate brass with quarter turn ceramic disc valve and requires 2 faucet. Elkay Faucet Model LK940GN04L2H, or equivalent by T&S Brass and or provide as indicated on plumbing fixture schedule.
 2. Trim: (Type L2) ASME A112.18.1; 8" centerset wall mount faucet with 8" arch tube spout 2" lever handles 2" inlet chrome. Vandal resistant aerator standard with 1.5 gpm, chromo plate brass with quarter turn ceramic disc valve and requires 2 faucet. Elkay Faucet Model LK945AT08L2T, or equivalent by T&S Brass and or provide as indicated on plumbing fixture schedule.
- I. SK-5: Single Compartment Bowl floor mount: ASME A112.19.3; 39" x 27-1/2" x 14" outside dimensions, 14 gauge, Type 304 stainless steel with a buffed satin finish, center drain. Elkay Model WNSF81362 or provide as indicated on plumbing fixture schedule.
1. Trim: (Type L1) ASME A112.18.1; 8" centerset wall mount faucet with 4" Gooseneck Spout 2" Lever handles 1/2" offset inlets. 2.2 GPM vandal resistant aerator standard with 1.5 and .5 GPM insert included, chromo plate brass with quarter turn ceramic disc valve and requires 2 faucet. Elkay Faucet Model LK940GN04L2H, or equivalent by T&S Brass and or provide as indicated on plumbing fixture schedule.
 2. Trim: (Type L3) ASME A112.18.1; Wall mounted with adjustable arms 7-1/4"- 8-3/4", chrome plated, L-Type swing spout, 9-1/2" center to center, 1.5 GPM pressure compensating softflow aerator, vandal proof, ceramic quarter-turn cartridge, and integral stop valves for servicing the faucet. Chicago Faucet Model 640-L9E35-369YAB, or equivalent by T&S Brass and or provide as indicated on plumbing fixture schedule.
- J. Accessories:
1. Chrome plated 17 gage brass P-trap with clean-out plug and arm with escutcheon.
 2. Chrome plated 17 gage brass basket strainer.

3. Removable key stops.
 4. Flexible supplies.
 5. Trap and waste insulated and offset to meet ADA compliance.
- K. Provide offset waste on all sinks.

2.8 LAB SINKS (LS-1)

- A. Manufacturers:
1. Kewaunee
 2. Fisher Hamilton Industries
 3. Total Lab Solutions
 4. Durcon
 5. LOC Scientific
- B. Fixture Trim Manufacturers:
1. Chicago Faucet Co.
 2. T & S Brass
 3. Symmons
 4. Speakman
- C. Supply Fittings Manufacturers:
1. Chicago.
 2. McGuire.
 3. Brasscraft.
 4. Zurn.
- D. Drop-in Type Sinks:
1. Single Compartment Bowl: ASME A112.19.3; 17 x 20 x 5-1/2 inch outside dimensions drop-in type stainless steel or refer to Drawings. Provide minimum 18 gauge, Type 304 stainless steel with insulation undercoating. (coordinate with lab furniture for exact dimension).
 2. Single Compartment Bowl: ASTM- D-635 Lipped Drop-in 18"L x 15"W x 8" D Duratop epoxy sink with poly drain outlet, overflow and stopper. (Coordinate with lab furniture for exact dimension).
 3. Single Compartment Bowl: ASTM- D-635 Lipped Drop-in 18"L x 15"W x 5" D (ADA) Duratop epoxy sink with poly drain outlet, overflow and stopper. (Coordinate with lab furniture for exact dimension).
- E. Provide stainless steel strainer, outlet, standpipe overflow, and stopper for all sinks unless otherwise specified.

- F. Provide tailpieces and trap compatible with waste piping systems for all sinks unless otherwise specified.
- G. Provide units that comply with SEFA 7, Laboratory Fixtures. Provide Chicago Model 930 CP -317 faucet & fittings or as indicated on Drawings, complete with washers, locknuts, nipples, and other installation accessories. Include wall and deck flanges, escutcheons, handle extension rods, and similar items.
- H. Provide Chicago Model 982-909CAGCP turret or as indicated on Drawings, complete with washers, locknuts, nipples, and other installation accessories. Include wall and deck flanges, escutcheons, handle extension rods, and similar items.
- I. Finish: Polished chrome on brass body with a clear acid and solvent-resistant epoxy coating unless specified otherwise.
- J. Equip valve handles with color coded plastic index buttons as follows:

Service	Indexing	Button Color	Lettering Color
Cold Water (Potable)	CW	Green	White
Hot Water (Potable)	HW	Red	White
Lab Air	AIR	Orange	Black
Natural Gas	GAS	Dk. Blue	White
Vacuum	VAC	Yellow	Black
Deionized Water	DI	White	Black
Carbon Dioxide	CO2	Pink	Black
Reverse Osmosis Water	RO	White	Black
Argon	AR	Violet	White
Helium	HE	Black	White
Hydrogen	H2	Pink	Black
Specialty Gas	SG	Lt. Blue	Black

Trim Manufacturers:

1. Chicago Faucets
 2. Watersaver Faucet Co., Inc.
 3. Zurn
 4. Royal Brass
- K. Preparation: Provide openings, accesses, cutouts, etc., in casework units and tops as necessary to permit installation of fittings at the Project Site.

2.9 LAVATORY and SINK INSULATION & SHIELD KIT

- A. Manufacturers:
 1. Truebro/IPS
 2. Plumberex
 3. Zurn
- B. Product Description: Safety Covers conforming to ANSI A177.1 and consisting of insulation kit of molded closed cell vinyl construction, 3/16 inch thick, white color, for insulating tailpiece, P-trap, valves, and supply piping. Furnish with weep hole and angle valve access covers.

- C. Provide Lavatory shield: Rigid enclosure is dimensionally engineered to comply with ADA requirements, design aesthetics and mechanical cooperation. LAV SHIELD conceals electronic faucet components, mixing valves, trap primers and instantaneous water heaters*, eliminating vandalism while allowing wheelchair accessibility under lavatories. Available in the standard model for field fit applications or may be ordered as a factory pre-cut which closely follows the underside contours of the lavatory specified.
 - 1. UL listing in accordance with ADA Standards.
 - 2. Flammability - UL-94 V-0, 5VA ASTM D-635-91 4 (ATB) 2.1 (AEB).

2.10 WASH FOUNTAINS (WF-1)

- A. Manufacturers:
 - 1. Acorn.
 - 2. Willoughby.
- B. Supply Fittings Manufacturers:
 - 1. Chicago.
 - 2. McGuire.
 - 3. Brasscraft.
 - 4. Zurn.
- C. All wash fountains shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.
- D. Acorn 3423-ES-AD-1-H or provide as indicated on plumbing fixture schedule. 4 user, 16 gauge stainless steel and shall have integral backsplash.
- E. Accessories: Push button self-closing valve, spray head, self-draining, air circulating type soap tray on top pf spray head, and soap dish on each side of bowl, thermostatic mixing valve, tempered water only, supporting tube, spud and strainer, operating mechanism, foot levers and rail, combination stop, strainer and check valves.

2.11 BATHTUBS AND SHOWERS

- A. Fixture Manufacturers:
 - 1. Aquarius
 - 2. American Standard Plumbing
 - 3. Eljer Plumbingware
 - 4. Kohler Co.
- B. Trim Manufacturers:
 - 1. Chicago Faucet Co.
 - 2. Leonard
 - 3. Powers

4. Symmons
- C. Bathtub: ANSI Z124.1; molded glass fiber reinforced polyester, with slip-resistant bottom surface, contoured shape, 60 inches long x 30 inches wide color as selected by Architect.
- D. Bath and Shower Trim: ASME A112.18.1; concealed shower and over rim supply with diverter spout, pressured balanced mixing valve, bent shower arm with flow control and adjustable spray ball joint showerhead with maximum 2.5 gpm flow and escutcheon, lever operated pop-up waste and overflow. Leonard Model 4503 or provide as indicated on plumbing fixture schedule.

2.12 SHOWERS (Regular) – (SH-1)

- A. Manufacturers:
 1. Chicago Faucet Co.
 2. Acorn Engineering Company.
 3. Speakman.
 4. Leonard Valve Co.
 5. Symmons
 6. Powers
- B. SH-1: ASME A112.18.1; concealed shower supply with pressure balanced or thermostatic mixing valves, integral service stops, chrome plated vandal-proof institutional head with integral wall mounting flange, built-in 1.5 gpm flow, and escutcheon. Acorn – SV16-LVR – 519 - MSH - F1.5 or provide as indicated on plumbing fixture schedule.

2.13 SHOWERS (ADA) – (SH-2)

- A. Manufacturers:
 1. Acorn Engineering Company.
 2. Powers.
 3. Approved equal.
- B. SH-2 ADA: ASME A112.18.1 and ASSE 1016-2011; concealed shower supply with pressure balanced and thermostatic mixing valves, integral service stops, hand held shower () with 69 inch metal clad hose and 24 inch glide mounted on right hand side (), flow rate 1.5 GPM. ACORN – SV16-LVR – HHC15 - HSH - HHSE - IVB – SB – PK or provide as indicated on plumbing fixture schedule.

2.14 SHOWER (Regular) – (SH-3)

- A. Manufacturers:
 1. Chicago Faucet Co.
 2. Acorn Engineering Company.
 3. Speakman.

4. Leonard Valve Co.
 5. Symmons
 6. Powers
- B. SH-3: ASME A112.18.1; Wall mounted shower systems, slow compression-type volume control/shutoff, H-06 institutional shower head, 1.6 GPM. Factory pre-assembled with 18 gauge stainless steel cover, exposed parts chrome plated, vandal resistant. Acorn 450B or provide as indicated on plumbing fixture schedule.

2.15 SHOWER (Regular) – (SH-4)

- A. Manufacturers:
1. Acorn Engineering Company.
- B. SH-4: ASME A112.18.1; 6-Person column shower systems, Constructed of type 304 stainless steel. Column and column cap are 16 gauge, and base flange is 13 gauge. Access panel located near bottom of column.
- C. Accessories:
1. Drain option:
 - a. Off-line vent with supplies from below.
 - b. Centrally rising vent with supplies from above.
 - c. Centrally rising vent with supplies from below.
 - d. Off-line vent with supplies from above.
 2. Showerhead type: (6'-0" or 5'-6")
 - a. S15 - Standard Showerhead (Flow Rate = 1.5 GPM/5.7 LPM)
 - b. SX15 - Severe Service Showerhead (Flow Rate = 1.5 GPM/5.7 LPM)
 - c. SF - Deluxe Showerhead w/ Ball Joint (Flow Rate = 1.5 GPM/5.7 LPM)
 - d. ES - Economy Soft Flow w/ Ball Joint (Flow Rate = 2.0 GPM/7.6 LPM)
 3. Valve Type:
 - a. Hot/Tempered and Cold Supplies:
 - 1) EF - Equa-Flo Pressure Balancing Valve
 - 2) HD - Equa-Flo HD Pressure Balancing Valve
 - 3) TMV - Thermostatic Mixing Valve
 - b. Single Tempered/Cold Supply:
 - 1) AST - Air Pushbutton
 - 2) SV - Single Compression Valve
 4. Drain: Provide standard column slot drain with clamping ring type. Shroud and anchor and other kit to be provide for proper installation as required by the manufacturer.

2.16 WHIRLPOOL VALVE

- A. Manufacturers:
1. Leonard Valve Co.
 2. Chicago Faucet Co.

3. Delta Faucet Co., Commercial Div.
 4. Lasco Mfg.
 5. Symmons
- B. WP-1; ADA: ASME A112.18.1; exposed supply with pressure balanced thermostatic mixing valves, integral service stops, hand held shower with 9' inch metal clad hose. Leonard Model TM-356-26-W/HA, or provide as indicated on plumbing fixture schedule.

2.17 DRINKING FOUNTAINS

- A. Manufacturers:
1. Elkay Mfg.
 2. Halsey Taylor
 3. Oasis Corp.
 4. Haws.
 5. Murdock.
- B. Supply Fittings Manufacturers:
1. Chicago.
 2. McGuire.
 3. Brasscraft.
 4. Zurn.
- C. All drinking fountains shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.
- D. Fountain (DF-1): Two station face-mounted fountain made of white granite. Marblyte solid surface material. Chrome plated vandal resistant bubblers, self closing vandal resistant push buttons, stream regulator and freeze resistant. Add for screw driver stops. Halsey Taylor Model 7120FR or provide as indicated on plumbing fixture schedule.
- E. Fountain (DF-2): Stainless steel wall drinking fountain Bi-Level ADA, mechanical front bubbler button, non-refrigerated, Frost resistant, Vandal-Resistant, double bubbler and non-electrical required. Halsey Taylor Model HVR-BLFR LR or provide as indicated on plumbing fixture schedule.
- F. Fountain (DF-3): Stainless steel wall drinking fountain with cuspidor, mechanical front bubbler button, non-refrigerated, double bubbler and non-electrical required. Halsey Taylor Model 7688004583 or provide as indicated on plumbing fixture schedule.
- G. Fountain (DF-4): Stainless steel wall drinking fountain with cuspidor, mechanical front bubbler button, non-refrigerated, bottle filling station with double bubbler and non-electrical required. Halsey Taylor Model HTHB-HACDBLSS-NF or provide as indicated on plumbing fixture schedule.

- H. Fountain (DF-5): Stainless steel wall drinking fountain with cuspidor, mechanical front bubbler button, non-refrigerated, bottle filling station with double bubbler and with electrical requirement. Halsey Taylor Model HTHB-HVRBL-NF or provide as indicated on plumbing fixture schedule.

2.18 ELECTRIC DRINKING FOUNTAIN

- A. Manufacturers:
1. Elkay Mfg.
 2. Halsey Taylor
 3. Oasis Corp.
 4. Haws.
- B. Supply Fittings Manufacturers:
1. Chicago.
 2. McGuire.
 3. Brasscraft.
 4. Zurn.
- C. All electric water coolers shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.
- D. Fountain: (EDF-1) For Outdoor
1. ARI 1010; Single wall/handicapped mounted electric water cooler with stainless steel top, stainless steel body, vandal resistant, frost resistant with mechanical front bubbler button. Provide vandal resistant bubbler. Halsey Taylor 825008FW83 or provide as indicated on plumbing fixture schedule.
 2. Capacity: 8.0 gph of water with inlet at 50 degrees F drinking water, based on 80 degree F inlet water and room temperature of 90 degrees Fahrenheit.
 3. Electrical: 115V/60Hz
 4. Provide cane touch apron as needed.
- E. Fountain: (EDF-1) For Indoor
1. ARI 1010; Single wall/handicapped mounted electric water cooler with stainless steel top, stainless steel body, vandal resistant, frost resistant with mechanical front bubbler button. Provide vandal resistant bubbler. Halsey Taylor HVR8 ADA or provide as indicated on plumbing fixture schedule.
 2. Capacity: 8.0 gph of water with inlet at 50 degrees F drinking water, based on 80 degree F inlet water and room temperature of 90 degrees Fahrenheit.
 3. Electrical: 115V/60Hz
 4. Provide cane touch apron as needed.

- F. Fountain: (EDF-2) For Indoor
1. ARI 1010; ADA-Bi-Level wall mounted , GreenSpec Listed, cabinet stainless steel panels, cooler top non-corrosive stainless steel cooler top, number 300 series with stain finish resists satins and anti-splash ridge. Vandal- resistant bubbler is one piece, chrome-plated with integral hood guard design. Vandal resistant pushbutton, storage tank stainless steel evaporator. Halsey Taylor Model 8754080083 provide as indicated on plumbing fixture schedule.
 2. Capacity: 7.6 gph of water with inlet at 80 degrees F and room temperature of 90 degrees Fahrenheit.
 3. Electrical: 120 volt / 60 Hz units furnished with plug-in 3 wire grounding type service cord, single phase.
 4. Provide cane touch apron, Halsey Taylor Model 42522 for HAC Series or provide as indicated on plumbing fixture schedule.
- G. Fountain: (EDF-3) Indoor With Bottle Filler
1. ARI 1010; (ADA) Hydroboost bottle filling station, bi-level cooler, wall mount, non-filtered 8 GPH Stainless. Mechanically activated, sanitary sensor activated, green counter, laminar flow, antimicrobial, real drain. Electronic bottle filler sensor with mechanical front and side bubbler pushbar. Halsey Taylor Model HTHB-HAC8BLSS-NF provide as indicated on plumbing fixture schedule.
 2. Capacity: 7.6 gph of water with inlet at 80 degrees F and room temperature of 90 degrees Fahrenheit.
 3. Electrical: 115V / 60HZ. Maximum 1/5 hp compressor, cord and plug for connection to electric wiring system including grounding connector.
 4. Provide cane touch apron, Halsey Taylor Model 42522 for HAC Series or provide as indicated on plumbing fixture schedule.
- H. Fountain: (EDF-4) For Outdoor
1. ARI 1010; Bi-level wall/Handicapped mounted electric water cooler with stainless steel top, stainless steel body, elevated anti-squirt bubbler with stream guard, automatic stream regulator, push button, mounting bracket, refrigerated with integral air cooled condenser. Mechanical actuation. Vandal resistant. Provide vandal resistant bubbler. Freeze proof. Halsey Taylor Model 875108FW83 or provide as indicated on plumbing fixture schedule.
 2. Capacity: 8.0 gph of water with inlet at 50 degrees F drinking water, based on 80 degree F inlet water and room temperature of 90 degrees Fahrenheit.
 3. Electrical: 115V/60Hz
 4. Provide cane touch apron.
- I. Fountain: (EDF-5) For Outdoor With Filler
1. ARI 1010; (ADA) Hydroboost bottle filling station, bi-level cooler, wall mount, non-filtered 8 GPH Stainless. Mechanically activated, sanitary sensor activated, green counter, laminar flow, antimicrobial, real drain. Electronic bottle filler sensor with mechanical front and side bubbler pushbar. Freeze proof. Halsey Taylor Model HTHB-HVR8BLR-NF or provide as indicated on plumbing fixture schedule.

2. Capacity: 8.0 gph of water with inlet at 50 degrees F drinking water, based on 80 degree F inlet water and room temperature of 90 degrees Fahrenheit.
3. Electrical: 115V/60Hz
4. Provide cane touch apron.

2.19 EMERGENCY EYE AND FACE WASH (EW-1)

- A. Manufacturers:
 1. Encon Safety Products
 2. Haws.
 3. Guardian Safety Equipment
- B. ANSI Z358.1; Barrier Free, pedestal mounted eye/face wash with stainless steel bowl, Schedule 40 galvanized pipe and fittings, 1/2" U.S. made chrome-plated stay-open ball valve, powder-coated cast aluminum flag handle and floor flange. Unit shall have (4) polypropylene GS-Plus™ spray heads with integral "flip-top" dust covers, filters and 1.6 GPM flow control orifices mounted on a chrome-plated brass eyewash assembly. Unit shall include ANSI compliant sign. Tailpiece and chrome plated brass P-trap supplied by others. Furnish universal emergency sign. ADA Guardian Model GBF-1704 BC w/ G6020 or provide as indicated on plumbing fixture schedule. For ADA
- C. ANSI Z358.1; Pedestal mounted, eye/face wash with stainless steel bowl, Schedule 40 galvanized pipe and fittings, 1/2" U.S. made chrome-plated brass stay-open ball valve, powder-coated cast aluminum flag handle and floor flange. Unit shall have (4) polypropylene GS-Plus™ spray heads with integral "flip-top" dust covers, filters and 1.6 GPM flow control orifices mounted on a chrome-plated brass eyewash assembly. Unit shall include ANSI compliant sign. Guardian Model G-1704 BC w/ G3600LF or provide as indicated on plumbing fixture schedule. For Non – ADA

2.20 EMERGENCY COMBINATION SHOWER WITH EYE AND FACE WASH (EW-#)

- A. Manufacturers:
 1. Encon Safety Products
 2. Haws Drinking Faucet Co.
 3. Guardian Safety Equipment
 4. Speakman
 5. Or approved equal
- B. Barrier Free, all stainless steel construction, corrosion resistant, combination eye/face wash and shower safety station with stainless steel shower head, stainless steel bowl, stainless steel flag handle and floor flange, 1 1/4" IPS Schedule 40 stainless steel pipe and fittings, 1" IPS and 1/2" IPS U.S. made stainless steel stay open ball valves, and polished stainless steel pull rod. Unit shall have (4) polypropylene 'GS Plus' spray heads with integral "flip-top" dust covers, filters, and 1.8-GPM flow control orifices mounted on a stainless steel head assembly. Unit shall include ANSI compliant sign.

- C. Performance: Unit complies with ADA requirements for accessibility by handicapped persons. Unit shall meet or exceed ANSI Z358.1 – 2004, and come with a full 2-year warranty.
- D. Fixture:
 - 1. (EW-2): Guardian Equipment GBF1994 or provide as indicated on plumbing fixture schedule.
 - 2. (EW-3): Guardian Equipment GBF 2150SSH-PCC for all Lab Classrooms.
 - 3. (EW-4): Guardian Equipment GBF1909SSH-GC (orange) For Central Plant and unfinished area.
- E. Alarm Option:
 - 1. AP275-200 alarm unit, with light and horn. (blue color light) Light and horn shall be installed in corridor outside of science lab (120 VAC, 0.5 AMP).
 - 2. Locate the blue light in the ceiling of the main corridor area directly outside room where emergency shower is installed. Provide one light per shower/valve configuration. Guardian AP280-235 (120v/1/60hz – 0.11 amp) for GBF 2150SSH-GC and Guardian AP280-230 (120v/1/60hz – 0.11 amp) for GBF 1909SSH-GC
- F. Hot water Option: TMV G3800LF Thermostatic mixing valve per ANSI Z358.1-2014.
- G. Supply and Waste Piping: 1-1/4 inch galvanized steel pipe pedestal with floor flange.
- H. Furnish universal emergency sign.

2.21 SERVICE SINKS (SS-1)

- A. Manufacturers:
 - 1. Fixture Manufacturers:
 - a. Fiat Products
 - b. Florestone
 - c. Stern Williams
 - 2. Fixture Trim Manufacturers:
 - a. Chicago Faucet Co.
 - b. Fiat Products
 - c. Stern Williams
 - d. T & S Brass & Bronze Works Inc.
- B. SS-1: Single bowl 24 x 24 x 10 inch high. Receptor composed of pearl grey marble chips and white Portland cement ground smooth, grouted and sealed to resist stains, floor mounted, with 1-1/4 inch wide shoulders, vinyl bumper guard, stainless steel dome strainer. Stern Williams Model MTB-2424 or provide as indicated on plumbing fixture schedule.
- C. Accessories:
 - 1. Sink Fittings: Trim: ASME A112.18.1 exposed wall type supply with cross handles, spout wall brace, vacuum breaker, hose end spout, strainers, eccentric adjustable inlets, integral screwdriver stops with covering caps and adjustable threaded wall flanges. Stern Williams Model T-10-VB.

2. Three (3) feet of 5/8 inch diameter plain end reinforced synthetic hose with stainless steel wall bracket. Stern Williams Model T-35.
 3. Mop hanger. Stern Williams Model T-40.
 4. Or provide as indicated on plumbing fixture schedule.
- D. SS-2: 12" corner type w/drop front, bowl 32 x 32 x 12 inch high. Receptor composed of pearl grey marble chips and white Portland cement ground smooth, grouted and sealed to resist stains, floor mounted, with 1-1/4 inch wide shoulders, vinyl bumper guard, stainless steel dome strainer, floor mounted. Stern Williams Model SBC-1725 or provide as indicated on plumbing fixture schedule.
- E. Accessories:
1. Sink Fittings: Trim: ASME A112.18.1 exposed wall type supply with cross handles, spout wall brace, vacuum breaker, hose end spout, strainers, eccentric adjustable inlets, integral screwdriver stops with covering caps and adjustable threaded wall flanges. Stern Williams Model T-10-VB.
 2. Three (3) feet of 5/8 inch diameter plain end reinforced synthetic hose with stainless steel wall bracket. Stern Williams Model T-35.
 3. Mop hanger. Stern Williams Model T-40.
 4. Or provide as indicated on plumbing fixture schedule

2.22 UTILITY SINK

- A. Manufacturers:
1. Fixture Manufacturers:
 - a. Fiat Products
 - b. Florestone
 - c. Stern Williams
 2. Fixture Trim Manufacturers:
 - a. Chicago Faucet Co.
 - b. Fiat Products
 - c. Stern Williams
 - d. T & S Brass & Bronze Works Inc.
- B. US-1: Single bowl 20 x 24 x 15 inch high. Single compartment floor mounted poly sink. Fiat Model P-1 or provide as indicated on plumbing fixture schedule
- C. Supply Fitting: ASME A112.18.1 (Type E); chrome plated brass spout, metering valve cartridge, supply fitting with open grid strainer, water economy aerator with 0.5 gpm flow, ADA compliant. Chicago Faucet Co. Series, or equivalent by T&S Brass, and American Standard. Chicago Faucet 895-317E2805-5ABCP.
- D. Provide plaster trap as required.

2.23 SHAMPOO BOWLS, SB-1:

- A. Provide shampoo bowls in cosmetology lab. Belvedere Model #8600. Provide floor mounted carrier to support bowl.

2.24 FLOOR DRAINS

- A. Manufacturers:
 - 1. Zurn Industries
 - 2. Mifab
 - 3. Watts
- B. Floor Drain (FD-1): ASME A112.21.1; Top round floor drain, lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer. Zurn ZN-415-BZ1 (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule. For restroom only.
- C. Floor Drain (FD-2): ASME A112.21.1; Top round floor drain, lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable light duty square nickel-bronze strainer with removable perforated sediment bucket. Zurn ZN-415N-P (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule. For Janitor Closet and general space only.
- D. Floor Drain (FD-3): ASME A112.21.1; Cast iron flanged receptor with seepage holes, acid resistant coated interior and indirect waste drain, nickel bronze rim and secured grate. Secondary strainer or sediment bucket with. Zurn ZN-1970-KC-11 (Vandal-Proof Secured Top) with 4" funnel drain for freezer drain only or provide as indicated on plumbing fixture schedule. For Kitchen and AHU area
- E. Floor Drain (FD-4): ASME A112.21.1; medium duty drains with 9" round top, duco cast iron body and flashing collar with cast iron bar. Zurn ZN-550 (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule. For Central Plant area
- F. Floor Drain (FD-5): ASME A112.21.1; Large capacity suspended sediment bucket, fabricated steel body with galvanized coating inside and outside, cast iron grate, stainless steel ported bucket with mesh screen and lift bar. Zurn ZN-539 (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule. For Central Plant and Cooling Tower area
- G. Hubdrain (HD-1): Zurn Z-551 Series (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule.
- H. Hubdrain (HD-2): Stainless Steel. Zurn Z-1726 Series (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule.

2.25 FLOOR SINKS

- A. Manufacturers:
 - 1. Zurn Industries
 - 2. Mifab
 - 3. Watts
- B. Floor Sink (FS-1): Cast iron body with integral seepage pan, acid resistant interior, nickel bronze rim and secured 1/2 grate. Aluminum dome bottom strainer and eight (8) inch

square top. Zurn ZN-1910-K Series (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule. For Kitchen and AHU area

- C. FS-2: Zurn ZN-1900-KC, 12 inches, 3/4 grate (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule. For Kitchen
- D. FS-3: Zurn ZN-1900-KC, 12 inches, 1/2 grate (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule.

2.26 TRAP SEAL PRIMERS

- A. Manufacturers:
 - 1. PPP Inc.
 - 2. Jay R. Smith Mfg.
 - 3. Siouxchief
 - 4. Zurn Industries
 - 5. Mifab
 - 6. Watts
 - 7. Sloan
- B. Trap Seal Primers-Pressure Drop Type (TP-1)
 - 1. Adjustable to the static line pressure by use of the adjusting screw. System operating range is 20 psi minimum to 80 psi. The trap Primer is to be connected to a cold water supply with isolation valve.
 - a. PPP Model P1-500 will prime 1-4 floor drains using DU-U Distribution unit.
 - b. PPP Model P2-500 will prime 1-2 floor drains using DU-U Distribution unit.
- C. Trap Seal Primers-Flush Valve Type (TP-2)
 - 1. Vacuum breaker trap primer attached to water closet flush valve, similar to Sloan VBF-72-A.
- D. Trap Seal Primer: (TP-3), Jay R. Smith 2699 Series.
- E. Trap Seal Primers-electronic Type (TP-E)
 - 1. Vacuum breaker trap primer attached to water supply manifold, similar to Zurn Z-1020 with copper waterway.
 - 2. Accessories:
 - a. Slow closing 24 VAC solenoid valve.
 - b. 120 – 24 VAC transformers.
 - c. Brass atmospheric vacuum breaker.
 - d. Copper connection outlets

2.27 TRAP GUARDS Delete this unless the school district wants it

- A. Provide trap guards (TG-2) inline floor drain trap sealer to be manufactured the Green Solution Sure seal Vent Guard, Model #SSX009V. (X = 2 for 2"; 3 for 3"; 4 for 4").

2.28 PLANTER DRAINS

- A. Manufacturers:
 - 1. Josam Mfg.
 - 2. Jay R. Smith Mfg.
 - 3. Wade Spec. Products
 - 4. Zurn Industries

- B. ASME A112.21.1; lacquered cast iron body with clamping collar and gravel stop and removable polyethylene dome with stainless steel screen. Jay R. Smith Model 2675

2.29 FRENCH DRAIN SYSTEM

- A. Manufacturer:
 - 1. NDS, or equal.

- B. FD-1: Structural foam polyolefin round drywell system with UV inhibitors. 24" dia., 28.75" high, 49 gal. with 18-1.5" knockout leaching ports and 3-4.5" knockout inlet/outlet ports per panel.

- C. NDS Model FWAS24, or equal.

2.30 TRENCH DRAIN

- A. Design: Provide the following type of drain systems.
 - 1. Manufacturers:
 - a. Josam
 - b. Zurn
 - c. JR Smith
 - d. Mifab
 - e. Duratrench
 - f. Wade
 - g. ABT, Inc.

- B. TD-1: (Pool Deck)
 - 1. Design: Provide the following type of drain systems.
 - a. 2" Wide Pre-sloped Stainless Trench Drains.

 - 2. Provide a complete drain system made up of selected components that together shall make a functional trench drain system. The trench drain components provided and installed shall be the trench drain body, load bearing frame, trench drain grate, grate locking mechanism, channel joint sealing, and outlet connection.

 - 3. Trench Body Material: DTSH = Stainless steel trench body with flashing collar for membrane applications T304 standard. The trench drain body shall be constructed from 16ga (min.) T304 stainless steel and have a minimum clear opening as indicated in the plans. Trench invert shall have a vee bottom and shall have an integral flashing flange for clamping of a waterproofing membrane. Sections shall be up to 96" long (typical), but can be fabricated in longer lengths as required (up to 50' lengths possible). If multiple sections are required, the sections shall bolt together via a flange and can be sealed with a gasket or by on

site welding. Each of the sections shall be labeled to indicate proper flow and placement. Trench body shall have a class 2b finish standard. Optional mill or bead blast finish as required on the contract documents.

- a. Slope:
 - 1) 0.5 percent.
 - 2) 1.0 percent.
 - 3) As indicated on the Drawings.
- b. Grate:
2" wide presloped polyester fiber reinforced polymer concrete trench body, T304 stainless steel mesh grate with ADA compliant & heel proof openings
- c. Grate Locking:
 - 1) GLWCB - Welded and threaded cross bar.
- d. Outlet:
 - 1) Pipe Size: 3".
 - 2) Pipe Type:SS.
 - 3) Location: Bottom.
- e. Joint Sealant:
 - 1) SLUR - Joints shall be fully sealed with urethane joint sealant. The joint sealant shall be applied to a clean bell and spigot joint. The sealant shall be applied as a continuous 3/8" diameter bead from the top of the joint through the bottom and back to the top on the other side to ensure a proper seal. Additional sealant can be applied to the exterior of the joint as required to provide a positive seal.
- f. Dura Trench Model 03M24SS: T304 stainless steel mesh grate with ADA compliant & heel proof openings. Grating shall be 03M24SS heel proof and ADA compliant stainless steel mesh grate.

C. TD-2: (Restroom)

1. Design: Provide the following type of drain systems.
 - a. 4" Wide Polymer-Concrete Channel Trench Drains.
 - b. Model J R SMITH 9833 or approved equal.
2. Provide a complete drain system made up of selected components that together shall make a functional trench drain system. Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
3. Channel Sections: Narrow, interlocking-joint, sloped-invert, polymer-concrete modular units with end caps.
 - a. Include rounded bottom, with built-in invert slope of 0.6 percent and with outlets in number, sizes, and locations indicated.
 - b. Include extension sections necessary for required depth.
 - c. Dimensions: 4-inch (102-mm) inside width. Include number of units required to form total lengths indicated.
 - d. Frame: galvanized steel for grates.
4. Grates: Manufacturer's designation heavy duty, with slots or perforations, and of width and thickness that fit recesses in channel sections.
 - a. Material: Galvanized steel.
 - 1) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections
5. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

- D. TD-3: (General Area)
1. Design: Provide the following type of drain systems.
 - a. 6" precast polypropylene U.V. inhibitors. Channel interlocking design with built in slope of 0.6 percent. Radiused bottom, with stainless steel stainless steel frame.
 - b. Model J R SMITH 9930 or approved equal.
 2. Provide a complete drain system made up of selected components that together shall make a functional trench drain system. Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
 3. Channel Sections: Interlocking-joint, PP modular units, with end caps. Include flat, rounded, or inclined bottom, with level invert and with outlets in number, sizes, and locations indicated.
 4. Dimensions: 4-inch (102-mm) inside width. Include number of units required to form total lengths indicated.
 5. Grates: With slots or perforations and widths and thickness that fit recesses in channel sections.
 - a. Material: Galvanized steel.
 - 1) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.
 6. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.
- E. TD-4: (Stainless Steel General and Shower Area)
1. Design: Provide the following type of drain systems.
 - a. 2" Wide and 5" body 14ga type 304 stainless steel ADA shower drain.
 - b. Model J R SMITH 9666 or approved equal.
 2. Provide a complete drain system made up of selected components that together shall make a functional trench drain system. Modular system of stainless-steel channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
 3. Channel Sections: Interlocking joint, stainless steel with level invert.
 - a. Dimensions: 2-inch (102-mm) inside width. Include number of units required to form total lengths indicated.
 4. Grates: Manufacturer's designation "[**heavy**] [**medium**] duty," with slots or perforations, and of width and thickness that fit recesses in channels.
 - a. Material: Stainless steel.
 - 1) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.
 5. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.
- F. TD-5: (12" Greenhouse & Ag barn)
1. Forms-F12FR: Pre - manufactured trench forms using recyclable non - CFC EPS foams. Forms to be round bottom, pre -sloped or non - sloped. Form segments are 12" (305 mm) wide. Trench width created to be within 1/16" (1.58mm) of specified. Invert slope per application requirement as noted on plans. Non - sloping sections must have written approval by engineer prior to installation. Form work to be anchored against floatation to the earth without penetrating the subgrade using steel no- float legs and an anchor slab pour. Means to assure constant rail spacing and grate seat dimension must be provided. Non -

petroleum based form release is to be used for smooth interior walls and easy form removal. Invert slope is as noted on plans Trench former F12FR by ABT, INC.

2. Grating: 12.606D. FG: Galvanized gray iron heel safe/ada grates. Grates to have a 0.162 FT²/LFt (0.049 m²/Lm) open area. Grates shall pass a proof load 494 psi (Modified AASHTO M-306 Test Method) applied to a 9 inch wide x 9 inch long load contact area. Grates must be flush with top of rails. Covers lay in their seats and are not retained.
 3. Frames/Rails: F20G - Post fabrication hot dipped galvanized 1.75" x 1.75" x 0.188" (44.5 mm x 44.5 mm x 4.8 mm) steel rails. Standard headed concrete anchors conforming to or exceeding American Concrete Institute's specifications. Grate rails to provide a minimum of 1.188 square inches concrete bearing area per inch of trench length on each side. Auxiliary frames are to be used as noted on plans to facilitate radii, intersections, grade changes and expansion, control & construction joints. Load bars are to be installed as noted on the plans to reinforce rails where unsupported by concrete.
 4. Drain shall be (x) xx'-0" section with slope toward the center from each end.
- G. TD-6: (18" Greenhouse & Ag barn)
1. Forms-F18FR: Pre - manufactured trench forms using recyclable non - CFC EPS foams. Forms to be round bottom, pre -sloped or non - sloped. Form segments are 18" (457 mm) wide. Trench width created to be within 1/16" (1.58mm) of specified. Invert slope per application requirement as noted on plans. Non - sloping sections must have written approval by engineer prior to installation. Form work to be anchored against floatation to the earth without penetrating the subgrade using steel no- float legs and an anchor slab pour. Means to assure constant rail spacing and grate seat dimension must be provided. Non - petroleum based form release is to be used for smooth interior walls and easy form removal. Invert slope is as noted on plans Trench former TR18 by ABT, INC.
 2. Grating: 18.606D.FG: Galvanized gray iron heel safe/ada grates. Grates to have a 0.250 FT²/LFt (0.076 m²/Lm) open area. Grates shall pass a proof load 494 psi (Modified AASHTO M-306 Test Method) applied to a 9 inch wide x 9 inch long load contact area. Grates must be flush with top of rails. Covers lay in their seats and are not retained.
 3. Frames/Rails: F20G - Post fabrication hot dipped galvanized 1.75" x 1.75" x 0.188" (44.5 mm x 44.5 mm x 4.8 mm) steel rails. Standard headed concrete anchors conforming to or exceeding American Concrete Institute's specifications. Grate rails to provide a minimum of 1.188 square inches concrete bearing area per inch of trench length on each side. Auxiliary frames are to be used as noted on plans to facilitate radii, intersections, grade changes and expansion, control & construction joints. Load bars are to be installed as noted on the plans to reinforce rails where unsupported by concrete.
 4. Drain shall be (x) xx'-0" section with slope toward the center from each end.
- H. TD-7: (Animal Holding)
1. Design: Provide the following type of drain systems.
 - a. 6" Wide stainless steel ADA shower drain.
 - b. Model J R SMITH 9660 or approved equal.

2. Provide a complete drain system made up of selected components that together shall make a functional trench drain system. Modular system of stainless steel channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
3. Channel Sections: Interlocking joint, stainless steel with level invert.
 - a. Dimensions: 6-inch (102-mm) inside width. Include number of units required to form total lengths indicated.
4. Grates: Manufacturer's designation "[**heavy**] [**medium**] duty," with slots or perforations, and of width and thickness that fit recesses in channels.
 - a. Material: Stainless steel.
 - b. Locking Mechanism: Manufacturer's standard device for securing grates to channel sections
5. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

2.31 CLEANOUTS

- A. Cleanouts shall be provided where indicated on Drawings and elsewhere as required by code.
 1. Cleanouts in pipelines shall consist of cast iron ferrule and heavy duty cleanout plug with square head as scheduled on the Drawings. Where piping is concealed in floors or walls cleanouts shall be installed in or near surface of floor or walls and have countersunk plugs with covers
- B. Cleanouts shall be provided at the base of the stack on all sanitary, waste and drainage stacks. Base of stack cleanouts on piping located within walls or partitions shall be cast iron cleanout tee with countersunk plug and chromium-plated round access cover, J.R. Smith figure or approved equal.
- C. Manufacturers:
 1. Josam Mfg.
 2. Jay R. Smith Mfg.
 3. Wade Spec. Products
 4. Zurn Industries
 5. Mifab
 6. Watts
- D. Floor, Outdoors: Coated cast iron body with gasket seal ABS plug and round cast iron scoriated non-skid cover. Jay R. Smith, Model 4220-F-C-U.
- E. Floor, Indoors (CO): Coated cast iron body with gasket seal ABS plug, threaded top assembly with round nickel bronze scoriated cover in service areas. Jay R. Smith, Model 4025 – F-C-U.
- F. Wall Cleanout (WCO): Line type with lacquered cast iron body with bronze taper thread plug and round stainless steel access cover secured with vandal proof screw. Jay R. Smith Model 4420-U.

- G. Floor, Stainless Steel Indoors (CO): Coated cast iron body with gasket seal ABS plug, threaded top assembly with round stainless steel scoriated cover in service areas. Jay R. Smith Model 9760 Series.

2.32 ROOF DRAINS

- A. Roof Drain (RD-1):
1. Assembly: ASME A112.21.2M and ASME 112.3.1 or ASME 112.6.4
 2. Body: Lacquered cast iron with sump.
 3. Strainer: Removable aluminum dome with vandal proof screws.
 4. Accessories: Coordinate with roofing type, provide all required accessories:
 - a. Membrane flange and membrane clamp with integral gravel stop.
 - b. Under deck ring with wide flange.
 - c. Roof sump receiver.
 - d. Waterproofing flange.
 - e. Adjustable threaded extensions collar, bearing pan with SS hardware.
 5. Model:
 - a. Josam – 21500-AE-CR-1-26
 - b. J. R. Smith – 1015AD-C-R
 - c. Zurn – ZA100-C-EA-R
 - d. Wade – 3000-AE-189
 - e. Mifab – R1200-EU-B-M-80
- B. Roof Drain (RD-2): For Storm Shelter per ICC-500
1. Assembly: Roof Penetration Housings CRD.
 2. Body: Stainless steel construction with sump.
 3. Strainer: Impact-Resistant removable steel dome with vandal proof screws.
 4. Accessories: Coordinate with roofing type, provide all required accessories:
 - a. Membrane flange and membrane clamp with integral gravel stop.
 - b. Adjustable under deck clamp.
 - c. Roof sump receiver.
 - d. Waterproofing flange.
 - e. Use threaded connection for pipe sizes 6" or larger.
 - f. Provide fixed extensions whenever possible in place of adjustable extensions when the distance needed is longer than what can be adjusted.
- C. Overflow Roof Drain (OD-1):
1. Assembly: ASME A112.21.2M and ASME 112.3.1 or ASME 112.6.4.
 2. Body: Lacquered cast iron with sump.
 3. Strainer: Removable aluminum dome with vandal proof screws.
 4. Waterdam extended to two (2) inches above flood elevation.
 5. Accessories: Coordinate with roofing type:
 - a. Membrane flange and membrane clamp with integral gravel stop.
 - b. Adjustable under deck clamp.

- c. Roof sump receiver.
 - d. Waterproofing flange.
 - e. Adjustable threaded extensions collar, bearing pan with SS hardware.
6. Model:
- a. Josam – 21500-AE-CR-1-26
 - b. J. R. Smith – 1015AD-C-R
 - c. Zurn – ZA100-C-EA-R
 - d. Wade – 3000-AE-189
 - e. Mifab – R1200-EU-B-M-80
- D. Overflow Roof Drain (OD-2): For Storm Shelter per ICC-500
- 1. Assembly: Roof Penetration Housings COFRD.
 - 2. Body: Stainless steel construction with sump.
 - 3. Strainer: Impact-Resistant removable steel dome with vandal proof screws.
 - 4. Internal water standpipe extended to two (2) inches above flood elevation.
 - 5. Accessories: Coordinate with roofing type:
 - a. Membrane flange and membrane clamp with integral gravel stop.
 - b. Adjustable under deck clamp.
 - c. Roof sump receiver.
 - d. Waterproofing flange.
 - e. Provide fixed extensions whenever possible in place of adjustable extensions when the distance needed is longer than what can be adjusted
- E. Deck Drain (DD-1):
- 1. Assembly: ASME A112.21.2M and ASME 112.3.1 or ASME 112.6.4.
 - 2. Body: Lacquered cast iron with sump.
 - 3. Strainer: Adjustable promenade nickel bronze top with vandal proof screws.
 - 4. Accessories: Coordinate with roofing type, provide all required accessories:
 - a. Membrane flange and membrane clamp.
 - b. Adjustable under deck clamp.
 - c. Roof sump receiver.
 - d. Waterproofing flange.
 - e. Adjustable threaded extensions collar with SS hardware.
 - f. Heel proof grate.
 - 5. Model:
 - a. Josam – 23730-3-12-51-VP
 - b. J. R. Smith – 1470-E-R-C-U-HP-NB
 - c. Zurn – ZFG-C-VP-C-EA-R
 - d. Wade – 3121-EB-53-VP
 - e. Mifab – R1100-PR-1-6-15-B-U
- F. All roof drains shall be provided with no-hub connection.

2.33 HOSE BIBS

- A. Manufacturers:

1. Josam Mfg.
 2. Jay R. Smith Mfg.
 3. Woodford
 4. Zurn Industries
 5. Chicago
 6. Wade
- B. HB-1:
1. Manufacturers: Woodford Model B24 or provide as indicated on plumbing fixture schedule.
 2. Interior: Polish brass, anti-siphon, vacuum breaker, enclosed in flush mounted wall box and adjustable brass nut with deep stem guard.
- C. HB-2:
1. Manufacturers: Woodford Model B65, or provide as indicated on plumbing fixture schedule.
 2. Interior: Polish brass Bronze, automatic draining freezeless wall hydrant, single check hose connection anti-siphon vacuum breakers, hydrants drain as handle shut off , permanent type brass valve body with hemispherical seating surface.
- D. HB-3:
1. Manufacturers: Woodford Model 24 or provide as indicated on plumbing fixture schedule.
 2. Interior: Polish brass, anti-siphon, vacuum breaker and adjustable brass nut with deep stem guard.

2.34 WALL HYDRANTS

- A. Manufacturers:
1. Josam Mfg.
 2. Jay R. Smith Mfg.
 3. Woodford.
 4. Zurn Industries
 5. Mifab
 6. Watts
- B. Exterior Wall Hydrant (WH-1):
1. Woodford RB65, Non-Freeze, or provide as indicated on plumbing fixture schedule.

2. ASSE 1019; Chrome, non-freeze, self-draining type with lockable recessed box hose thread spout, hand wheel locks shield and removable key, and integral vacuum breaker.
- C. Back of the House Wash (WH-2):
1. Woodford B22, Non-Freeze, or provide as indicated on plumbing fixture schedule.
 2. Wall Hydrant : ASSE 1019; non-freeze, self-draining type with lockable recessed box hose thread spout, hand wheel locks shield and removable key, and integral vacuum breaker for hot and cold water.
- D. Kitchen Yard Hydrant (WH-3):
1. Woodford HCB67, ASSE 1019, or provide as indicated on plumbing fixture schedule.
 2. Lockable box type, non-freeze hot and cold mixer, chrome finish with permanent type brass valve body with hemispherical seating surface, automatic draining and hose connection, backflow preventer and check valve.
- E. Roof Hydrant (WH-4):
1. Woodford SRH-MS, ASSE 1057, or provide as indicated on plumbing fixture schedule.
 2. The hydrant Features:
 - a. The hydrant valve body is drilled and tapped with 1/8" drain hole which must be piped to a drain location.
 - b. Rod guide eliminates side pull on rod, reduces wear on packing, packing nut & stem.
 - c. Adjustable link for easy adjustment and positive lever lock tension.
 - d. One piece variable flow plunger with large cushion type seal.
 3. All necessary mounting hardware for proper installation on a commercial roof is supplied, including a 2 degree shim for pitch adjustment.
 4. Contractor to route drain line to the nearest floor receptor as applicable. Pitch drain line uniformly toward drain outlet.

2.35 RECESSED VALVE BOX

- A. Manufacturers: Guy Gray, or approved equal.
- B. RVB-1, Refrigerator/Ice Machine: Stainless steel preformed rough-in box with brass valves with wheel handle slip in finishing cover. IPS Model SSMIB8AB.
- C. RVB-2, Washing Machine: Galvanized steel preformed rough-in box with brass long shank valves with wheel handles, valves with single lever handle, socket for two (2) inch waste, slip in finishing cover. IPS Model SSWB-3.

2.36 DOWNSPOUT OVERFLOW

- A. Nozzle Style:
1. Manufacturers: Jay R. Smith 1770 Series or provide as indicated on plumbing fixture schedule.
 2. Product Description: Cast bronze body and wall flange round with offset bottom section.

- B. Hinged Cover Style:
 - 1. Manufacturers: Jay R. Smith 1775-U Series or provide as indicated on plumbing fixture schedule.
 - 2. Product Description: Fabricated Type 304 Stainless Steel Downspout Cover with Hinged Perforated Cover.

2.37 AREA DRAINS

- A. Manufacturers: Jay R. Smith 2250 Series or provide as indicated on plumbing fixture schedule.
- B. Coated cast iron body and flashing collar with cast iron tractor grate and slotted sediment bucket.

2.38 ANIMAL WATER SYSTEM

- A. Manufacturers: Wasco, Trojan, SMB Manufacturing, Muduoban, or approved equal.
- B. WN-1: water nipple, 304 stainless steel body and trigger, provide Vasco nipple drinking bracket model C14628N and Trojan Model 75.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 31 13 - Administrative Requirements: Coordination and project conditions.
- B. Verify walls and floor finishes are prepared and ready for installation of fixtures.
- C. Verify electric power is available and of correct characteristics.
- D. Confirm millwork is constructed with adequate provision for installation of counter top lavatories and sinks.

3.2 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome plated rigid or flexible supplies to fixtures with loose key or screwdriver stops, reducers, and escutcheons.
- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall supports wall carriers and bolts.
- E. Seal fixtures to wall and floor surfaces with sealant, color to match fixture.
- F. For ADA accessible water closets, install flush valve with handle to wide side of stall.

- G. Emergency Shower: Provide a floor drain at each shower installation. Jay R. Smith Model 2005-A07NB-P or provide as indicated on plumbing fixture schedule.
- H. Ice maker: Provide floor sink and cold-water outlet RVB-1 to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.
- I. Water Heater: Provide floor drain to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.
- J. Janitor Closet: Provide floor drain to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.
- K. Commercial Washer: Provide floor drain to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.
- L. Washing Machine: Provide Hot and cold water outlet RVB-2 to each location. Coordinate with Architecture Drawings prior to rough-in.
- M. Provide power wiring, including control power transformers as required for all sensor type fixtures.
- N. Bolt carriers to the floor.
- O. All sinks shall have an offset rear centered drain.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Review millwork shop-drawings. Confirm location and size of fixtures and openings before rough in and installation.

3.5 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.
- B. Hot water temperature outlet at each sink and lavatory shall be adjusted to 105 degree F maximum except for water supplying clothes washing machines and kitchen equipment which shall supply with 140 degree F.

3.6 CLEANING

- A. Clean plumbing fixtures and equipment.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

- A. Do not permit use of fixtures before final acceptance.

END OF SECTION 22 40 00

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide all work for mechanical, plumbing and fire protection systems required in the project to be properly installed, tested, and performing their intended function.

1.3 QUALITY ASSURANCE

- A. Perform all work in accordance with the latest edition of the applicable codes, specifications, local ordinances, industry standards, utility company regulations, nationally accepted codes.
- B. All materials and distribution, and utilization equipment shall be UL Listed.
- C. All equipment and materials shall be new, unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.
- D. Eliminate any abnormal sources of noise that are considered by the Architect or Engineer not to be an inherent part of the systems as designed without additional cost to the Owner.

1.4 COORDINATION WITH OTHER TRADES

- A. Coordinate the work of this division with all other divisions to ensure that all components of the mechanical, plumbing and fire protection system will be installed at the proper time and fit the available space.
- B. Locate and size all openings in work of other trades required for the proper installation of the mechanical, plumbing and fire protection system components.
- C. Make all mechanical, plumbing and fire protection connections to all equipment furnished by this division and as required by any other division.
- D. Electrical wiring, control equipment and motor starters indicated on the electrical drawings, except items otherwise specifically noted, shall be furnished, and installed by the electrical trades. Items of electrical control equipment specifically mentioned to be furnished by the mechanical trades, either in these specifications or on the mechanical drawings, shall be furnished, mounted, and wired by this trade unless where otherwise specified in Division 26 or noted on the electrical drawings to be by the electrical trades. All wiring shall be in accordance with all requirements of the electrical Sections of these specifications.
- E. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment. All controllers furnished with mechanical equipment shall have overload protection in all phases. It shall be the responsibility of each subcontractor furnishing motors and devices to advise Electrical

Contractor of exact function of systems to assure proper type of starter with correct number auxiliary contacts for proper operation of the system.

- F. The mechanical trades shall coordinate with the electrical contractor to ensure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.
- G. The design of the electrical systems is based on the mechanical equipment scheduled and shown on the drawings. Where changes or substitutions are made that involve additional electrical work (larger-size motors, larger number of motors, additional wiring of equipment, etc.), the mechanical contractor shall be responsible for added cost and coordination with the electrical subcontractor. The mechanical contractor shall pay the electrical trades for the cost of the additional work and materials except for changes by addendum.
- H. Motor control equipment which is furnished loose under Division 23 shall be delivered to the Electrical Contractor at the site for custody, erection in place, and wiring as specified.
- I. Smoke detection systems will be furnished and installed under Division 26 – electrical. Coordinate locations with Electrical Contractor.

1.5 DRAWINGS

- A. The drawings are schematic in nature but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the mechanical, plumbing and fire protection equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment that the Contractor proposes to furnish will fit in the space. The drawings are not intended to show exact locations of pipes and ducts, or to indicate all offsets and fittings or supports, but rather to indicate approximate layout.
- B. The mechanical, plumbing and fire protection Drawings are necessarily diagrammatic in character and cannot show every connection in detail in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- C. When the mechanical, electrical, plumbing and fire protection Drawings do not give exact details as to the elevation of pipe, conduit, and ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Exposed piping and ductwork are generally intended to be installed true and square to the building construction and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.

1.6 SUBMITTALS

- A. Provide shop drawings and complete product data as indicated in each specification section.
- B. Coordination Drawings: Using the mechanical ductwork shop drawings as a basis, provide a composite set of AutoCAD drawings in which the major mechanical, plumbing and fire protection equipment, ductwork and piping are superimposed on the architectural reflected ceiling plan and structural framing plan. Include spot elevations of bottom of steel along with finished ceiling height. Prepare at 1/8-inch scale or larger, one drawing per building area. Provide 1/4-inch scale enlargements of locations where special attention to rough-in dimensions as required to ensure all systems will fit within the available space. Obtain approval of coordination drawings prior to duct fabrication and mechanical system hanger rough-ins.
- C. Shop Drawings will be reviewed and returned to the Contractor with one of the following categories:
 - 1. **Reviewed:** No further submittal action is required. Submittal to be included in O & M Manual.
 - 2. **Revise and Resubmit:** Contractor to resubmit submittal as indicated in comments section of Engineer's Submittal Cover Letter.
 - 3. **Rejected:** Contractor to resubmit new submittal when alternate or substitution is not approved and be required to furnish product named in Specification and or Drawings.
 - 4. **Furnish as Corrected:** Contractor to submit letter verifying that required corrections noted on Engineer's Submittal Cover Letter have been received and complied with by manufacturer. If equipment on site is not in compliance with corrections noted, contractor shall be responsible for the cost of removing and replacing equipment.
- D. Materials and equipment which are purchased or installed without Submittal review and approval will be removed and replaced with specified equipment at Contractor's expense.
- E. Provide a specification review that consists of a copy of related specification section with notations indicating compliance or deviation with each element of specification.

1.7 SUBSTITUTIONS OF PRODUCTS

- A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance, and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability, or record of satisfactory performance. It is not intended to preclude the use of equal or better materials or equipment provided that same meets the requirements of the particular project and is approved in an Addendum as a substitution prior to the submission of proposals.
- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect and Engineer at a minimum of seven (7) business days prior to the date for receipt of proposals. Each such request shall include a specification line by line review annotated to certify compliance, the name of the manufacturer and model, material or equipment for which it is to be substituted and a

complete description of the proposed substitute including dimensional drawings, cutsheets, performance and test data and any other information necessary for an evaluation. The Engineers decision of approval or disapproval of a proposed substitution shall be final.

- C. If the Engineer approves any proposed substitution prior to receipt of proposals, such approval will be set forth in an Addendum. Offerors shall not rely upon approvals made in any other manner.
- D. The Engineer and Owner reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final.
- E. Availability of specified items:
1. Verify prior to submittal of Proposal that all specified items will be available in time for installation during orderly and timely progress of the work.
 2. In the event specified items will not be so available, notify the Architect / Engineer prior to receipt of Proposals. Submit Request for Substitutions in accordance with this section.
 3. The request will not be considered if the product or method cannot be provided as a result of the Contractor's failure to pursue the work promptly or coordinate activities properly.
 4. Costs of delays because of non-availability of specified items, when such delays could have been avoided by the Contractor, will be back-charged as necessary and shall not be borne by the Owner.
- F. A request constitutes a representation that Offeror:
1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
 2. Will provide same warranty for Substitution as for specified product, except when inability to provide specified Warranty is reason for request for substitution as described above.
 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 5. Will reimburse the Owner and pay for all costs, including Architect/Engineer's redesign and evaluation costs resulting from the use of the proposed substitution, or for review or redesign services associated with re-approval by authorities having jurisdiction.
- G. No substitutions will be considered after the Award of Contract.**

1.8 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Division 1 - General Requirements and each specification section.

1.9 INTERFERENCE DRAWINGS

- A. Where field conditions prohibit the installation of the mechanical, plumbing or fire protection system components within the available space as indicated on drawings, the Contractor shall prepare a sketch to the minimum 1/8-inch scale, clearly depicting the conflict along with an alternate installation arrangement that satisfies the design intent of the documents without incurring additional cost.
- B. Obtain written approval of proposed interference resolution prior to proceeding with alternate installation.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Equipment listed below shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. Contractor shall adequately protect equipment such as but not limited to: Chillers, Air Handling Units, Fan coil Units, Roof top Units, Air Terminal Units, Boilers, Pumps, Air Devices, exhaust fans, variable frequency drives, ductwork, duct insulation, piping insulation, hydronic piping, air duct accessories, unit heaters, etc. from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging; original factory packaging shall not be deemed as acceptable protection of equipment.
- C. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.
- D. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- E. Protect units from physical damage. Leave factory covers in place until startup of machine.

1.11 GENERAL ELECTRICAL REQUIREMENTS

- A. Provide electric motors, control panels, certain control and safety devices and control wiring when specified or required for proper operation of electrical systems associated with mechanical equipment specified in Division 23.
- B. Electrical materials and work provided shall be in accordance with Division 26.
- C. Notify Architect/Engineer in writing 14 days before bids are due if it is necessary to increase horsepower of any motors or change any electrical requirements listed or shown. After this period, costs incurred because of changes shall be assumed by the responsible Contractor.

1.12 ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

- A. Mechanical equipment with factory assembled and/or attached electric equipment shall be Underwriters' Laboratories (UL) listed as an assembly when such listing is available from UL and shall meet the latest edition of the National Electrical Code.
- B. Unless otherwise specified, the electrical supply being furnished is a 460-volt, 3 phase, 3 wire, 60 hertz source. No neutral connection is available from the 460-volt source. The manufacturer shall include any transformers for equipment requiring other voltages (277volt, 220-volt, 120-volt, 24 volt, etc.).
- C. Electric Motors:
 - 1. For each piece of equipment requiring electric drive, provide a motor having started and running characteristics consistent with torque and speed requirements of the driven machine.
 - 2. Manufacturers furnishing motors shall verify motor horsepower with the characteristic power curves of driven equipment on shop drawings.
 - 3. Each motor shall be furnished in accordance with Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
 - 4. Contractor shall verify electrical characteristics of each motor with electrical drawings.
 - 5. Motors which are shipped loose from equipment shall be set by supplying subcontractor.
 - 6. Alignment of motors factory coupled to equipment and motors field coupled to equipment shall be rechecked by millwright after all connections (belt drives, gear drives, impellers, piping, etc.) have been completed and again after 48 hours of operation in designed service.
 - 7. Where possible, motors shall be factory mounted.

PART 2 – PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 OWNER INSTRUCTION - GENERAL

- A. Installing Contractor shall coordinate and provide on-site Owner training for all new equipment by factory trained specialists for all Mechanical and Plumbing equipment in two (2) separate training meetings. One (1) training session shall be prior to Owner's acceptance and occupancy, and the other training session shall occur (30) thirty days later. Sign-in sheets are required for both meetings and shall be included in close out submittals.
- B. Use Operation and Maintenance manuals and actual equipment installed as basis for instruction.
- C. At conclusion of on-site training program have Owner personnel sign written certification they have completed training and understand equipment operation. Include copy of training certificates in final Operation and Maintenance manual submission.

- D. Refer to individual equipment specifications for additional training requirements.

END OF SECTION 23 05 00

SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes single and three phase motors for application on equipment provided under other sections and for motors furnished loose to Project.
- B. General: Provide motors for all equipment. Select for starting torque and starting current suitable for equipment loads and starting equipment. Horsepower rating shown on drawings are required, but motor must not be loaded more than 1.0 x nameplate horsepower. Provide larger motor if required to stay within this limitation and include all costs for any required increases in electrical system.
- C. Electrical Characteristics: Provide nameplate ratings same as circuit voltage indicated on electrical drawings. Coordinate to give proper operation with starting equipment scheduled. See Division 26.

1.3 REFERENCES

- A. American Bearing Manufacturers Association:
 - 1. ABMA 9 – Load Ratings and Fatigue Life for Ball Bearings.
- B. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 – Motors and Generators.
- C. All motors furnished shall be designed, manufactured, and tested in accordance with the latest applicable standards of NEMA, ANSI, IEEE, and ASTM. As a minimum requirement, all motors shall conform to the latest applicable sections of NEMA Standard No. MG-1. Motors must meet or exceed the rebate levels for premium efficiency Motors established by the Consortium for Energy Efficiency (CEE).

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: Submit catalog data for each motor furnished loose. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.
- B. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.

- C. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 - PRODUCTS

2.1 ELECTRIC MOTORS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Baldor
 2. Marathon
 3. General Electric
 4. Weg
 5. A.O. Smith
- B. Motors 3/4 hp and Larger: Three-phase motor as specified below.
- C. Motors Smaller Than 3/4 hp: Single-phase motor as specified below, except motors less than 250 watts or 1/4 hp may be equipment manufacturer's standard.
- D. All motors controlled by a Variable Frequency Drive shall be NEMA MG-1 Section 31 Inverter-Fed Rated.
- E. Three-phase Motors: NEMA MG-1, Design B, class H premium, energy-efficient squirrel-cage induction motor, with windings to accomplish starting methods and number of speeds as indicated on Drawings.
1. Service Factor: 1.15
 2. Enclosure: Concealed Indoor: ODP, Exposed Indoor: Guarded ODP, Outdoor: Type II TEFC, Outdoor Weather Protected: Type I TEAO.
 3. Design for continuous operation in 40 degrees C environment, with temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
 4. Insulation System: NEMA Class F.
 5. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
 6. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for re-lubrication, rated for minimum ABMA 9, L-10 life of 40,000 hours. Calculate bearing load with NEMA standard shaft extension. Stamp bearing sized on nameplate.
 7. Sound Power Levels: Conform to NEMA MG 1.
 8. Factory finish starters shall be provided with integral phase failure protection to shut down motor upon loss of an electrical phase and automatically reset upon return of 3 phase power.
- F. Single Phase Motors:
1. Permanent split-capacitor type where available, otherwise use split-phase start / capacitor run or capacitor start / capacitor run motor.

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

- 2. Service Factor: 1.35.
- G. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.

2.2 SOURCE QUALITY CONTROL

- A. General: All motor starters and magnetic contactors are specified in Division 26, except as follows:
 - 1. Starters and motors specified as part of a packaged piece of equipment.
 - 2. Centrifugal chillers which are provided with remote mounted starters under the chiller specification.
 - 3. Variable speed controllers for variable volume air handling units and cooling towers.
- B. Provide a tabulation of motors with all pertinent information required for properly rated motor controllers to be provided under Division 26.
- C. Provide a tabulation of matched motors and starters provided under Division 23.
- D. Variable speed motors controlled by variable frequency drives in general shall be of standard design called out in this specification. The manufacturer shall be notified on the requisition that the motor will be used in conjunction with a variable frequency drive and its type of frequency generation. It shall be the responsibility of the motor manufacturer to ensure that this motor will be capable of operating under the torque requirements and speed range within temperature specifications. The normal speed range shall be 4 to 1 ratio. The motor / drive system shall be capable of maintaining full torque throughout. The motors specified for variable speed application shall be capable of operating at 90 hertz maximum frequency as a minimum requirement but at reduced torque's above 60 HZ.
- E. Efficiency: Minimum full load efficiency shall be as follows:

Open Drip-Proof (ODP)				Totally Enclosed Fan Cooled (TEFC)			
	1200 RPM	1800 RPM	3600 RPM		1200 RPM	1800 RPM	3600 RPM
HP	Minimum Efficiency	Minimum Efficiency	Minimum Efficiency	HP	Minimum Efficiency	Minimum Efficiency	Minimum Efficiency
1	82.5	85.5	77.0	1	82.5	85.5	77.0
1.5	86.5	86.5	84.0	1.5	87.5	86.5	84.0
2	87.5	86.5	85.5	2	88.5	86.5	85.5
3	88.5	89.5	85.5	3	89.5	89.5	86.5
5	89.5	89.5	86.5	5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	7.5	91.0	91.7	89.5
10	91.7	91.7	89.5	10	91.0	91.7	90.2
15	91.7	93.0	90.2	15	91.7	92.4	91.0
20	92.4	93.0	91.0	20	91.7	93.0	91.0
25	93.0	93.6	91.7	25	93.0	93.6	91.7
30	93.6	94.1	91.7	30	93.0	93.6	91.7

40	94.1	94.1	92.4	40	94.1	94.1	92.4
50	94.1	94.5	93.0	50	94.1	94.5	93.0
60	94.5	95.0	93.6	60	94.5	95.0	93.6
75	94.5	95.0	93.6	75	94.5	95.4	93.6
100	95.0	95.4	93.6	100	95.0	95.4	94.1
125	95.0	95.4	94.1	125	95.0	95.4	95.0
150	95.4	95.8	94.1	150	95.8	95.8	95.0
200	95.4	95.8	95.0	200	95.8	96.2	95.4

PART 3 - EXECUTION

3.1 REQUIREMENTS

- A. All equipment shall be installed in accordance with the manufacturer's recommendations and printed installation instructions.
- B. All items required for a complete and proper installation are not necessarily indicated in the plans or in the specifications. Contractor's price shall include all items required as per manufacturer's requirements.

3.2 INSTALLATION

- A. General: Install in a professional manner. Any part of parts not meeting this requirement shall be replaced or rebuilt without extra expense.
- B. Install rotating equipment in static and dynamic balance.
- C. Provide foundations, supports, and isolators properly adjusted to allow minimum vibration transmission within the building. Refer to Section 23 05 48.
- D. Correct objectionable noise or vibration transmission in order to operate equipment satisfactorily as determined by the Engineer.

END OF SECTION 23 05 13

SECTION 23 05 14 - VARIABLE FREQUENCY DRIVES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

- A. This specification is to cover a complete Variable Frequency motor Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor. The drive shall be designed specifically for variable torque applications. It is required that the drive manufacturer has an existing independent service organization.
- B. The drive and all necessary controls as specified herein shall be supplied by the drive Manufacturer. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of ten (10) years.
- C. For Air Handling Units with multiple fans (Fan Array) and motors, VFD manufacturer shall provide internal individual motor overloads to match quantity of fan motors. Refer to Air Handling Unit Schedule for fan motor quantity

1.3 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Institute of Electrical and Electronic Engineers (IEEE)
 - a. Standard 519-1992, IEEE Guide for Harmonic Content and Control.
 - 2. Underwriter's laboratories
 - a. UL508C
 - 3. National Electrical Manufacturer's Association (NEMA)
 - a. ICS 7.0, AC Adjustable Speed Drives
 - 4. IEC 16800 Parts 1 and 2
- B. Testing:
 - 1. All printed circuit boards shall be completely tested and burned-in before being assembled into the completed VFD. The VFD shall then be subjected to a computerized systems test (cold), burn-in, and computerized systems test (hot). The burn-in shall be at 104 degrees Fahrenheit at full rated load, on a motor. Drive input power shall be continuously cycled for maximum stress and thermal variation.
 - 2. All testing and manufacturing procedures shall be ISO 9001 certified.
- C. Failure Analysis:

1. VFD manufacturer shall have an analysis laboratory to evaluate the failure of any component. The failure analysis lab shall allow the manufacturer to perform complete electrical testing, x-ray of components, and decap or delaminate of components and analyze failures within the component.

D. Qualifications:

- a. VFD's and options shall be UL listed as a complete assembly. VFD's that require the customer to supply external fuses for the VFD to be UL listed are not acceptable.

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Submit VFD's only after coordination with approved Air Handling Units, Pumps, and Cooling Tower Submittals (If applicable).
- C. All Variable Frequency Drives serving various equipment such as but not limited to: Air handling Units, Pumps and Cooling towers shall be supplied by the same manufacturer.
- D. Submittals shall include, as a minimum, the following information:
 1. Outline Dimensions
 2. Weight
 3. Compliance to IEEE 519 - harmonic analysis for particular job site including total harmonic voltage distortion and total harmonic current distortion.
 - a. The VFD manufacture shall provide calculations specific to the installation, showing total harmonic voltage distortion is less than five (5) percent. Input line filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with IEEE standard 519 (latest version), guide for Harmonic Control and Reactive Compensation for Static Power Converters. The acceptance of this calculation must be completed prior VFD installation.
 - b. If the voltage THD exceeds five (5) percent, the VFD manufacturer is to recommend the additional equipment required to reduce the voltage THD to an acceptable level.

1.5 WARRANTY

- A. The warranty shall be (2) two years and shall begin from date of Certificate of Substantial Completion. The warranty shall include all parts, labor, travel time and expenses to provide on-site warranty.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver equipment in manufacturer's original, unopened containers with identification labels intact.
- B. The contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather,

moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

- C. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.7 MANUFACTURERS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. ABB.
 - 2. Yaskawa.

PART 2 - PRODUCTS

2.1 ADJUSTABLE FREQUENCY DRIVES

- A. The adjustable frequency drives (VFD's) shall be solid state, with a Pulse Width Modulated (PWM) output. The VFD package as specified herein shall be enclosed in a NEMA 1 enclosure (NEMA 3R if outdoors or unconditioned space), completely assembled and tested by the manufacturer. The VFD shall employ a full wave rectifier (to prevent input line notching), Integral Line Reactor(s), Capacitors, and Insulated Gate Bipolar Transistors (IGBT's) as the output switching device. The drive efficiency shall be 97 percent or better at full speed and full load. Fundamental power factor shall be 0.98 at all speeds and loads.
 - 1. Input 480 VAC +/- 10 percent, 3 phase, 48-63 Hz. The overvoltage trip level shall be 30 percent over the nominal, and the under-voltage trip level shall be 35 percent over the nominal voltage as a minimum.
 - 2. Output Frequency 0 to 250 Hz. Operation above 60 Hz shall require programming changes to prevent inadvertent high-speed operation.
 - 3. Environmental operating conditions: 0 to 104 Degree Fahrenheit, 0 to 3300 feet above sea level, less than 95 percent humidity, non-condensing.
 - 4. Conditioned indoors enclosure shall be rated NEMA 1 and shall be UL listed as a plenum rated drive. Drives without this rating are not acceptable.
 - 5. VFD's located in un-conditioned spaces or outdoors shall have rated NEMA 4X enclosure and shall be UL listed as a plenum rated drive. Drives without this rating are not acceptable.
- B. All VFD's shall have the following features:
 - 1. All VFD's shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad is to be used for local control, for setting all parameters, and for stepping through the displays and menus. The keypad shall be removable, capable of remote mounting, and shall

have its own non-volatile memory. The keypad shall allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFD's.

2. The keypad shall include Hand-Off-Auto membrane selections. When in "Hand", the VFD will be started, and the speed will be controlled from the up/down arrows. When in "Off", the VFD will be stopped. When in "Auto", the VFD will start via an external contact closure and the VFD speed will be controlled via an external speed reference. The drive shall incorporate "bump less transfer" of speed reference when switching between "Auto" and "Hand" modes and vice-versa.
3. The VFD's shall utilize pre-programmed application macros specifically designed to facilitate start-up. The Application Macros shall provide one command to ACS400-US-reprogram all parameters and customer interfaces for a particular application to reduce programming time.
4. The VFD shall have the ability to automatically restart after an over current, overvoltage, under voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts shall be programmable.
5. The VFD shall be capable of starting into a rotating load (forward or reverse) and accelerate or decelerate to setpoint without safety tripping or component damage (flying start). The VFD shall also be capable of DC injection braking at start to stop a reverse spinning motor prior to ramp.
6. The VFD shall be equipped with an automatic extended control power loss ride-through circuit, which will utilize the inertia of the load to keep the drive powered. Minimum power loss ride-through shall be one-cycle, based on full load and no inertia. Typical control power loss ride-through for a fan load shall be 2 seconds minimum.
7. If the input reference (4-20mA or 2-10V) is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communication bus.
8. The customer terminal strip shall be isolated from the line and ground.
9. The drive shall employ current limit circuits to provide trip free operation:
 - a. The Slow Current Regulation limit circuit shall be adjustable to 150 percent (minimum) of the VFD's normal duty current rating. This adjustment shall be made via the keypad, and shall be displayed in actual amps, and not as percent of full load.
 - b. The Current Switch-off limit shall be fixed at 350 percent (minimum, instantaneous) of the VFD's normal duty current rating.
10. The overload rating of the drive shall be 110 percent of its normal duty current rating for one (1) minute in every ten (10) minutes. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430-150 for 4-pole motors.

11. The VFD shall have an integral Line Reactor(s) to reduce the harmonics to the power line and to increase the fundamental power factor. The minimum impedance shall be three (3) percent.
12. The VFD shall be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay outputs shall include programmable time delays that will allow for drive acceleration from zero speed without signaling a false under load condition.
13. The VFD shall have programmable "Sleep" and "Wake up" functions to allow the drive to be started and stopped from the level of a process feedback signal.
14. A complete factory wired and tested bypass system consisting of an output contactor and bypass contactor. Overload protection shall be provided in both drive and bypass modes.
15. The following operators shall be provided:
 - a. Bypass Hand-Off-Auto
 - b. Drive mode selector
 - c. Bypass mode selector
 - d. Bypass fault reset
16. The following indicating lights (LED type) shall be provided:
 - a. Power-on
 - b. External fault
 - c. Drive mode selected
 - d. Bypass mode selected
 - e. Drive running
 - f. Bypass running
 - g. Drive fault
 - h. Bypass fault
 - i. Automatic transfer to bypass selected
17. Customer Interlock Terminal Strip: Provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in Hand, Auto, or Bypass modes.
18. The following relay (form C) outputs from the bypass shall be provided.
 - a. Drive run

- b. Bypass run
 - c. Drive fault Bypass fault (motor overload or under load (broken belt))
- 19. Automatic or manual bypass (field selectable)
 - 20. Manual or automatic bypass fault (field selectable)
 - 21. Dedicated digital input that will transfer motor from VFD mode to bypass mode upon dry contact closure.
 - 22. Door interlocked pad lockable circuit breaker which will disconnect all input power from the drive and all internally mounted options.
 - 23. Fast acting semi-conductor fuses exclusive to the VFD - fast acting semi-conductor fuses allow the VFD to disconnect from the line prior to clearing upstream branch circuit protection, maintaining bypass capability. Bypass designs which have no such fuses, or that incorporate fuses common to both the VFD and the Bypass will not be accepted.
 - 24. Class 10 or 20 (selectable) electronic motor overload protection shall be included in the microprocessor bypass to protect the motor in bypass mode.
- C. All VFD's to have the following adjustments:
- 1. Two (2) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed.
 - 2. PID Setpoint controller shall be standard in the drive, allowing a pressure or flow signal to be connected to the VFD, using the microprocessor in the VFD for the closed loop control. The VFD shall have 250 mA of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The auxiliary power supply shall have overload and over current protection. The PID setpoint shall be adjustable from the VFD keypad, analog inputs, or over the communications bus.
 - 3. Two (2) programmable analog inputs shall accept a current or voltage signal for speed reference or for reference and actual (feedback) signals for PID controller. Analog inputs shall include a filter; programmable from 0.01 to 10 seconds to remove any oscillation in the input signal. The minimum and maximum values (gain and offset) shall be adjustable within the range of 0 - 20 ma and 0 - 10 Volts. Additionally, the reference must be able to be scaled so that maximum reference can represent a frequency less than 60 Hz, without lowering the drive maximum frequency below 60 Hz. Process variables shall be modifiable by math functions such as multiplication and division between the two signals (fan tracking), high/low select, as well as inverted follower.
 - 4. Five (5) programmable digital inputs for maximum flexibility in interfacing with external devices. One digital input is to be utilized as a customer safety connection point for fire, freeze, and smoke interlocks (Enable). Upon remote, customer reset (reclosure of interlock) drive is to resume normal operation.
 - 5. One (1) programmable analog output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, and other data.

6. Two (2) programmable digital relay outputs. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; Continuous current rating 2 amps RMS. Outputs shall be true form C type contacts; open collector outputs are not acceptable. Relays shall be capable of programmable on and off delay times.
 7. Seven (7) programmable preset speeds.
 8. Two independently adjustable accel and decel ramps. These ramp times shall be adjustable from 1 to 1800 seconds.
 9. The VFD shall Ramp or Coast to a stop, as selected by the user.
- D. The following operating information displays shall be standard on the VFD digital display. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of two operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable):
1. Output Frequency
 2. Motor Speed (RPM, percent, or Engineering units)
 3. Motor Current
 4. Calculated Motor Torque
 5. Calculated Motor Power (kW)
 6. DC Bus Voltage
 7. Output Voltage
 8. Heat sink Temperature (0°F)
 9. Analog Input Values
 10. Analog Output Value
 11. Keypad Reference Values
 12. Elapsed Time Meter (resettable)
 13. kWh meter (resettable)
 14. mWh meter
 15. Digital input status
 16. Digital output status
- E. The VFD shall have the following protection circuits. In the case of a protective trip, the drive shall stop, and announce the fault condition in complete words (alphanumeric codes are not acceptable).

1. Over current trip 350 percent instantaneous (170 percent RMS) of the VFD's variable torque.
 2. Current rating.
 3. Overvoltage trip 130 percent of the VFD's rated voltage.
 4. Under voltage trip 65 percent of the VFD's rated voltage.
 5. Over temperature +90 degrees Celsius.
 6. Ground Fault either running or at start.
 7. Adaptable Electronic Motor Overload (I 2 t). The Electronic Motor Overload protection shall protect the motor based on speed, load curve, and external fan parameter. Circuits, which are not speed dependant, are unacceptable. The electronic motor overload protection shall be UL approved for this function.
- F. Speed Command Input shall be via:
1. Keypad.
 2. Two Analog inputs, each capable of accepting a 0-20mA, 4-20mA, 0-10V, 2-10V signal.
 3. Floating point input shall accept a three-wire input from a Dwyer Photohelic (or equivalent type) instrument.
 4. Serial Communications
- G. Serial Communications
1. The VFD shall have an RS-485 port as standard. The standard protocol shall be BACnet. Optional protocols that must be available are Johnson Controls N2 bus, Siemens Building Technologies FLN, LonWorks, Profibus and DeviceNet.
 2. Serial communication capabilities shall include, but not be limited to, run-stop control; speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, and accel/decel time adjustments. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed/frequency, current (in amps), percent torque, power (kW), kilowatt hours (resettable), operating hours (resettable), relay outputs, and diagnostic warning and fault information. Additionally, remote (LAN) VFD fault reset shall be possible. A minimum of 15 field parameters shall be capable of being monitored.
 3. The VFD shall allow the DDC to control the drive's digital and analog outputs via the serial interface. The serial communications interface shall allow for DO (relay) control and AO (analog) control. In addition, all drive digital and analog inputs shall be capable of being monitored by the DDC system.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the drive-in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.
- B. Power wiring shall be completed by the electrical contractor. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

3.2 START-UP

- A. Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the owner, and a copy kept on file at the manufacturer.

3.3 PRODUCT SUPPORT

- A. Factory trained application engineering and service personnel that are thoroughly familiar with drive products offered shall be locally available at both the specifying and installation locations.

END OF SECTION 23 05 14

SECTION 23 05 16 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Expansion joints.
 - 2. Pipe alignment guides.
 - 3. Pipe anchors.
- B. Related Sections:
 - 1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product and installation requirements for piping hangers and supports.
 - 2. Section 23 21 13 - Hydronic Piping: Product and installation requirements for piping used in heating and cooling systems.

1.3 DESIGN REQUIREMENTS

- A. Provide structural work and equipment required for expansion and contraction of piping. Verify anchors, guides, and expansion joints provide and adequately protect system.
- B. Expansion Compensation Design Criteria:
 - 1. Installation Temperature: 50 degrees Fahrenheit.
 - 2. Hot Water Heating System Temperature: 210 degrees Fahrenheit.
 - 3. Domestic Hot Water: 140 degrees Fahrenheit.
 - 4. Safety Factor: 30 percent.

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate layout of piping systems, including flexible connectors, expansion joints, expansion compensators, loops, offsets, and swing joints. Submit shop drawings sealed by a registered professional engineer.
- C. Product Data:
 - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

- D. Design Data: Indicate criteria and show calculations. Submit calculations sealed by a registered professional engineer.
- E. Manufacturer's Installation Instructions: Submit special procedures.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- G. Welders' Certificate: Include welders' certification of compliance with AWS D1.1.
- H. Manufacturer's Field Reports: Indicate results of inspection by manufacturer's representative.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.
- B. Operation and Maintenance Data: Submit adjustment instructions.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

1.7 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience.
- B. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.
- B. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.9 WARRANTY

- A. Furnish five (5) year manufacturer warranty for leak free performance of packed expansion joints.

PART 2 - PRODUCTS

2.1 EXPANSION JOINTS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Amber / Booth
 2. Triplex
 3. Mason Industries
- B. Stainless Steel Bellows Type:
1. Pressure Rating: 200 psig WOG and 250 degrees Fahrenheit.
 2. Maximum Compression: 1-3/4 inch.
 3. Maximum Extension: 1/4 inch.
 4. Joint: As specified for pipe joints.
 5. Size: Use pipe sized units
 6. Application: Steel piping three (3) inch and smaller.
- C. External Ring Controlled Stainless Steel Bellows Type:
1. Pressure Rating: 200 psig WOG and 250 degrees Fahrenheit.
 2. Maximum Compression: 15/16 inch.
 3. Maximum Extension: 5/16 inch.
 4. Maximum Offset: 1/8 inch.
 5. Joint: Flanged
 6. Size: Use pipe sized units
 7. Accessories: Internal flow liner.
 8. Application: Steel piping three (3) inch and larger.
- D. Double Sphere, Flexible Compensators:
1. Body: Multi-layered Kevlar tire cord fabric reinforced with EPDM cover, liner and fabric frictioning with reinforcing ring.
 2. Working Pressure: 215 psi
 3. Maximum Temperature: 250 degrees Fahrenheit.
 4. Maximum Compression: 1-1/4 inch through 6-inch pipe; 1-1/2-inch 8 inch through 12 inch; 1-1/5 inch for 14 inch.
 5. Maximum Elongation: 3/4 inch through 6-inch pipe; 1-1/2-inch 8 inch through 12 inch; 5/8 inch for 14 inch.
 6. Maximum Offset: 3/8 inch through 6-inch pipe; 7/8-inch 8 inch through 12 inch; 1 inch for 14 inch.
 7. Maximum Angular Movement: 15 degrees.
 8. Joint: Steel flanges or ductile iron pipe flanges.
 9. Size: Use pipe sized units
 10. Accessories: Control rods.
 11. Application: Steel piping two (2) inch and larger.

2.2 ACCESSORIES

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Amber / Booth
 2. Triplex

3. Mason Industries

- B. Pipe Alignment Guides: Two-piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1-inch-thick insulation, minimum 3-inch travel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install Work in accordance with ASME B31.9.
- B. Rigidly anchor pipe to building structure to prevent stresses and transfer of loading to connected equipment.
- C. Provide support and anchors for controlling expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required. Refer to Section 23 05 29 for pipe hanger installation requirements.
- D. Provide grooved piping systems with minimum one joint per inch pipe diameter instead of flexible connector supported by vibration isolation. Grooved piping systems need not be anchored.
- E. Provide expansion loops as indicated on Drawings.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Furnish inspection services by flexible pipe manufacturer's representative for final installation and certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

END OF SECTION 23 05 16

SECTION 23 05 19 - METERS AND GAGES FOR HVAC PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Pressure gages.
2. Pressure gage taps.
3. Stem type thermometers.
4. Dial thermometer.
5. Thermometer supports.
6. Test plugs.
7. Bladder-type expansion tanks.
8. Air vents.
9. Combination Dir and Air Separators.
10. Strainers.
11. Flow controls.
12. Relief valves.
13. Volume Tanks

- B. Related Sections:

1. Section 23 21 23 - Hydronic Pumps: Execution requirements for piping connections to products specified by this section.

1.3 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.

- B. Product Data: Submit for manufactured products and assemblies used in this Project.

1. Manufacturer's data and list indicating use, operating range, total range, accuracy, and location for manufactured components.
2. Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.
3. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each piping specialty.
4. Submit electrical characteristics and connection requirements.

- C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures, application, selection, and hookup configuration. Include pipe and accessory elevations.

- D. Grooved joint couplings and fittings shall be shown on drawings and product submittals and be specifically identified with the applicable Victaulic style or series number.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of components and instrumentation.
- B. Operation and Maintenance Data: Submit instructions for calibrating instruments, installation instructions, assembly views, servicing requirements, lubrication instruction, and replacement parts list.

1.5 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Protect systems from entry of foreign materials by temporary covers, caps and closures, completing sections of the work, and isolating parts of completed system until installation.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not install instruments when areas are under construction, except rough in, taps, supports and test plugs.

1.8 WARRANTY

- A. Furnish one (1) year manufacturer warranty for piping specialties.

PART 2 - PRODUCTS

2.1 PRESSURE GAGES

- A. Manufacturers:
 - 1. Weiss
 - 2. Marsh Bellofram
 - 3. Weksler
 - 4. Dwyer
- B. Gage: ASME B40.1, UL 404 with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.
 - 1. Case: Stainless steel.
 - 2. Bourdon Tube: Phosphor bronze.

3. Dial Size: 4-1/2 diameter.
4. Mid-Scale Accuracy: One (1) percent.
5. Scale: Psi.

2.2 PRESSURE GAGE TAPS

- A. Manufacturers:
1. Weiss
 2. Marsh Bellofram
 3. Weksler
 4. Pete's Plug
 5. Schrader
- B. Needle Valve: Brass, 1/4-inch NPT for minimum 300 psi.
- C. Ball Valve: Brass 1/4-inch NPT for 250 psi.
- D. Pulsation Damper: Pressure snubber, brass with 1/4-inch NPT connections.
- E. Siphon: Brass, 1/4-inch NPT angle or straight pattern.

2.3 STEM TYPE THERMOMETERS

- A. Manufacturers:
1. Terice
 2. Weiss
- B. Thermometer: Rigid 90°F angle, blue colored, organic, mercury fill, Valox case, brass stem, 1/2 NPT brass thermowell, acrylic window, lens front, magnifying tube type, scale face of aluminum, white background with black graduations and markings
1. Scale Size: 5-1/2" long.
 2. Molded Valox - V-shaped black case.
 3. Window: Double Strength Glass
 4. Stem: Brass, 1/2-inch NPT, and 2 inches long.
 5. Accuracy: ±2% of full scale ASME B40.4 Grade A.
 6. Calibration: Both degrees Fahrenheit and degrees Celsius.

2.4 DIAL THERMOMETERS

- A. Manufacturers:
1. Terice
 2. Weiss
- B. Thermometer: 300 stainless steel, hermetically sealed, bimetallic, silicone dampened on ranges to 300°F coil, adjustable angle, 1/2 NPT, double strength glass window, balanced, black finish pointer, dial face of aluminum, white background with black and blue graduations and markings.

1. Dial Size: 5-inch diameter dial.
2. Window: Double strength glass.
3. Stem: 300 Stainless Steel, 1/4" diameter NPT, 2-1/2" long.
4. Length of Capillary: Minimum five (5) feet.
5. Accuracy: ±1% of full scale ASME B40.4 Grade A.
6. Calibration: Both degrees Fahrenheit and degrees Celsius.

2.5 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions, and with cap and chain.
- B. Flange: Three (3) inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.6 TEST PLUGS

- A. Manufacturers:
 1. Pete's Plug
- B. 1/4-inch NPT or 1/2-inch NPT brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with:
 1. Neoprene core for temperatures up to 200 degrees F.
- C. Test Kit:
 1. Carrying case, internally padded and fitted containing:
 - a. One 2-1/2 inch 3-1/2-inch diameter pressure gages.
 - b. Two gage adapters with 1/8-inch probes.
 - c. Two 1-1/2-inch dial thermometers.

2.7 BLADDER-TYPE EXPANSION TANKS

- A. Manufacturers:
 1. Wheatly
 2. Bell and Gossett
 3. Wessels
 4. Armstrong
- B. Tank: Welded steel, rated for maximum 125-psig working pressure and 375 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 1. Size: As indicated on Drawings.
- C. Bladder: Heavy duty butyl-FDA approved.

- D. Gage Glass Set: Brass compression stops, guard, and 3/4-inch red line glass, maximum 24 inches length, long enough to cover tank for two (2) inches above bottom to two (2) inches below top.
- E. Quick Connect Air Inlet:
 - 1. Expansion Tank: Inlet tire check valve, manual air vent, tank drain, and pressure relief valve.
- F. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check back flow prevention device, test cocks, strainer, vacuum breaker, and by-pass valves.
- G. Hot Water Heating System:
 - 1. Select expansion tank pressure relief valve at 20 psi maximum.
 - 2. Set pressure reduction valve at select 12 psi.
- H. Chilled Water System:
 - 1. Select expansion tank pressure relief valve at 25 psi maximum.
 - 2. Set pressure reduction valve at 12 psi.
- I. Do not insulate ASME stamp and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.

2.8 AIR VENTS

- A. Manufacturers:
 - 1. Armstrong
 - 2. ITT
 - 3. Sarco
- B. Manual Type: Short vertical sections of two (2) inch diameter pipe to form air chamber, with 1/8-inch brass needle valve at top of chamber.
- C. Float Type:
 - 1. Brass, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
- D. Washer Type:
 - 1. Brass with hygroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring-loaded ball check valve.

2.9 COMBINATION DIRT AND AIR SEPARATORS

- A. Manufacturers:

1. Bell and Gossett
 2. Armstrong
 3. Wessels
 4. Thrush
- B. Dip Tube Fitting: For 125 psig operating pressure; to prevent free air collected in boiler from rising into system.
- C. Dirt & Air Separator: Each separator must be designed with a blow-down valve, skim valve, and automatic air vent. The separator must also utilize in its design a stainless-steel coalescing medium to aid in the separation of air and dirt in the system entrained water. The separator must be constructed in accordance with the latest revision of the ASME Boiler and Pressure Vessel Code and stamped for 125 psi working pressure.

2.10 STRAINERS

- A. Manufacturers:
1. Bell and Gossett
 2. Keckley
 3. Armstrong
 4. Mueller
- B. Size two (2) inch and Smaller:
1. Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32-inch stainless steel perforated screen.
- C. Size 2-1/2 inch to four (4) inch:
1. Flanged iron body for 175 psig working pressure, Y pattern with 3/64-inch stainless steel perforated screen.
- D. Size five (5) inch and Larger:
1. Flanged iron body for 175 psig working pressure, basket pattern with 1/8-inch stainless steel perforated screen.

2.11 FLOW CONTROLS

- A. Manufacturers:
1. Bell and Gossett
 2. Nibco
 3. ITT Hoffman
- B. Construction: Ametal® Brass or bronze body, y-pattern, with union on inlet, and outlet, temperature and pressure test plug on inlet and outlet combination blow-down and back-flush drain.

- C. Calibration: Factory set to control flow within five (5) percent of design flow over entire operating pressure.
- D. Control Mechanism: Stainless steel or nickel-plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring.
- E. Accessories: In-line strainer on inlet and ball valve on outlet.

2.12 RELIEF VALVES

- A. Manufacturers:
 - 1. Bell and Gossett
 - 2. McDonnell-Miller
- B. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated capacities ASME certified and labeled.

2.13 VOLUME TANKS

- A. Manufacturers:
 - 1. Chemline
 - 2. Wessels
 - 3. Wendland
- B. Internal baffle to insure water mixing, ASME pressure rated to 125 psi at 400 degrees F, welded design, provide air vent and drain. Provide with tank supports for vertical installation. Gallon capacity as indicated on drawings. Select diameter as required to maintain an overall installed height less than or equal to the Architectural screen wall (where a screen wall is shown on Architectural drawings).

PART 3 - EXECUTION

3.1 INSTALLATION - THERMOMETERS AND GAGES

- A. Install pressure gages for each pump, locate taps before strainers and on suction and discharge of pump, pipe to gage.
- B. Install gage taps in piping with isolation valves.
- C. Install pressure gages with pulsation dampers. Provide needle valve or ball valve to isolate each gage. Extend nipples to allow clearance from insulation.
- D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Allow clearance from insulation.
- E. Install thermometers in air duct systems on flanges.
- F. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets.

- G. Locate duct-mounted thermometers minimum ten (10) feet downstream of mixing-dampers, coils, or other devices causing air turbulence.
- H. Coil and conceal excess capillary on remote element instruments.
- I. Install static pressure gages to measure across filters and filter banks, (inlet to outlet). On multiple banks, provide manifold and single gage.
- J. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- K. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- L. Adjust gages and thermometers to final angle, clean windows, and lenses, and calibrate to zero.

3.2 INSTALLATION - HYDRONIC PIPING SPECIALTIES

- A. Locate test plugs adjacent to pressure gages and pressure gage taps and as indicated on Drawings.
- B. Install manual air vents at system high points.
- C. For automatic air vents in ceiling spaces or other concealed locations, install vent tubing to nearest drain.
- D. Provide air separator on suction side of system circulation pump and connect to expansion tank.
- E. Provide drain and hose connection with valve on strainer blow down connection.
- F. Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove temporary strainers after cleaning systems.
- G. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps.
- H. Support pump fittings with floor mounted pipe and flange supports.
- I. Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.
- J. Select system relief valve capacity greater than make-up pressure reducing valve capacity. Equipment relief valve capacity not to exceed rating of connected equipment.
- K. Pipe relief valve outlet to nearest floor drain.
- L. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

- M. Insulate all volume tanks to match adjacent intake and discharge piping and jacketing requirements.

END OF SECTION 23 05 19

SECTION 23 05 23 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Globe valves.
 - 2. Ball valves.
 - 3. Plug valves.
 - 4. Butterfly valves.
 - 5. Swing check valves.
 - 6. Spring loaded check valves.
 - 7. Flanges and unions.

1.3 SUBMITTALS

- A. Product Data: Submit Manufacturers catalog information with valve data and ratings for each service.
- B. Welders Certificate: Include welder's certification of compliance with ASME Section IX.
- C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of valves.
- B. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

1.5 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not install valves underground when bedding is wet or frozen.

1.8 WARRANTY

- A. Furnish one (1) year manufacturer warranty for valves.

1.9 EXTRA MATERIALS

- A. Furnish two (2) packing kits for each size valve.

PART 2 - PRODUCTS

2.1 HEATING AND COOLING VALVES

A. Globe Valves:

1. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Nibco
 - b. Crane
 - c. Milwaukee Valve
2. Two (2) inches and Smaller: Construction: Bronze body, bronze trim, union bonnet, rising stem and hand-wheel, inside screw, renewable plug disc and stainless-steel seat ring, solder or threaded ends.
3. Two (2) inches and Larger: Construction: Iron body, bronze trim, bolted bonnet, rising stem, hand-wheel, outside screw and yoke, rotating plug-type disc with renewable seat ring and disc, flanged ends.

B. Ball Valves:

1. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Nibco
 - b. Crane
 - c. Belimo
 - d. Milwaukee Valve
2. Two (2) inches and Smaller: Bronze two-piece body, full port stainless steel ball and stem, Teflon seats and stuffing box ring, lever handle with balancing stops, solder or threaded ends with union.
3. Two (2) inches and Larger: Cast steel body, stainless steel ball and stem, Teflon seat and stuffing box seals, lever handle, or gear drive hand-wheel for sizes ten (10) inches and larger, flanged.
4. Where piping is insulated, ball valves shall be equipped with two (2) inch extended handles of non-thermal conductive material. Also provide a protective sleeve to prevent damage to vapor seal when valve adjustment is made. Memory stops shall be adjustable after insulation is applied.

C. Plug Valves:

1. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:

- a. Nibco
 - b. Crane
2. Two (2) inches and Smaller: Bronze body, bronze tapered plug, full port opening, non-lubricated, Teflon packing, threaded ends. Furnish one plug valve wrench for every ten plug-valves with minimum of one wrench.
 3. Two (2) inches and Larger: Cast iron body and plug, full port opening, pressure lubricated, Teflon packing, flanged ends. Furnish each plug valve with wrench with setscrew.
- D. Butterfly Valves:
1. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Nibco
 - b. Crane
 - c. Dezurik
 - d. Haleson
 - e. Milwaukee Valve
 2. Body: Cast or ductile iron with resilient replaceable EPDM seat, lug ends, extended neck.
 3. Disc: Aluminum bronze.
 4. Operator: 10 position lever handle on sizes two and half (2 1/2) inches to four (4) inches.
 5. Hand-wheel and gear drive on sizes larger than six (6) inches.
- E. Swing Check Valves:
1. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Nibco
 - b. Crane
 - c. Dezurik
 - d. Haleson
 - e. Milwaukee Valve
 2. Two (2) and Smaller: Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder, or threaded ends.
 3. Two and a half (2-1/2) inches and Larger: Iron body, bronze trim, bronze, or bronze faced rotating swing disc, renewable disc and seat, flanged ends or Ductile iron body, 316 stainless steel clapper, synthetic rubber bumper/seal and bonnet.
- F. Spring Loaded Check Valves:
1. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:

- a. Nibco
 - b. Crane
 - c. Dezurik
 - d. Haleson
 - e. Milwaukee Valve
2. Construction: Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer, or threaded lug ends.
 3. Two (2) and Smaller: Red bronze body, 301 stainless steel spring-actuated disc, EPDM o-ring, 300 series stainless steel stem and spring, in-line, lift-type check valve.

2.2 FLANGES AND UNIONS

- A. Unions for Pipe two (2) inches and Smaller:
 1. Ferrous Piping: 150 psig malleable iron, threaded.
 2. Copper Pipe: Bronze, soldered or push-to-connect joints.
- B. Flanges for Pipe two (2) inches and Larger:
 1. Ferrous Piping: 150 psig forged steel, slip-on.
 2. Copper Piping: Bronze.
- C. Gaskets: 1/16-inch-thick preformed neoprene.
- D. Accessories: Stainless Steel bolts, nuts, and washers.
- E. Dielectric Connections:
 1. Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
 2. Waterway fitting with zinc electroplated steel or ductile iron body, threaded or plain end, water impervious isolation barrier.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- B. Install valves with stems upright or horizontal, not inverted.
- C. Install unions downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment, or other apparatus.
- D. Install butterfly or ball shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
- E. Install calibrated-orifice, balancing valves at each branch connection to return main.
- F. Install globe or ball valves for throttling, bypass, or manual flow control services.

- G. Provide spring loaded check valves on discharge of water pumps.
- H. Provide flow controls in water re-circulating systems.
- I. Use only butterfly valves in chilled and condenser water systems for throttling and isolation service.
- J. Use 1 1/4" inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.
- K. Install valves in accessible locations to permit removal of bonnet.
- L. Install valve stems in vertical position. Valve stems installed in horizontal position shall be no less than 30 degrees from horizontal.

END OF SECTION 23 05 23

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe hangers and supports.
 - 2. Hanger rods.
 - 3. Inserts.
 - 4. Flashing.
 - 5. Equipment roof curbs and support rails.
 - 6. Sleeves.
 - 7. Mechanical sleeve seals.
 - 8. Formed steel channel and angle.
 - 9. Equipment bases and supports.
 - 10. Portable roof pipe supports.
- B. Related Sections:
 - 1. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.
 - 2. Division 7 - Thermal and Moisture Protection.

1.3 ACTION SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: For each type of product indicated.
- C. Shop Drawings: Show fabrication and installation details and include calculations for the following: include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Pipe stands.
 - 4. Equipment supports.
- D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- E. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather, construction traffic, dirt, water, chemical, and mechanical damage.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply Firestopping materials when temperature of substrate material and ambient air is below 60 degrees Fahrenheit.
- B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of Firestopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

1.8 WARRANTY

- A. Furnish one (1) year manufacturer warranty for pipe hangers and supports.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Carpenter & Paterson Inc.
 - 2. Flex-Weld, Inc.
 - 3. Globe Pipe Hanger Products Inc.
 - 4. Michigan Hanger Co.
 - 5. B-Line Systems
 - 6. Carpenter & Patterson Inc.
 - 7. Anvil International
 - 8. Piping Technology & Products
 - 9. Grinnell
- B. Hydronic Piping:
 - 1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.

2. Hangers for Cold Pipe Sizes two (2) inches and larger: Carbon steel, adjustable, clevis.
 3. Hangers for Hot Pipe Sizes 2 inches to 4 inches: Carbon steel, adjustable, clevis.
 4. Hangers for Hot Pipe Sizes six (6) inches and larger: Adjustable steel yoke, cast iron roll, double hanger.
 5. Multiple or Trapeze Hangers: Galvanized Steel channels with welded spacers and hanger rods.
 6. Multiple or Trapeze Hangers for Hot Pipe Sizes six (6) inches and larger: Galvanized Steel channels with welded spacers and hanger rods, cast iron rollers.
 7. Wall Support for Pipe Sizes three (3) inches and smaller: Cast iron hooks.
 8. Wall Support for Pipe Sizes four (4) inches and larger: Welded galvanized steel bracket and wrought steel clamp.
 9. Wall Support for Hot Pipe Sizes six (6) inches and larger: Welded galvanized steel bracket and wrought steel clamp with adjustable steel yoke and cast-iron roll.
 10. Vertical Support: galvanized Steel riser clamp.
 11. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 12. Floor Support for Hot Pipe Sizes four (4) Inches and smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 13. Floor Support for Hot Pipe Sizes six (6) inches and larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
 14. Copper Pipe Support: Copper-plated, carbon steel ring.
 15. Hydronic Piping shall not have support brackets welded to hydronic piping.
- C. Roof Mounted Hydronic Piping:
1. Refer to Division 7 –for hanger requirements and approved manufacturers.

2.2 HANGER RODS

- A. Hanger Rods: Hot dipped galvanized, mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 INSERTS

- A. Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FLASHING

- A. In accordance with Division 7 - Thermal and Moisture Protection.

2.5 HOODED CURB

- A. Vent Hoods, Sleeves, Penetration Flashings, and Accessories: Minimum 24-gauge stainless steel.

2.6 EQUIPMENT ROOF CURBS AND SUPPORT RAILS

- A. Equipment roof curbs and support rails must be coordinated with roof type specified under Division 7.
- B. Roof mounted exhaust fans, intake hoods, relief hoods and supply fans shall be set on equipment manufacturers 12" high fabricated welded 18-gauge galvanized steel shell and base, mitered three (3) inch cant if required by roofing type, variable step to match roof insulation, 1-1/2-inch-thick curb insulation, factory installed treated wood nailer. Curb shall set level on roof without the need for blocking.
- C. Roof mounted unitary air conditioning units shall be set on a structural type of curb or equipment support rail. Curb or support rail shall be compatible with required vibration isolation specified under Section 23 05 48. Curb or support rail shall be 12" high welded 18-gauge galvanized steel shell and base, mitered three (3) inch cant if required by roofing type, variable step to match roof insulation, 1-1/2-inch-thick insulation, 3 lb. density, factory installed wood nailer and stainless-steel cap. Curb shall set level on roof without the need for blocking. Field bolted curbs are not acceptable.
- D. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. The Pate Co.
 - b. Custom Curb, Inc.
 - c. Roof Products, Inc.
- E. Refer to Division 7 - Thermal and Moisture Protection for additional requirements.

2.7 SLEEVES

- A. Sleeves for Pipes through fire rated or non-fire rated Floors: 18 gage thick galvanized steel.
- B. Sleeves for Pipes through Rated or Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- C. Sleeves for Round Ductwork: Galvanized steel.
- D. Sleeves for Rectangular Ductwork: Galvanized steel.
- E. Sealant: Refer to Section 07 92 00 - Building Sealants.

2.8 MECHANICAL SLEEVE SEALS

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Thunderline Link-Seal, Inc.
2. NMP Corporation

- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.9 FORMED STEEL CHANNEL AND ANGLE

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Allied Tube & Conduit Corp.
 2. B-Line Systems
 3. Midland Ross Corporation, Electrical Products Division
 4. Unistrut Corp.
- B. Product Description: Galvanized 14 gage thick steel angle and galvanized 12 gage thick steel channel with holes 1-1/2 inches on center. Metal framing system for equipment support.
- C. All channel members and angles shall be hot-dipped galvanized and fabricated from structural grade steel and conform to applicable ASTM specifications.
- D. Structural members to be loaded within manufacturers design limitations and published data.

2.10 EQUIPMENT BASES AND SUPPORTS

- A. In accordance with Division 3 – Concrete
- B. Provide concrete equipment pads, reinforced with 6-inch x 6-inch welded wire mesh, chamfered edges and to be six (6) inches larger than base of equipment. Pad heights as follows:
1. Hot Water Boilers: four (4) inches.
 2. Floor Mounted Pumps: four (4) inches.
 3. Floor Mounted Water Volume Tanks: four (4) inches.
 4. Air Handling Units: four (4) inches.
 5. Water Heaters: four (4) inches.
 6. Water Softeners: four (4) inches.
 7. Air Compressor: four (4) inches.
 8. Floor Mounted Expansion Tanks: four (4) inches.
 9. Floor Mounted chemical feeder tanks: four (4) inches.
 10. Floor Mounted Fans: four (4) inches.
 11. Chillers: four (4) inches.
 12. Condensing Units: four (4) inches.
 13. Heat Pump Units: four (4) inches.
 14. Dust Collectors: four (4) inches.
 15. Plasma cutters: four (4) inches.
- C. Provide vibration isolation in accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

2.11 PORTABLE ROOF PIPE SUPPORTS

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Advanced Support Products (ASP)
 2. PHP System Design
- B. Steel and PVC Piping: Provide rooftop portable pipe supports in 8'-0" maximum intervals for steel, 4'-0" maximum intervals for PVC piping. Roof supports shall be manufactured by Advanced Support Products (ASP), model SS6000P with height adjustable crossbar and clevis hangers. Product specifications:
1. Support Base: 17" circular base, injected molded polypropylene, with 227 sq. in. of surface on bottom, designed for weight displacement.
 2. Base Dimensions: 3"H x 17" in diameter, designed for weight displacement, with molded insert for square tubing and two threaded rod couplings molded in.
 3. Height: Adjustable.
 4. Frame: 1-5/8" x 1-5/8" 12-gauge channel (ASTM A653), hot- dipped galvanized.
 5. Hardware: Corner brackets and leg brackets bolted with 1/2" x 2-1/2" bolt & 1/2" nut; frame bolted to support base with 1/2" x 2-1/2" bolts, 1/2" nuts and washers. Leg brackets and all thread rods, nuts and washers shall be hot- dipped galvanized.
 6. Required accessories: 1/2" threaded rod, clevis hangers, strut clamps and protection pads.
- C. Condensate disposal piping: Provide rooftop portable pipe supports in 8'-0" maximum intervals for steel condensate piping. Roof supports shall be manufactured by Advanced Support Products (ASP), model REC-SA (Rubber EcoCurb) with channel. Product specifications:
1. Bases: 100% recycled Vulcanized Rubber with UV inhibitors.
 2. Frame: 1-5/8" x 1-5/8" 12-gauge channel (ASTM A653), hot- dipped galvanized.
 3. Hardware: 1/2" threaded rods (12" high); 1/2" nuts & washers, hot- dipped galvanized.
 4. Height: Adjustable.
 5. Required accessories: Strut clamps and protection pads.
 6. Hot dipped galvanized threaded rods, nuts and washers.
- D. Protection pads: Provide protection pad sheets between the roof / grade and support system. Protection pads shall not be adhered to either the roof or the support system.
1. Material: Porous rubber.
 2. Weight: 2 lbs.
 3. Dimensions: 18" square X 1/2" thick.

2.12 CROSSOVER BRIDGE WITH STAIRS

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Advanced Support Products (ASP)
 - 2. PHP System Design

- B. Materials:
 - 1. Support Base: 17" circular base, injected molded polypropylene, with 227 sq. in. of surface on bottom, designed for weight displacement.
 - 2. Base Dimensions: 3"H x 17" in diameter, designed for weight displacement, with molded insert for square tubing and two threaded rod couplings molded in.
 - 3. Height: Adjustable.
 - 4. Frame: 4"x4" angle iron (ASTM 572), grade 50 and 1" x 3/16" bar grating, 19-w-4 carbon steel, ends capped with 1" x 3/16" steel flat bar, welded, hot- dipped galvanized.
 - 5. Handrails: 1-1/2" schedule 40 pipe, welded; handrails fastened to ramp by flat plate connection; all steel ASTM 572, grade 50, hot- dipped after fabrication.
 - 6. Hardware: Grating clips with 1-1/2" self tapping screws, 1/2" x 1-1/2" bolts and 1/2" nuts; hot-dipped galvanized after fabrication.
 - 7. Accessories: 1/2" threaded rod, clevis hangers, strut clamps and protection pads.

- C. Roof protection pads: Provide roof protection pads sheets between the roof and support system. Roof protection pads shall not be adhered to either the roof or the support system.
 - 1. Material: Porous rubber.
 - 2. Weight: 2 lbs.
 - 3. Dimensions: 18" square X 1/2" thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive sleeves.
- B. Verify openings are ready to receive Firestopping/Firesafing.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of Firestopping material.
- B. Remove incompatible materials affecting bond.

- C. Install damming materials to arrest liquid material leakage.
- D. Obtain permission from Architect/Engineer before using powder-actuated anchors.
- E. Do not drill or cut structural members.
- F. Obtain permission from Architect/Engineer before drilling or cutting structural members.

3.3 STRUCTURAL STEEL

- A. All structural steel used to fabricate supports shall conform to ASTM A36.

3.4 CUTTING AND PATCHING

- A. In accordance with Division 7 - Thermal and Moisture Protection

3.5 FIRESTOPPING

- A. In accordance with Division 7 - Thermal and Moisture Protection.

3.6 FIRESTOPPING ACCESSORIES

- A. In accordance with Division 7 - Thermal and Moisture Protection.

3.7 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe four (4) inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.8 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with ASME B31.1
- B. Support horizontal piping as scheduled.
- C. Install hangers with minimum 1/2-inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2-inch minimum vertical adjustment.
- F. Support vertical piping at every other floor.
- G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.

- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Prime coat exposed steel hangers and supports.
- L. Provide clearance in hangers and from structure and other equipment for installation of pipe insulation. Refer to Section 23 07 19 - HVAC Piping Insulation.

3.9 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum four (4) inches thick and extending six (6) inches beyond supported equipment.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members or formed steel channel. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.10 INSTALLATION - FLASHING

- A. Provide flexible flashing and metal Counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Provide curbs for mechanical roof installations 12 inches minimum above roofing surface. Flash and counter-flash with sheet metal; seal watertight. Attach Counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.
- C. Adjust storm collars tight to pipe with bolts, caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.
- D. Refer to Division 7 - Thermal and Moisture Protection for additional requirements.

3.11 INSTALLATION - SLEEVES

- A. Provide sleeves at all piping and ductwork penetrations of interior walls and slabs. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors two (2) inches above finished floor level. Caulk sleeves.
- E. Extend sleeves through walls two (2) inches each side.
- F. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with Firestopping insulation and caulk. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

- G. Install stainless steel escutcheons at finished surfaces.

3.12 INSTALLATION - FIRESTOPPING

- A. Install material at all fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items.
- B. Apply primer where recommended by manufacturer for type of Firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply Firestopping material in sufficient thickness to achieve required fire and smoke rating.
- D. Compress fibered material to maximum 40 percent of its uncompressed size.
- E. Fire Rated Surface:
 - 1. Seal opening at floor, wall, and partition as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
- F. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated wall and partition floor as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - 2. Install escutcheons, floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - 3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
 - 4. Interior partitions: Seal pipe penetrations. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.13 INSTALLATION - ACCESS DOORS

- A. Access Doors: Provide access doors as required for access to equipment, valves, controls, cleanouts, and other apparatus where concealed. Access doors shall have concealed hinges and screwdriver cam locks. Minimum size to be 12 inches x 12 inches

in walls only for hand access and 24 inches x 24 inches minimum for all ceilings for maintenance access.

- B. All access doors located in wet areas such as restrooms, locker rooms, shower rooms, kitchen and any other wet areas shall be constructed of stainless steel.
- C. Access Doors:
 - 1. Plastic Surfaces: Milcor Style K.
 - 2. Ceramic Tile Surface: Milcor Style M.
 - 3. Drywall Surfaces: Milcor Style DW.
 - 4. Install panels only in locations approved by the Architect and with trim styles and color coordinated with surface to be installed in.

3.14 INSTALLATION – EQUIPMENT REQUIRING ROOF PORTALBE BASES

- A. Verify that roof surface is smooth and clean to extent needed to receive material.
- B. Clean surfaces to receive 17" circular bases removing any loose gravel and foreign matter before setting 17" circular bases.
- C. Provide protective pad conforming to the new or existing roof manufacturer's system under each 17" circular bases. Do not adhere to the roof system or to circular bases.

3.15 FIELD QUALITY CONTROL

- A. Inspect installed Firestopping for compliance with specifications and submitted schedule.

3.16 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.17 PROTECTION OF FINISHED WORK

- A. Protect adjacent surfaces from damage by material installation.

3.18 PIPE HANGERS

- A. Minimum hanger rod size shall be ½".
- B. Maximum hanger rod spacing shall not exceed 10'-0" on center for pipe sizes 2" and above. Do not exceed 7'-0" hanger spacing for pipes sizes less than 2" diameter.
- C. For trapeze supports provide a minimum of (2) two ½" hanger rods at each end of trapeze for a total of (4) four for pipes 10" or larger.
- D. Beam clamps are not acceptable.

END OF SECTION 23 05 29

SECTION 23 05 48 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Vibration isolation for building mechanical systems.
- B. Related Sections:
 - 1. Section - 23 05 16 - Expansion Fittings and Loops For HVAC Piping
 - 2. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- C. Mason Industries model numbers are listed for identification only.
- D. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Mason Industries
 - 2. Kinetics Noise Control
 - 3. Amber / Booth
 - 4. VMC
 - 5. Vibration Eliminator

1.3 PERFORMANCE REQUIREMENTS

- A. It is the intent of this specification to provide vibration isolation supports for all equipment, piping and ductwork as may be required to prevent transmission of vibration to the building structure. It will be the Contractor's responsibility to select and install vibration isolators which will enable the noise criteria standards to be met, to the extent that the noise can be controlled by the vibration isolators.
- B. All vibration isolation devices, including auxiliary steel bases and pouring forms, shall be designed and furnished by a single manufacturer or supplier.
- C. Unless otherwise noted or scheduled, spring type vibration isolators shall be used for all equipment driven by motors of 0.5 HP and larger. Deflections as tabulated are minimums and it shall be the responsibility of the isolation manufacturer to determine the amount of spring deflection required for each isolator to achieve optimum performance in order to prevent the transmission of objectionable vibrations and meet the noise criteria referenced herein.
- D. Unless otherwise noted, equipment driven by motors 0.25 HP and smaller shall be isolated by means of Type ND elastomeric mounts or Type HD elastomeric hangers properly sized for 0.35-inch deflection.
- E. All elastomeric isolators shall be of high-quality synthetic rubber with anti-ozone and anti-oxidant additives.

- F. Design and treat vibration isolators for resistance to corrosion. Furnish phosphatized steel components with epoxy powder paint coating. Components exposed to the weather shall be epoxy powder paint coated or hot-dipped galvanized. Furnish zinc electroplated nuts, bolts, and washers. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer.
- G. Isolators for equipment installed outdoors shall be designed to provide adequate restraint due to normal wind conditions and to withstand wind loads of 30 lbs/sq.ft. Wind loading shall be applied to all exposed surface of the isolated equipment in order to identify worst case load.
- H. Air handling equipment subjected to excessive horizontal air thrust operating at three (3) inches S.P. shall be furnished with Type WBI/WBD isolated thrust resisters to limit displacement to 1/4 inch.
- I. Height savings brackets used with isolators having 2.5-inch deflection or greater shall be of the precompression type to limit exposed bolt length.
- J. All spring isolators shall be completely stable in operation and shall be designed for not less than 50 percent reserve deflection beyond actual operating conditions. All spring isolators must be completely stable in operation and have a Kx/Ky ratio of at least 1:1.
- K. All isolation materials and flexible connectors shall be of the same manufacturer and shall be selected and certified using published or factory certified data. Any variance or non-compliance with these specification requirements shall be corrected by the contractor at no additional cost to the Owner. Manufacturer may purchase other manufactured products in order to meet this specification and shall guarantee outsourced product as a single point of responsibility. Outsourced products must be identified as such in the submittal for approval.
- L. The contractor and manufacturer of the isolation and equipment shall refer to the isolator schedule which lists isolator types and isolator deflections.
- M. Deflection table is based on maintaining rooms at the following maximum sound levels, in Noise Criteria (NC) as defined by ASHRAE and ANSI S1.8.
 - 1. Offices
Executive: 30
Conference rooms: 30
Private: 35
Open-plan areas: 35
Computer/business machine areas: 40
Public circulation: 40
 - 2. Schools
Lecture and classrooms: 30
Open-plan classrooms: 35
 - 3. Libraries: 25
 - 4. Theaters
Theater: 25
Stage house: 25
Trap room: 25
Orchestra pit: 25
Rehearsal rooms: 25

Teaching studios: 30
Practice rooms: 30
Ensemble rooms: 30
Shop: 45

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate assembly, materials, thickness, dimensional data, and layout as well as connection details.
- C. Product Data: Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating materials and dimensional data. All steel bases and concrete inertia bases shall be completely detailed. Include clearly outlined procedures for installing and adjusting the isolators.
- D. Design Data: Submit calculations indicating maximum room sound levels are not exceeded.
- E. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.
- F. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.
- G. Manufacturer's Field Reports: Indicate vibration isolation installation is complete and in accordance with instructions. Provide a copy of field report to Architect/Engineer.

1.5 QUALITY ASSURANCE

- A. The vibration isolation manufacturer, or qualified representative, shall be responsible for providing such supervision as may be necessary to assure correct installation and adjustment of the isolators. Vibration isolation manufacturer shall also inspect vibration isolation in units with factory provided isolation in order to confirm scheduled deflection and isolator type is in accordance with this specification. Upon completion of the installation and after the system is put into operation, the manufacturer, or representative, shall make a final inspection and submit his report to the Architect and Engineer in writing certifying the correctness of installation and compliance is in accordance approved submittal data.

1.6 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATOR TYPES

All vibration isolators described in this section shall be the product of a single manufacturer. Submittals and certification sheets shall be in accordance with Specification 1.3 of this section.

- A. Type WSW: Two layers of 3/8-inch thick neoprene pad consisting of square waffle modules separated horizontally by a 16-gauge galvanized shim. Where the load bearing area of the equipment is not the same size/shape as the load bearing area/shape of the

pad, load distribution plates, minimum ¼" thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized. Pads shall be sized for approximate deflection of 0.12 inch to 0.16 inch.

- B. Type ND: Neoprene mountings shall have minimum static deflection of 0.35 inch. All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Bolt holes on the bottom and a tapped hole with a mounting bolt and washer shall be provided. Steel rails shall be used above the mountings under equipment such as small vent sets to compensate for the overhang. Where the load bearing area of the equipment or support structure is not the same size/shape as the load bearing area/shape of the pad, load distribution plates, minimum ¼" thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized.
- C. Type SLF: Spring isolators shall be free-standing and laterally stable without any housing and complete with a steel-washer-reinforced molded neoprene cup of 1/4-inch neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have minimum additional travel to solid equal to 50 percent of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height.
- D. Type SLR: Restrained spring mountings shall have an SLF mounting as described in Specification 2.1 C, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position under outdoor equipment, there must be an internal isolation pad in addition to the friction pad on bottom.
- E. Type HD: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch-thick neoprene element. The neoprene element shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers.
- F. Type 30N: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch-thick neoprene elements at the top and a steel spring as described in 2.1 C, seated in a steel-washer-reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers, nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30-degree arc from side to side before contacting the cup bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30-degree capability.
- G. Type PC30N: Hangers shall be as described in Specification 2.1 F, but they shall be precompressed and locked at the rated deflection by means of a resilient seismic up stop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30-degree capability.

- H. Type WBI/WBD: Horizontal thrust restraints shall consist of a spring element in series with a neoprene molded cup, as described in paragraph 2.1 C, with the same deflection as specified for the mountings or hangers supporting the unit. The spring element shall be designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 1/4-inch movement at start and stop. The assembly shall be furnished with a rod and angle brackets for attachment to both the equipment and the ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrical on either side of the unit.
- I. Type SLR-MT: Restrained air spring mountings shall be manufactured with upper and lower steel sections connected by a replaceable flexible DuPont Kevlar reinforced neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of 3 Hz. Air springs shall be designed for a burst pressure that is a minimum of three times the published maximum operating pressure. Restrained air springs shall be within a rigid housing that includes vertical limit stops to prevent air spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch {12mm} shall be maintained around restraining bolts and between the housing and the air springs so as not to interfere with the air spring action. Limit stops shall be out of contact during normal operation. Air spring systems shall be connected to a supplementary air supply compressor (supplied with the air spring system) through a Mason Industries air spring control panel and equipped with three leveling valves to maintain level within plus or minus 0.125". Air spring mounts are to be located between the supporting steel and the roof or the grillage and dunnage as shown on the drawings when there is no provision for direct mounting. Submittals shall include natural frequency, load and damping tests performed by an independent lab or acoustician.

2.3 FLEXIBLE PIPE CONNECTIONS (CHILLERS AND BASE-MOUNTED PUMPS)

- A. Type SFDEJ, SFEJ, SFDCR or SFU with Control Rods CR (required): Flanged and threaded rubber flexible joints shall be peroxide cured EPDM throughout with Kevlar tire cord reinforcement. Substitutions must have certifiable equal or superior characteristics. The raised face rubber flanges must encase solid steel rings to prevent pull out. Flexible cable wire is not acceptable. Sizes 1-1/2" through 14" shall have a ductile iron external ring between the two spheres. Sizes 16" through 24" may be single sphere. Sizes 3/4" through 2" may have one sphere, bolted threaded flange assemblies and cable retention. Minimum ratings through 14" shall be 250psi at 170°F and 215psi at 250°F, 16" through 24" 180psi at 170°F and 150psi at 250°F. Higher published rated connectors may be used where required. Safety factors shall be a minimum of 3/1. All flexible joints must be factory tested to 150% of maximum pressure for 12 minutes before shipment. The piping gap shall be equal to the length of the flexible joint under pressure. Control rods passing through 1/2" thick Neoprene washer bushings large enough to take the thrust at 1000psi of surface area may be used on unanchored piping where the manufacturer determines the condition exceeds the flexible joint rating without them. Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- B. Isolators shall be installed as recommended by the manufacturer. Isolate all mechanical equipment 0.5 hp and over per the isolation schedule and these specifications.

3.2 PIPING ISOLATION

- A. Horizontal Pipe Isolation: All pumped water, pumped condensate, and refrigerant piping size 1-1/4 inch and larger within mechanical rooms and on pipe size 2 inch and larger outside mechanical rooms shall be isolated. Outside equipment rooms this piping shall be isolated for the greater of 50 feet or 100 pipe diameters from externally isolated equipment. For the first 3 support locations from externally isolated equipment provide Type 30N hangers or Type SLF floor mounts with the same deflection as equipment isolators. All other piping within the equipment rooms shall be isolated with the same specification isolators with a 1" inch minimum deflection. Install piping hangers at regular intervals according to the pipe hanger schedule. Where floor supports are required, provide sufficient spring capacity to absorb expansion and contraction of piping, and yet to permit piping to function as a floating system. Size hangers for 200 percent rated load. Coordinate selection of piping supports with equipment supports to accommodate expansion and contraction without creating excessive stresses at equipment connections.
- B. Pipe Riser Isolation: All vertical pipe risers 1-1/4 inch and larger, where specifically shown and detailed on riser drawings shall be fully supported by Type SW SLF isolators with brackets. Refer to details on Drawings. Steel spring deflection shall be 3/4 inch minimum. In locations where added deflection is required due to pipe expansion/contraction, the spring deflection shall be a minimum of 4 times the anticipated deflection change. Springs shall be selected to keep the riser in tension. Wall sleeves for take-offs from riser shall be sized for insulation O.D. plus two times the anticipated movement to prevent binding. Provide Type SWS wall sleeves. In addition to submittal data requirements previously outlined, riser diagrams and calculations shall be submitted for approval. Calculations must show anticipated expansion and contraction at each support point, initial and final loads on the building structure, and spring deflection changes. Submittal data shall include certification that the piping system has been examined for excessive stresses and that none will exist in the design proposed.

3.3 INSTALLATION

- A. Comply with manufacturer's instructions for the installation and load application of vibration isolation materials and products. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation or shipment.
- B. Locate isolation hangers as near the overhead support structure as possible.
- C. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.
- D. Install isolated inertia base frames and steel bases on isolator units as indicated so that a minimum of one (1) inch clearance below base will result when supported equipment has been installed and loaded for operation.
- E. Install Work in accordance with ASME B31.9.
- F. Install flexible pipe connectors to equipment supported by vibration isolation. Provide line size flexible connectors.
- G. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end.
- H. Refer to Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping.

- I. Contractor shall install load distribution plates provided by vibration isolation manufacturer on WSW type isolators. Plates shall be aligned with isolation pad.

EQUIPMENT ISOLATION SCHEDULE						
EQUIPMENT	LOCATION					
	ELEVATED STRUCTURE			SLAB ON GRADE		
	ISOLAT OR TYPE	MINIMUM DEFLECT ION (Inches)	BASE (1) TYPE	ISOLAT OR TYPE	MINIMUM DEFLECT ION (Inches)	BASE (1) TYPE
AIR HANDLING UNITS (NOTE 2) FLOOR MOUNTED TO 15 HP 20 HP & OVER SUSPENDED UP TO 15 HP 20 HP & OVER HIGH PRESSURE FAN SECTION (NOTE 1) UP TO 30 HP 40 HP & OVER	SLF SLF 30N PC30N SLF/W BI SLF/W BI	0.75 1.5 1 1.75 1.5 2.5	- - - - RBMK RBMK	SLF SLF 30N PC30N SLF/W BI SLF/W BI	0.75 0.75 1 1 0.75 1.5	- - - - RBMK RBMK
CENTRIFUGAL FANS CL. I & II UP TO 54-1/2" W.D. Up to 15 HP 20-50 HP 60 HP & OVER CL. I & II 60" W.D. & OVER/ALL CL. III FANS UP TO 15 HP 20-50 HP 60 HP & OVER	SLF SLF SLF SLF/W BI SLF/W BI SLF/W BI	0.75 1.5 2.5 1.5 2.5 2.5	WF RBMK RBMK RBMK RBMK RBMK	SLF SLF SLF SLF/W BI SLF/W BI SLF/W BI	0.75 0.75 1.5 0.75 1.5 1.5	WF WF WF RBMK RBMK RBMK
AXIAL-FLOW FANS (NOTE 1) FLOOR MTD. UP TO 15 HP 20 HP & OVER SUSPENDED (NOTE 1) UP TO 15 HP 20 HP & OVER	SLF SLF 30N PC30N	0.75 1.5 1 1.75	- - - WF	SLF SLF 30N PC30N	0.75 0.75 1 1.5	- - - -
VENT (UTILITY SETS) FLOOR MTD. SUSPENDED	SLF 30N	0.75 1	- -	SLF 30N	0.75 0.75	- -
CABINET FANS, FAN SECTIONS (NOTE 1) CL. I & II UP TO 54-1/2" W.D. Up to 15 HP 20-50 HP SUSPENDED UP TO 15 HP	SLF SLF 30N PC30N	0.75 1.5 1 1.75	- - - -	SLF SLF 30N 30N	0.75 0.75 0.75 1.75	- - - -

20 HP & OVER							
PUMPS							
FLOOR MTD. UP TO 60 HP	SLF	1.50	RBMK	SLF	0.75	RBMK	
FLOOR MTD. 75 HP AND LARGER	SLF	2.50	RBMK	SLF	0.75	RBMK	
SUSPENDED INLINE	PC30N	1.75	-	PC30N	1.75	-	
REFRIGERATION UNITS							
RECIPROCATING	SLF	1.5	RBMK	SLF	0.75	RBMK	
COMPRSSORS	SLR/IC	1.5	-	SLF	0.75	-	
RECIPROCATING COND. UNITS & CHILLERS	S	1.5	-	WSW	0.15	-	
HERMETIC	SLR	1.5	RBMK	WSW	0.15	-	
CENTRIFUGALS	SLF	0.75	-	WSW	0.15	-	
OPEN CENTRIFUGALS	SLR/IC						
ABSORPTION MACHINES	S						
AIR COMPRESSORS							
TANK TYPE (HORIZONTAL TANK)	SLF	1.5	-	SLF	0.75	-	
TANK TYPE (VERTICAL TANK)	SLF	1.5	-	SLF	0.75	-	
COOLING TOWERS & CLOSED-CIRCUIT COOLERS							
UP TO 500 TONS	SLR	0.75	(1)	WSW	0.15	-	
OVER 500 TONS	SLR	2.5	(1)	WSW	0.15	-	
AIR COOLED CONDENSERS							
UP TO 50 TONS	SLR	0.75	(1)	WSW	0.15	-	
OVER 50 TONS	SLR	1.5	(1)	WSW	0.15	-	
ROOFTOP AIR CONDITIONING UNITS							
REQUIRING WEATHER SEAL	SLF	0.75	RSC/C	-	-	-	
UP TO 5000 CFM (12 TON)	SLR	1.5	MAB	-	-	-	
OVER 5000 CFM (12 TON)	SLR	1.5	RSC/C	-	-	-	
OTHER TYPES	SLR	1.5	MAB	-	-	-	
UP TO 25 TONS			(1)				
OVER 25 TONS			(1)				
BOILER (PACKAGE TYPE)							
ALL SIZES	SLR	0.75		WSW	0.15	-	
ENGINE DRIVEN GENERATORS							
UP TO 60 HP	SLR	1.5	RBMK	SLR	0.75	-	
75 HO & OVER	SLR	2.5	RBMK	SLR	0.75	-	

Notes:

1. Provide steel base type WF if equipment requires base frame or does not include integral base rail for vibration isolation.
2. Provide WSW isolator type with load distribution plate for floor mounted AHU's that are internally isolated. Isolation deflection and type specified refers to factory isolation requirements.

END OF SECTION 23 05 48

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Tags.
 - 3. Stencils.
 - 4. Pipe markers.
 - 5. Ceiling tacks.
 - 6. Labels.
 - 7. Lockout devices.
 - 8. Pipe painting (if required)
- B. Related Sections:
 - 1. Section 09 91 00 - Painting and Staining.
- C. Color scheme for identification must be coordinated with district standards. Color scheme specified is bases of design if required for project. Contractor shall confirm painting requirements with Architect/District.

1.3 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME A13.1 - Scheme for the Identification of Piping Systems.
 - 2. District Standards for identification and color scheme.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturers catalog literature for each product required.
- B. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- E. Identify painting requirements as directed by Architect/District. Contractor to confirm if painting of piping is required for project. Contractor shall provide primer coat on un-insulated outdoor condenser water piping as a minimum.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.6 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.
- B. Conform to ANSI / OSHA Pipe Marking Specifications.
- C. Specification is not limited to manufacturers listed. Substitutions are allowed in accordance with Division 1 - General Requirements and Division 23, Section 23 05 00 - Common Work Results for HVAC.

1.7 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

PART 2 - PRODUCTS

2.1 NAMEPLATES

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Craftmark Identification Systems.
 - 2. Safety Sign Co.
 - 3. Seton Identification Products.
 - 4. Almetek Industries.
 - 5. Marking Services, INC. (MSI).
- B. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.2 TAGS

- A. Plastic Tags:
 - 1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 - 2. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches.
- B. Metal Tags:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 2. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with finished edges.
- C. Information Tags:
1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 2. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches with grommet and self-locking nylon ties.
- D. Tag Chart: Typewritten letter size list of applied tags and location in plastic laminated chart to indicate valve make, size, model, and service.

2.3 STENCILS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Craftmark Identification Systems.
 2. Safety Sign Co.
 3. Seton Identification Products.
 4. Almetek Industries.
 5. Marking Services, INC. (MSI).
- B. Stencils: With clean cut symbols and letters of following size:
1. Up to two (2) inches Outside Diameter of Insulation or Pipe: 1/2-inch-high letters.
 2. 2-1/2 to six (6) inches Outside Diameter of Insulation or Pipe: one (1) inch high letters.
 3. Over six (6) inches Outside Diameter of Insulation or Pipe: 1-3/4 inches high letters.
 4. Ductwork and Equipment: 1-3/4 inches high letters.
- C. Stencil Paint: As specified in Section 09 91 00 Paintings and Staining, semi-gloss enamel, colors, and lettering size in conformance with ASME A13.1.

2.4 PIPE MARKERS

- A. Plastic Pipe Markers:
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
23 05 53 - 3

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.
- B. Plastic Tape Pipe Markers:
1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 2. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- C. Plastic Underground Pipe Markers:
1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 2. Bright colored continuously printed plastic ribbon tape, minimum six (6) inches wide by 4 mil thick, manufactured for direct burial service.

2.5 CEILING TACKS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Craftmark Identification Systems.
 2. Safety Sign Co.
 3. Seton Identification Products.
 4. Almetek Industries.
 5. Marking Services, INC. (MSI).
- B. Description: Steel with 3/4-inch diameter color-coded head.

2.6 LABELS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

1. Craftmark Identification Systems.
2. Safety Sign Co.
3. Seton Identification Products.
4. Almetek Industries.
5. Marking Services, INC. (MSI).

- B. Description: Laminated Mylar, size 1.9 x 0.75 inches, adhesive backed with printed identification and bar code.

2.7 LOCKOUT DEVICES

- A. Lockout Hasps:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
2. Reinforced nylon hasp with erasable label surface; size minimum 7-1/4 x 3 inches.

- B. Valve Lockout Devices:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
2. Nylon device preventing access to valve operator, accepting lock shackle.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 91 00 Paintings and Staining for stencil painting.

3.2 INSTALLATION

- A. Apply stencil painting in accordance with Section 09 91 00 Paintings and Staining.
- B. Install identifying devices after completion of coverings and painting.
- C. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

- D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
- E. Install tags using corrosion resistant chain or 4 ply 0.018 smooth copper wire. Tags shall be numerically sequenced with all valves of each system type grouped together.
- F. Install underground plastic pipe markers six (6) to eight (8) inches below finished grade, directly above buried pipe.
- G. All exterior visible piping shall be identified with UV and acid resistant outdoor pipe markers.
- H. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Identify in-line pumps and other small devices with tags.
- I. Identify control panels and major control components outside panels with plastic nameplates.
- J. Identify air terminal units and radiator valves with numbered tags.
- K. Tag automatic controls, instruments, and relays. Key to control schematic.
- L. Identify insulated piping, concealed, or exposed indoor with plastic tape pipe markers. Use tags on piping 3/4-inch diameter and smaller. Use plastic pipe UV protected markers on exterior piping. Identify service and flow direction. Install in clear view and align with axis of piping. Locate identification at every 20 feet on center for straight runs including risers and drops. Locate identification adjacent to each valve and tee, at each side of penetration of wall or enclosure, and at each obstruction.
- M. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment. Coordinate with Architect.
- N. Identify un-insulated piping with plastic pipe markers. Locate identification at every 20 feet on center for straight runs including risers and drops. Locate identification adjacent to each valve and tee, at each side of penetration of wall or enclosure, and at each obstruction.

3.3 IDENTIFICATION SCHEDULE

- A. Markers shall be colored as indicated below per ANSI/OSHA Standards OR as specified in District Standards:

SYSTEM	COLOR	LEGEND
Chilled Water	Green	Chilled Water Supply Chilled Water Return
Domestic Water	Green	Domestic Water
Domestic Hot Water Supply	Yellow	Domestic Hot Water Supply
Domestic Hot Water Return	Yellow	Domestic Hot Water Return
Fire Protection	Red	Fire Protection

Automatic Sprinkler	Red	Fire Sprinkler
Gas	Yellow	Natural Gas
Condenser Water	Green	Condenser Water Supply
		Condenser Water Return

B. PIPE PAINTING:

1. All piping exposed to view in conditioned spaces shall be painted as indicated or as directed by the Architect in the field. Confirm all color selections and painting requirements with Architect/District prior to installation.
2. The entire fire protection piping system shall be painted red.
3. All outdoor un-insulated piping shall be painted with primer as a minimum.
4. All piping located in mechanical rooms and outdoor piping shall be painted as indicated in Painting Schedule. Painting requirement must be confirmed by contractor.

C. PAINTING SCHEDULE

SYSTEM	COLOR
Storm Sewer	White
Sanitary Sewer Waste and Vent	Light Gray
Domestic Cold Water	Dark Blue
Domestic Hot Water Supply and Return	Orange
Condenser Water Supply and Return	Light Green
Gas	Yellow
Chilled Water Supply and Return	Light Blue
Heating Hot Water supply and Return	Reddish Orange

END OF SECTION 23 05 53

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Testing, adjusting, and balancing of air systems.
 - 2. Testing, adjusting, and balancing of Hydronic piping systems
 - 3. Testing, adjusting, and balancing of refrigerating systems.
 - 4. Measurement of final operating condition of HVAC systems.
 - 5. Sound measurement of equipment operating conditions.
 - 6. Vibration measurement of equipment operating conditions.
- B. Related Sections:
 - 1. Sequences of operation for HVAC equipment as scheduled on Drawings.
- C. Testing, Adjusting and Balancing (TAB) contractor shall bid work specified under this section direct to Owner. TAB contractor shall not be hired by general contractor or any sub-contractor.
- D. Mechanical contractor is responsible for coordinating work with the TAB Contractor. Mechanical contractor requirements are specified herein.
- E. TAB Contractors:
 - 1. Engineered Air Balance
 - 2. Precision Air

1.3 REFERENCES

- A. Associated Air Balance Council:
 - 1. AABC MN-1 - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
- C. Natural Environmental Balancing Bureau:
 - 1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

1.4 SUBMITTALS

- A. Agency Data: Submit proof that the proposed testing, adjusting, and balancing agency meets the qualifications specified below.
- B. Engineer and Technicians Data: Submit proof that the Test and Balance Engineer assigned to supervise the procedures, and the technicians proposed to perform the procedures meet the qualifications specified below.
- C. Procedures and Agenda: Submit a synopsis of the testing, adjusting and balancing procedures and agenda proposed to be used for this project.
- D. Sample Forms: Submit sample forms, if other than those standard forms, if other than those standard forms prepared by the Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB) are proposed.
- E. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Follow the procedures and format specified below:
 1. Draft Reports: Upon completion of testing, adjusting and balancing procedures, prepare draft reports on the approved forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit two (2) complete sets of draft reports. Only one (1) complete set of draft reports will be returned.
 2. Final Report: Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit two (2) complete sets of final reports.
 3. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binder. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs.
 - a. General Information and Summary
 - b. Air Systems
 - c. Refrigerant Systems
 - d. Temperature Control Systems
 - e. Special Systems.
 4. Report Contents: Provide the following minimum information, forms and data:
 - a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, the Company, Engineer, and Project. Include addresses and contact names and telephone numbers. Also include a certification sheet containing the seal name address, telephone

number, and signature of the Certified Test and Balance Engineer. Include in this division a listing of the instrumentations used for the procedures along with the proof of calibration.

- b. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the AABC or NEBB, for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.
- c. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six (6) months prior to starting the project.

1.5 QUALITY ASSURANCE

- A. Test and Balance Engineer's Qualifications: A Professional Engineers registered in the State in which the services are to be performed and having at least three (3) years of successful testing, adjusting, and balancing experience on projects with testing and balancing requirements similar to those required for this project.
- B. Agency Qualifications:
 - 1. Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to the test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications and recording and reporting the results.
 - 2. The independent testing, adjusting, and balancing agency certified by National Environmental Balancing Bureau (NEBB) or by the Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project, and having at least one Professional Engineer registered in the State in which the services are to be performed, certified by NEBB or AABC as a Test and Balance Engineer.
- C. Codes and Standards
 - 1. NEBB: "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
 - 2. AABC: "National Standards for Total System Balance."
 - 3. American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) ASHRAE Handbook, 1999 HVAC Applications Volume, Chapter 36, Testing, Adjusting, and Balancing.
- D. Pre-Balancing Conference: Prior to beginning of testing, adjusting, and balancing procedures, schedule and conduct a conference with the Engineer and representatives of installers of the mechanical systems. The objective of the conference is final coordination and verification of the system operation and readiness for testing, adjusting, and balancing.

1.6 PROJECT CONDITIONS

- A. Systems Operation: Systems shall be fully operational prior to beginning procedures.

1.7 SEQUENCING AND SCHEDULING

- A. Test, adjust, and balance the air systems before hydronic, steam, and refrigerant systems.
- B. Test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within five (5) degrees Fahrenheit wet bulb temperature of maximum summer design condition, and within ten (10) degrees Fahrenheit dry bulb temperature of minimum winter design condition. Take final temperature reading during seasonal operation.
- C. Notice: Provide minimum 7 days advanced notice for each test. Include scheduled test dates and times.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 SERVICES OF THE MECHANICAL CONTRACTOR

- A. Examine the contract documents to become familiar with Project requirements and to discover conditions in systems design that may preclude proper TAB of systems and equipment.
- B. Examine the approved submittals for HVAC systems and equipment.
- C. Verify systems are complete and operable before commencing work. Verify the following:
 - 1. Systems are started and operating in safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed, and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
 - 12. Hydronic systems are flushed, filled, and vented.
 - 13. Pumps are rotating correctly.
 - 14. Proper strainer baskets are clean and in place or in normal position.
 - 15. Service and balancing valves are open.
 - 16. Re-sheave

- D. Contractor shall provide all volume dampers, balancing dampers, balancing valves, test ports and Pete's plugs as required by the Testing and Balancing Firm. Contractor shall furnish a set of sheet metal shop drawings and HVAC piping drawings to the Testing and Balancing Firm during the submittal phase and incorporate the Testing and Balancing Firm's mark-ups and requests into the project. Contractor shall provide all required equipment to facilitate Testing and Balancing Firm's work. This coordination shall be included in the Contractor's base bid price.
- E. Provide, correct, repair or replace deficient items or conditions found during the testing and balancing.
- F. Provide replacement sheaves as directed by TAB Contractor to achieve scheduled air volumes.
- G. For motors with a variable frequency drive, contractor shall provide belt and sheave adjustment such that units deliver their design cfm when speed drive is at 60 hertz.

3.2 SERVICES OF THE TESTING AND BALANCING CONTRACTOR

- A. Furnish instruments required for testing, adjusting, and balancing operations.
- B. Make instruments available to Architect/Engineer to facilitate spot checks during testing.
- C. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 INSTALLATION TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust fans and Equipment with Fans: +/- 5%
 - 2. Air Outlets and Inlets: +/- 5%
 - 3. Heating-Water Flow Rate: +/- 5%
 - 4. Cooling-Water Flow Rate: +/- 5%

3.4 ADJUSTING

- A. Verify recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

- C. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.
- D. Report defects and deficiencies noted during performance of services, preventing system balance.
- E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities.
- B. Make air quantity measurements in main ducts by Pitot tube traverse of entire cross-sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.
- E. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.
- F. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.05 inches positive static pressure near building entries in clean rooms.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.

- a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 6. Obtain approval from construction manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

3. Re-measure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 PROCEDURES FOR DUAL-DUCT SYSTEMS

- A. Verify that the cooling coil is capable of full-system airflow and set mixing boxes at full-cold airflow position for fan volume.
- B. Measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.
1. If insufficient static pressure exists, increase airflow at the fan.
- C. Test and adjust the constant-volume mixing boxes as follows:
1. Verify both hot and cold operations by adjusting the thermostat and observing changes in air temperature and volume.
 2. Verify sufficient inlet static pressure before making volume adjustments.
 3. Adjust mixing boxes to indicated airflows within specified tolerances. Measure airflow by Pitot-tube traverse readings or by measuring static pressure at mixing-box taps if provided by mixing-box manufacturer.
- D. Do not over pressurize ducts.
- E. Re-measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.
- F. Adjust variable-air-volume, dual-duct systems in the same way as constant-volume, dual-duct systems; adjust maximum- and minimum-airflow setting of each mixing box.

3.8 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at minimum set-

point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 3. Measure total system airflow. Adjust to within indicated airflow.
 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 6. Re-measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - b. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
 8. Record final fan-performance data.
- C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Balance variable-air-volume systems the same as described for constant-volume air systems.
 2. Set terminal units and supply fan at full-airflow condition.
 3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.

4. Readjust fan airflow for final maximum readings.
 5. Measure operating static pressure at the sensor that controls the supply fan if one is installed and verify operation of the static-pressure controller.
 6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
 7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
 8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
- D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
 2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
 3. Set terminal units at full-airflow condition.
 4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 5. Adjust terminal units for minimum airflow.
 6. Measure static pressure at the sensor.
 7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

3.9 PROCEDURES FOR MULTIZONE SYSTEMS

- A. Set unit at maximum airflow through the cooling coil.
- B. Adjust each zone's balancing damper to achieve indicated airflow within the zone.

3.10 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 - 1. Open all manual valves for maximum flow.
 - 2. Check liquid level in expansion tank.
 - 3. Check makeup water-station pressure gage for adequate pressure for highest vent.
 - 4. Check flow-control valves for specified sequence of operation and set at indicated flow.
 - 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
 - 6. Set system controls so automatic valves are wide open to heat exchangers.
 - 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 - 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.11 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
 - 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Owner/Engineer and comply with requirements in "Hydronic Pump Specification."
 - 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 - a. Monitor motor performance during procedures and do not operate motors in overload conditions.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 4. Report flow rates that are not within plus or minus 10 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
 - C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
 - D. Set calibrated balancing valves, if installed, at calculated pre-settings.
 - E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
 - F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
 - G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 1. Determine the balancing station with the highest percentage over indicated flow.
 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 3. Record settings and mark balancing devices.
 - H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
 - I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
 - J. Check settings and operation of each safety valve. Record settings.

3.12 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.13 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

- A. Balance the primary circuit flow first and then balance the secondary circuits.

3.14 PROCEDURES FOR DOMESTIC HOT WATER SYSTEMS

- A. The test and balance contractor shall provide testing, adjusting and balancing of the hot water system, once the system is fully installed and operational. Preliminary and final reports shall be prepared and issued to the General Contractor, Architect and Engineer.
- B. Preparation of the hot water system for balancing:
 - 1. Confirm outlet temperature of the system at water heaters and/or storage tanks.
 - 2. Verify recirculation pump operation and rotation.
 - 3. Confirm/adjust setpoint of each individual riser balancing valve to flow a minimum of 0.5 gpm or as otherwise noted on the documents.
- C. The test and balance report shall indicate the following:
 - 1. Pressure, temperature and flow in gpm at the discharge side of each balancing valve referencing the valve tag number.
 - 2. Pressure, temperature and flow in gpm at the suction side of each circulating pump.

3.15 PROCEDURES FOR HEAT EXCHANGERS

- A. Measure water flow through all circuits.
- B. Adjust water flow to within specified tolerances.
- C. Measure inlet and outlet water temperatures.
- D. Measure inlet steam pressure.
- E. Check settings and operation of safety and relief valves. Record settings.

3.16 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer's name, model number, and serial number.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.17 PROCEDURES FOR CHILLERS

- A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
 2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
 3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
 4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
 5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
 6. Capacity: Calculate in tons of cooling.
 7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.18 PROCEDURES FOR COOLING TOWERS

- A. A complete Factory CTI certified test of the cooling tower will be performed at the expense of the cooling tower manufacturer. A copy of this test (provided by others) shall be included in the final TAB report. Balance the flow over and through bypass connections of the tower.

3.19 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.20 PROCEDURES FOR BOILERS

- A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

3.21 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.
 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 3. Check the refrigerant charge.
 4. Check the condition of filters.
 5. Check the condition of coils.
 6. Check the operation of the drain pan and condensate-drain trap.
 7. Check bearings and other lubricated parts for proper lubrication.
 8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
1. New filters are installed.
 2. Coils are clean and fins combed.
 3. Drain pans are clean.
 4. Fans are clean.
 5. Bearings and other parts are properly lubricated.
 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan speed and the face velocity of filters and coils.
 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
 3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
 4. Balance each air outlet.

3.22 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.

2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Pump curves.
 2. Fan curves.
 3. Manufacturers' test data.
 4. Field test reports prepared by system and equipment installers.
 5. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
 2. Name and address of the TAB contractor.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.

5. Terminal units.
 6. Balancing stations.
 7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 3. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Filter static-pressure differential in inches wg (Pa).
 - f. Preheat-coil static-pressure differential in inches wg (Pa).
 - g. Cooling-coil static-pressure differential in inches wg (Pa).
 - h. Heating-coil static-pressure differential in inches wg (Pa).
 - i. Outdoor airflow in cfm (L/s).
 - j. Return airflow in cfm (L/s).
 - k. Outdoor-air damper position.
 - l. Return-air damper position.
 - m. Vortex damper position.
- F. Apparatus-Coil Test Reports:
1. Coil Data:
 - a. System identification.
 - b. Location.
 - c. Coil type.
 - d. Number of rows.
 - e. Fin spacing in fins per inch o.c.

- f. Make and model number.
 - g. Face area in sq. ft
 - h. Tube size in NPS (DN).
 - i. Tube and fin materials.
 - j. Circuiting arrangement.
2. Test Data (Indicated and Actual Values):
- a. Air flow rate in cfm (L/s).
 - b. Average face velocity in fpm (m/s).
 - c. Air pressure drop in inches wg (Pa).
 - d. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).
 - e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
 - f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
 - g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
 - h. Water flow rate in gpm (L/s).
 - i. Water pressure differential in feet of head or psig (kPa).
 - j. Entering-water temperature in deg F (deg C).
 - k. Leaving-water temperature in deg F (deg C).
 - l. Refrigerant expansion valve and refrigerant types.
 - m. Refrigerant suction pressure in psig (kPa).
 - n. Refrigerant suction temperature in deg F (deg C).
 - o. Inlet steam pressure in psig (kPa).
- G. Gas Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Fuel type in input data.
 - g. Output capacity in Btu/h (kW).
 - h. Ignition type.
 - i. Burner-control types.
 - j. Motor horsepower and rpm.
 - k. Motor volts, phase, and hertz.
 - l. Motor full-load amperage and service factor.
 - m. Sheave make, size in inches, and bore.
 - n. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 2. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm (L/s).
 - b. Entering-air temperature in deg F.
 - c. Leaving-air temperature in deg F.
 - d. Air temperature differential in deg F.
 - e. Entering-air static pressure in inches wg (Pa).
 - f. Leaving-air static pressure in inches wg (Pa).
 - g. Air static-pressure differential in inches wg (Pa).
 - h. Low-fire fuel input in Btu/h (kW).

- i. High-fire fuel input in Btu/h (kW).
 - j. Manifold pressure in psig (kPa).
 - k. High-temperature-limit setting in deg F.
 - l. Operating set point in Btu/h (kW).
 - m. Motor voltage at each connection.
 - n. Motor amperage for each phase.
 - o. Heating value of fuel in Btu/h (kW).
- H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Coil identification.
 - d. Capacity in Btu/h (kW).
 - e. Number of stages.
 - f. Connected volts, phase, and hertz.
 - g. Rated amperage.
 - h. Air flow rate in cfm.
 - i. Face area in sq. ft.
 - j. Minimum face velocity in fpm.
 2. Test Data (Indicated and Actual Values):
 - a. Heat output in Btu/h (kW).
 - b. Air flow rate in cfm.
 - c. Air velocity in fpm.
 - d. Entering-air temperature in deg F.
 - e. Leaving-air temperature in deg F.
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
 1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.

- f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Number, make, and size of belts.
 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Suction static pressure in inches wg (Pa).
- J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
 - a. System and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg (Pa).
 - e. Duct size in inches.
 - f. Duct area in sq. ft.
 - g. Indicated air flow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual air flow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig (Pa).
- K. Air-Terminal-Device Reports:
1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - i. Effective area in sq. ft.
 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary air flow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final air flow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.
- L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:
 - a. System and air-handling-unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 - e. Flowmeter type.
 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm (L/s).
 - b. Entering-water temperature in deg F.
 - c. Leaving-water temperature in deg F.
 - d. Water pressure drop in feet of head or psig (kPa).
 - e. Entering-air temperature in deg F.
 - f. Leaving-air temperature in deg F.
- M. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model number and serial number.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig (kPa).
 - h. Required net positive suction head in feet of head or psig (kPa).
 - i. Pump rpm.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.
 2. Test Data (Indicated and Actual Values):
 - a. Static head in feet of head or psig (kPa).
 - b. Pump shutoff pressure in feet of head or psig (kPa).
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig (kPa).
 - f. Final discharge pressure in feet of head or psig (kPa).
 - g. Final suction pressure in feet of head or psig (kPa).
 - h. Final total pressure in feet of head or psig (kPa).
 - i. Final water flow rate in gpm.
 - j. Voltage at each connection.
 - k. Amperage for each phase.
- N. Vibration Test:

1. Location of points:
 - a. Fan bearing, drive end
 - b. Fan bearing, opposite end
 - c. Motor bearing, center (when applicable)
 - d. Motor bearing, drive end
 - e. Motor bearing, opposite end
 - f. Casing (bottom or top)
 - g. Casing (side)
 - h. Duct after flexible connection (discharge)
 - i. Duct after flexible connection (suction)
 2. Test readings:
 - a. Horizontal, velocity and displacement
 - b. Vertical, velocity and displacement
 - c. Axial, velocity and displacement
 - d. Normally acceptable readings, velocity and acceleration
 - e. Unusual conditions at time of test
 - f. Vibration source (when non-complying)
- O. Instrument Calibration Reports:
1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

END OF SECTION 23 05 93

SECTION 23 07 13 - DUCT INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- B. Section Includes: Insulation systems for sheet metal duct conveying cold, hot, and grease laden air.

1.3 SYSTEM DESCRIPTION

- A. Design Requirements: Provide duct insulation systems which have been manufactured, fabricated, and installed to meet all thermal requirements of mechanical systems. Insulating systems shall be installed in strict accordance with manufacturer's field requirements and the current International Energy Conservation Code including all local amendments and criteria specified herein.
- B. Performance Requirements: Provide duct insulation systems which have been manufactured and installed to meet the following standards:
- C.
 - 1. NFPA 90A.
 - 2. NFPA 90B.
 - 3. UL 723, ASTM E84: Flamespread 25, smoke developed 50.
 - 4. ASTM C1136: 150 degrees F.
 - 5. ASTM C1290.
 - 6. UL 181 for Class I Air Duct.
 - 7. NAIMA AHS-152T.

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by **highlighting** or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show specific pertinent performance data and quantities appropriate to scope of work
- C. Submit manufacturer's product data and installation instructions.
- D. Provide drawings indicating typical duct insulation details, thickness and location. Identify areas and required insulation.
- E. Manufacturer's certificate that products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Utilize an installer having demonstrated five (5) years experience on projects of similar size and complexity.

- B. Condensation on any insulated system is not acceptable. Contractor shall replace insulation deemed unacceptable due to exposure to condensation at no additional cost to project.
- C. Insulation to provide minimum R-value in accordance with current International Energy Conservation Code including all local amendments and criteria specified herein.

1.6 DELIVERY, STORAGE & HANDLING

- A. Deliver insulation materials in manufacturer's original, unopened containers with identification labels intact.
- B. Contractor shall adequately protect insulation from damage after delivery to the project. Materials shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- C. Do not deliver materials to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS – MUST BE MANUFACTURED AND BRANDED BY ONE OF THE FOLLOWING:

- A. Fiber Glass Insulation: Subject to compliance with plans and specification, provide one of the following:
 - 1. Owens Corning
 - 2. Johns Manville
 - 3. CertainTeed
 - 4. Knauf brand Insulation
- B. Mastics and Adhesive: Subject to compliance with plans and specification, provide one of the following:
 - 1. Childers
 - 2. Foster
 - 3. Vimasco
- C. Fiberglass Reinforcing Cloth Mesh: Subject to compliance with plans and specification, provide one of the following:
 - 1. Perma Glass
 - 2. Alpha Glass
 - 3. Childers
 - 4. Vimasco
- D. Fire Wrap Insulation: Subject to compliance with plans and specification, provide one of

the following:

1. 3M Fire Barrier Duct Wrap
2. Vesuvius Pyroscat Duct Wrap
3. Unifrax Corporation

2.2 DUCT WRAP

- A. Material: Resilient blanket of fiberglass insulation factory laminated to foil/kraft vapor retarder facing.
- B. Density: 0.75 pounds per cubic foot.
- C. Installed minimum R value: 8.3.
- D. Nominal Thickness: 3.0 inches.
- E. Installed Thickness: 2-1/4 inches.
- F. Installed Thermal Conductivity (compressed): $k = 0.27$
- G. Operating Temperature (ASTM C411): up to 250° Fahrenheit.
- H. Insulation Jacket Temperature Limit (ASTM C1136): up to 150° Fahrenheit.
- I. Water Vapor Sorption (ASTM C1104): < 3 percent by weight at 120° Fahrenheit, 95% RH.
- J. Testing Method 1338: Fungi Resistance Comply with requirements.
- K. ASTM 665 Mineral Fiber Thermal Insulation: Comply with requirements.
- L. Surface Burning Characteristics (ASTM E84): Flame spread 25, smoke developed 50.

2.3 ACOUSTICAL FLEXIBLE DUCT LINER:

- A. Material: Acoustical insulation applied to interior of sheet metal ducts. Semi-rigid board of glass fibers with a tough, fire-resistant, anti-microbial, acrylic coating on the airstream side. Factory applied edge coating. Duct liner for rectangular and round duct as required.
- A. Density: 1.5 pounds per cubic foot.
- B. Installed minimum R value: 8.
- C. Thickness: 2 inches.
- D. Thermal Conductivity k , (ASTM C518): 0.24
- E. Acoustic Performance: Sound absorption coefficients at octave band center frequencies (Hz)

Freq. (Hz)	<u>125</u>	<u>250</u>	<u>500</u>	<u>1K</u>	<u>2K</u>	<u>4K</u>	<u>NRC</u>
TL (dB)	0.19	0.55	0.84	1.0	1.0	.98	.85
- F. Material Standards: Comply with NFPA 90A, NFPA 90B, and ASTM C1071.
- G. Operating Temperature (ASTM C411): 250 degrees Fahrenheit.

- H. Maximum Air Velocity (UL 181 Erosion test ASTM C1071): 6,000 fpm.
- I. Water Vapor Sorption (ASTM C1104): < 3 percent by weight at 120°F, 95% RH.
- J. Fungi Resistance (ASTM C1338 & G21): Comply with requirements.
- K. Bacteria Resistance (ASTM G22): Comply with requirements.
- L. Corrosiveness (ASTM C665): Will not cause corrosion greater than that caused by sterile cotton on aluminum or steel.
- M. Surface Burning Characteristics (ASTM E84, UL 723): Flame spread 25, smoke developed 50.

2.4 ACCESSORIES

- A. Pressure-Sensitivity Aluminum Foil Tapes:
 - 1. Material Standard: Listed and labeled under UL 181A, Part I, identified by name, date of manufacture, product name/number and UL 181A.
 - 2. Size: At least 2-1/2 inches wide.
- B. Heat-Activated Tapes:
 - 1. Material Standard: Listed and labeled under UL 181A, Part II, identified by name, date of manufacture, product name/number and UL 181A, may be used in all applications except for bonding to sheet metal.
 - 2. Size: At least three (3) inches wide.
- C. Mastic and Glass Fabric System:
 - a. Material Standard: Listed and labeled under UL 181A, Part III.
 - b. Size: At least three (3) inches wide.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- A. Comply with the instructions and recommendations of the duct insulation manufacturer.

3.2 INSTALLATION

A. ACOUSTICAL LINING OF SHEET METAL DUCT AND FITTINGS:

- 1. Completely cover all portions of duct designated to receive duct liner with duct liner material. Neatly butt all transverse joints with no interruptions or gaps. The black pigmented or mat faced surface of the duct liner shall face the airstream.
- 2. Affix duct liner to the sheet metal with 90 percent coverage of adhesive complying with the requirements of ASTM C916. All exposed leading edges and transverse joints shall be factory coated or coated with adhesive during fabrication.
- 3. Secure duct liner with mechanical fasteners, either weld-secured or impact-

driven. Compress the duct liner sufficiently to hold it firmly in place. Adhesive bonded pins are not permitted. Space mechanical fasteners with respect to duct liner interior width as follows:

- a. Maximum spacing for mechanical fasteners where air velocity is 0 – 2,500 FPM is as follows:
 1. From transverse end of liner: three (3) inches.
 2. Across width of duct: 12 inches on center.
 3. From corners of duct: four (4) inches.
 4. Along length of duct: 18 inches on center.
- b. Maximum spacing for mechanical fasteners where air velocity is 2,501 – 5,000 FPM is as follows:
 1. From transverse end of liner: three (3) inches.
 2. Across width of duct: six (6) inches on center.
 3. From corners of duct: four (4) inches.
 4. Along length of duct: 16 inches on center.
4. Provide galvanized metal clips on all leading edges of duct liner. Exposed insulation is not acceptable.
5. Cut duct liner to ensure overlapped and compressed longitudinal corner joints.
6. Cut duct liner board to ensure tight, overlapped corner joints. Support the top pieces of liner board at the edges by the side pieces.
7. If the specification requires use of multiple insulation layers, take the following additional steps:
 - a. Affix bottom layer of duct liner in normal manner.
 - b. Affix top layer of duct liner to bottom layer using a minimum of 90% adhesive coverage.
 - c. Treat the leading edges of the duct liner with galvanized angle clips to prevent separation of the 2 layers.
 - d. Use mechanical fasteners of the proper length for the double layer.
8. Application: Provide duct liner as follows:
 - a. Provide duct liner in first 10 feet of duct from roof mounted exhaust fans.
 - b. Provide duct liner in all return air boots and transfer ducts.
 - c. Provide duct liner in the first 20 feet of supply and return duct from roof mounted air handling units / roof top units.

B. THERMAL INSULATION WRAP ON DUCT AND FITTINGS:

1. Before applying duct wrap, air ducts must be clean, dry, and tightly sealed at all joints and seams.
2. All portions of duct designated to receive duct wrap shall be completely covered with duct wrap.

3. To ensure installed thermal performance, duct wrap insulation shall be cut to "stretch-out" dimensions as shown in tables in manufacturer's literature.
4. Remove a two (2) inch piece of insulation from the facing at the end of the piece of duct wrap to form an overlapping stapling and taping flap.
5. Install duct wrap insulation with facing outside so that the tape flap overlaps the insulation and facing at the other end of the piece of duct wrap. Adjacent sections of duct wrap insulation shall be tightly butted with the two (2) inch stapling and taping flap overlapping. On rectangular duct, install so insulation is not excessively compressed at corners. Staple seams approximately six (6) inches on center with 1/2-inch minimum steel outward clinching staples.
6. Seal seams and joints with glass fabric and mastic. Do not use cloth duct tape of any color or finish using reclaimed rubber adhesives on duct wrap insulation. Tightly butt adjacent sections of duct wrap with the two (2) inch tape flap overlapping.
7. Where rectangular ducts are 24 inches in width or greater, additionally secure duct wrap insulation to the bottom of the duct with mechanical fasteners such as pins and speed clip washers or cuphead weld pins, spaced on 18-inch centers (maximum) to prevent sagging of insulation. Do not overly compress insulation.
8. Seal all tears, punctures and other penetrations of the duct wrap facing using glass fabric and mastic.
9. Application: Provide duct wrap as follows:
 - a. All supply duct
 - b. All outside air supply and intake duct
 - c. All return air duct
 - d. All return air plenums on air units
 - e. All intake plenums on outside air handling units
 - f. All ductwork routed in un-conditioned spaces including but not limited to un-conditioned plenums (non-return air plenums), attics, exterior soffits, ventilated mechanical/boiler rooms and crawl spaces.

C. INTERIOR EXPOSED DUCT

1. Duct shall be galvanized double wall insulated round or rectangular with perforated liner. Insulation shall be acrylic coated to prevent biological growth and airside erosion. Provide 2", 1.5 pcf (installed R-Value of 8) on interior exposed duct. Duct and fittings shall use a bolted flange with neoprene gasket at each connection. Provide factory seal at flange and duct. Visual sealant on exposed interior duct to be painted is unacceptable.
2. Round duct to be galvanized spiral lockseam type.
3. Exposed round duct shall utilize single rod hangers with angle support rings. Double rod hangers are only acceptable on concealed duct.

4. Application: Provide double wall duct as follows:
 - a. Gymnasiums
 - b. Natatoriums
 - c. Return air plenums with ducted connection to return grilles
 - d. Ducted connections to return air grilles
 - e. Any area where ductwork is exposed

3.3 FIELD QUALITY CONTROL

- A. Inspection: Upon completion of installation of the duct system and before operation is to commence, visually inspect the system and verify that it has been correctly installed.
- B. Contractor shall inspect systems during test and balance to ensure that the formation of condensation is not present. Contractor shall be responsible for damage caused by condensation.

3.4 PROTECTION

- A. Protect installed work from damage due to subsequent construction activity on the site.

3.5 INSULATION SCHEDULE

- A. Supply and return ducts routed indoors (Ambient temperature \leq 85 degrees Fahrenheit, RH \leq 70 percent): R-8.3 (minimum).
- B. Supply, return, and exhaust ducts routed in unconditioned spaces including but not limited to: un-conditioned plenums (non-return air plenums), attics, exterior soffits, mechanical/boiler rooms and crawl spaces. (Ambient temperature \leq 95 degrees Fahrenheit, RH \leq 70 percent): R-8.3 (minimum).
- C. Supply, return and exhaust ducts routed outdoors or in spaces where temperature and relative humidity exceed that specified for unconditioned spaces: R-8.3 (minimum).
- D. R-values represent installed values.
- E. Provide multiple layers of insulation or thicker insulation to achieve R-values listed. If multiple layers are utilized, inner insulation layer shall not include vapor retarder.

END OF SECTION 23 07 13

SECTION 23 07 16 - HVAC EQUIPMENT INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. Section Includes:
 - 1. Chilled Water Components
 - 2. Heating Hot Water Components

1.2 SYSTEM DESCRIPTION

- A. Provide equipment insulation systems that have been manufactured, fabricated, and installed to meet the current International Energy Conservation Code and all local amendments and criteria specified herein.
- B. Performance Requirements: Provide equipment insulation systems which have been manufactured, fabricated, and installed to meet the following criteria:
 - 1. NFPA 90A Installation of Air Conditioning and Ventilation Systems.
 - 2. NFPA 90B Installation of Warm Air Heating and Air Conditioning Systems.

1.3 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by **highlighting** or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show specific pertinent performance data and quantities appropriate to scope of work
- C. Submit manufacturer's product data and installation instructions.
- D. Provide drawings indicating typical duct insulation details, thickness, and location. Identify areas and required insulation.
- E. Manufacturer's certificate that products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Utilize an installer having demonstrated five (5) years experience on projects of similar size and complexity.
- B. Condensation on any insulated system is not acceptable. Replace insulation damaged by condensation.
- C. Insulation to provide minimum R-Value in accordance with International Energy Conservation Code with Houston Amendment.

- D. Certifications: Manufacturer certification that products supplied meet or exceed specified requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver insulation materials in manufacturer's original, unopened containers with identification labels intact.
- B. Contractor shall adequately protect insulation from damage after delivery to the project. Materials shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- C. Do not deliver materials to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Glass Fiber Pipe Insulation: Subject to compliance with plans and specification, provide one of the following:
 - 1. Johns Manville
 - 2. Owens-Corning
 - 3. Knauf
 - 4. Certainteed
- B. Cellular Glass Insulation: Subject to compliance with plans and specification, provide one of the following:
 - 1. Pittsburg Corning
 - 2. Cell-U-Form
- C. Aluminum Jacketing: Subject to compliance with plans and specification, provide one of the following:
 - 1. Perma Glass Mesh
 - 2. Alpha Glass Mesh
 - 3. Childers Chil-Glas
 - 4. Vimasco
 - 5. RPR Products Inc.
- D. Mastics and Adhesives: Subject to compliance with plans and specification, provide one of the following:
 - 1. Childers
 - 2. Foster
 - 3. Vimasco

2.2 EQUIPMENT INSULATION

A. Glass Fiber Insulation Boards:

1. Thickness: Same thickness as connected piping.
2. Equipment Operating Temperature Limit (ASTM C411): Up to 450 degrees Fahrenheit.
3. Insulation Jacket Temperature Limit (ASTM C1136): -20 - 150 degrees Fahrenheit.
4. Vapor Retarder: ASJ vapor retarder facing.
5. Jacket Permeance (ASTM E96): 0.02 perm.
6. Jacket Puncture Resistance (ASTM D781): ASJ: 50 units.
7. Water Vapor Sorption (ASTM C1104): <2percent by weight at 120 degrees Fahrenheit.
8. Density: Same as adjoining pipe insulation.
9. Composition Surface Burning Characteristics (UL 723, ASTM E84): Flamespread 25, smoke developed 50.

B. Equipment and Tank Insulation:

1. Description: Flexible pipe and tank insulation made of semi-rigid fibrous glass board material with a laminated Kraft-aluminum foil ASJ facing.
2. Operating Temperature (ASTM C411): 0 - 650 degrees Fahrenheit.
3. Length: 36 inches.
4. Size: 1-1/2 inches.
5. Material Standard: Comply with ASTM C1393, Type II.
6. Material Standard: Comply with ASTM C795.
7. Material Standard: Comply with ASTM C1136, Type II.
8. Material Standard: Comply with NRC Guide 1.36.
9. Jacket Temperature Limitation (ASTM C1136): -20 - 50 degrees Fahrenheit.
10. Jacket Permeance (ASTM E961): 0.02 perm.
11. Puncture Resistance (ASTM D781): 50 units.
12. Compressive Strength at 10 % Deformation (ASTM C165): 125 psf.

2.3 CELLULAR GLASS INSULATION

- A. Rigid factory fabricated closed-cell equipment insulation:
 - 1. Thermal conductivity "k" of btuh-in / hr-sq.ft. degree F at 75-degree mean temperature.
 - 2. Density shall be an average of 8 lb./cu.ft.
 - 3. Compressive strength of 100 psi.

2.4 ALUMINUM JACKET

- A. Jacket for equipment and tanks shall be 0.16-inch-thick type 3105 aluminum with factory applied one mil polykraft moisture barrier.
- B. Fitting covers shall be factory made 0.024-inch type 1100 aluminum to match pipe covering. Fitting covers shall be manufactured to ASTM C-450 standards.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.
- B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gaping joints and excessive voids resulting from poor workmanship.
- C. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.
- D. Do not apply insulation to equipment, breeching, or stacks while hot.
- E. Apply insulation using staggered joint method for both single- and double-layer construction, where feasible. Apply each layer of insulation separately.
- F. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.
- G. Cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least two (2) inches. Apply over vapor barrier where applicable.
- H. Do not insulate boiler manholes, hand holes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.
- I. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.

- J. Equipment Exposed to Weather: Protect outdoor insulation from weather by installation of weather-barrier mastic protective finish, or jacketing, as recommended by manufacturer.

3.2 MANUFACTURER'S INSTRUCTIONS

- A. Comply with the instructions and recommendations of the equipment insulation manufacturer.

3.3 EXAMINATION

- A. Site Verification of Conditions:
- B. Verify that site conditions are acceptable for installation of equipment insulation.
- C. Do not proceed with installation of equipment insulation until unacceptable conditions are corrected.

3.4 INDOOR CHILLED WATER PUMPS

- A. Shall be insulated with rigid insulation board, two (2) inch thick, cut and formed into a box and secured in place with 3/4-inch-wide x .020 galvanized bands spaced on nine (9) inch centers. Bands shall be pulled snug over sheets of insulation board. All joints shall be well and neatly fitted and so arranged that the assembly may be dismantled with ease permitting access to the pump. All voids on the interior of box shall be filled with glass fiber blanket insulation. Exterior shall be finished with a trowel coat of vapor barrier mastic, a layer of one (1) inch mesh galvanized wire, and a coat of cement. Final finish shall be an eight-ounce canvas jacket, pasted and sealed in place.
- B. Pipe insulation shall be extended over all cold parts of chilled water pumps not directly over drainage basin of pump base.

3.5 OUTDOOR CHILLED WATER PUMPS

- A. Shall be insulated with cellular glass insulation, two (2) inch thick, cut and formed into a box and secured in place with 3/4-inch-wide aluminum bands spaced on nine (9) inch centers. Bands shall be pulled snug over insulation. All joints shall be well and neatly fitted and so arranged that the assembly may be dismantled with ease permitting access to the pump. Provide aluminum jacket over insulation.

3.6 ALUMINUM JACKET

- A. Install insulating materials per manufacturer's recommendations.
- B. Install aluminum jacketing per manufacturer's recommendations.
- C. Apply aluminum jacketing by lapping, sealing with caulking mastic and strapping with 1/2-inch x 0.20-inch Type 3105 aluminum bands on 12-inch centers.
- D. Use screws on vertical lines at circumferential joints. Space screws a maximum of 6 inches apart with a minimum of two screws per joint.
- E. Lap joints against weather so that water will run off lower edge.

- F. Use caulking mastic to seal circumferential laps on horizontal lines, longitudinal laps on vertical lines, and lap formed where aluminum jacketing meets mastic. Also seal any screws in jacketing.
- G. Prevent corrosion-causing galvanic action by ensuring that aluminum jacketing does not come in direct contact with other metals.
- H. Waterproof valve, flange, and fitting covers and irregular shapes with mastic.
- I. Paint mastic with one coat of aluminum paint. Paint exposed metal parts (i.e., uninsulated valves, flanges, and fittings) with one coat of aluminum paint.
- J. Equipment exposed in mechanical rooms and finished spaces less than 10 feet above finished floor shall have specified aluminum jacket for protection.

3.7 ABOVE GRADE CHILLED WATER COMPONENTS, INSULATED WITH FIBERGLASS

- A. Location: Indoor, conditioned spaces
- B. Support Inserts: At each support point, install a hard section of cellular glass on lower 180 degrees of piping, same thickness as adjacent insulation, to prevent compression at support bearing area. Seal and finish to match the adjoining insulation. Provide formed 16 ga. galvanized sheet-metal saddles.
- C. Installation: All equipment must be clean and dry at time of installation. Seal laps on jacket with adhesive. Provide three (3) inch butt strips at each joint between sections and seal with adhesive.

3.8 ABOVE GRADE CHILLED WATER COMPONENTS, INSULATE WITH CELLULAR GLASS

- A. Location: Outdoor, un-conditioned spaces and ventilated spaces
- B. The insulation shall be applied to equipment with all joints tightly butted. Joints may be rubbed slightly to achieve a tight fit. Seal all joints full depth with sealant. Insulation shall be secured with strips of fiber reinforced tape on 12-inch centers. The tape strips shall overlap by 50 percent.
- C. Apply asphalt mastic and 6 x 6 mesh fabric in accordance with manufacturer's recommended procedures.
- D. Metal jacketing shall be applied over the vapor retarder mastic with all laps positioned to shed water. All laps should overlap a minimum of 2 inches. Bands shall be spaced no greater than 12 inches on center.
- E. After asphalt mastic application, fittings shall be covered with prefabricated metal fitting covers supplied by aluminum jacketing supplier.

3.9 INSULATION SCHEDULE

- A. Chilled water components located within condition spaces.
 - 1. Insulation thickness: Match adjoining piping thickness.
- B. Chilled water components located in un-conditioned or ventilated spaces and outdoors

1. Insulation thickness: Match adjoining piping thickness.

3.10 PROTECTION AND REPLACEMENT

- A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 23 07 16

SECTION 23 07 19 - HVAC PIPING INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Pipe Insulation

1.3 SYSTEM DESCRIPTION

- A. Design Requirements: Provide pipe insulation systems which have been manufactured, fabricated, and installed to meet the current International Energy Conservation Code and all local amendments and criteria specified herein.
- B. Performance Requirements: Provide pipe insulation systems which have been manufactured, fabricated, and installed to meet the following criteria:
 - 1. NFPA 90A Installation of Air Conditioning and Ventilation Systems.

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by **highlighting** or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show specific pertinent performance data and quantities appropriate to scope of work.
- C. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
 - 1. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - a. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - b. Detail attachment and covering of heat tracing inside insulation.
 - c. Detail insulation application at pipe expansion joints for each type of insulation.
 - d. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - e. Detail removable insulation at piping specialties.
 - f. Detail application of field-applied jackets.
 - g. Detail application at linkages of control devices.

1.5 QUALITY ASSURANCE

- A. Installation Qualifications: Utilize an installer having demonstrated (5) five years experience on projects of similar size and complexity.
- B. Condensation on any insulated piping system is not acceptable. Replace insulation damaged by condensation at no additional cost.
- C. All materials shall conform to Composite Surface Burning Characteristics (UL 723, ASTM E84):
 - 1. Flamespread: 25
 - 2. Smoke developed: 50
- D. All materials shall have U.L. label.

1.6 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver insulation materials in manufacturer's original, unopened, undamaged containers with identification labels intact
- B. Contractor shall adequately protect insulation from damage after delivery to the project. Materials shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- C. Do not deliver materials to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Glass Fiber Pipe Insulation: Subject to compliance with plans and specification, provide one of the following:
 - 1. Johns Manville
 - 2. Owens Corning
 - 3. Knauf

4. Certainteed
- B. Cellular Glass Insulation: Subject to compliance with plans and specification, provide one of the following:
 1. Pittsburg Corning
 2. Cell-U-Foam
- C. Phenolic Foam Insulation: Subject to compliance with plans and specification, provide one of the following:
 1. Resolco
 2. Koolphen® K
- D. Aluminum Jacketing: Subject to compliance with plans and specification, provide one of the following:
 1. Childers
 2. Pabco
 3. RPR
- E. Fiberglass Reinforcing Cloth Mesh: Subject to compliance with plans and specification, provide one of the following:
 1. Perma Glass Mesh
 2. Alpha Glass Mesh
 3. Childers Chil-Glas
 4. Vimasco
- F. Mastics and Adhesives: Subject to compliance with plans and specification, provide one of the following:
 1. Childers
 2. Foster
 3. Vimasco

2.2 FIBERGLASS PIPE INSULATION

- A. High density factory molded fiberglass insulation with factory applied all service, and reinforced vapor retarder jacket. Provide with a factory applied pressure sensitive tape closure system and matching butt strips. Provide thickness scheduled.
 1. Thermal conductivity “k” of 0.23 of Btu-in / hr-sq.ft. °F at 75-degree mean temperature.
 2. Maximum jacket permeance shall be 0.02.

2.3 CELLULAR GLASS INSULATION

- A. Rigid factory fabricated closed-cell pipe insulation:
 1. Thermal conductivity “k” of 0.32 Btu-in / hr-sq.ft. °F at 75-degree mean temperature.
 2. Density shall be an average of 8 lb/cu.ft.
 3. Maximum jacket permeance shall be 0.02.
 4. Compressive strength of 100 psi.

2.4 PHENOLIC FOAM INSULATION

- A. Rigid factory molded phenolic foam insulation with factory applied, all service, and reinforced vapor retarder jacket. Provide with a factory applied pressure sensitive tape closure system and matching butt strips. Provide thickness scheduled.
 - 1. Thermal conductivity "k" of 0.15 btu-in / hr-sq.ft. °F at 75°-degree mean temperature.
 - 2. Maximum jacket permeance shall be 0.02.
 - 3. Compressive strength of 100 psi

2.5 ALUMINUM JACKET

- A. Jacket for piping shall be 0.016-inch-thick type 3105 aluminum with factory applied one mil polykraft moisture barrier.
- B. Fitting covers shall be factory made 0.024-inch type 1100 aluminum to match pipe covering.

PART 3 -EXECUTION

3.1 SITE INSPECTION

- A. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.
- B. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufacturer's recommendations.

3.2 PREPARATION

- A. Ensure that all pipe and fitting surfaces over which insulation is to be installed are clean and dry.
- B. Ensure that insulation is clean, dry and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation.
- C. Ensure that pressure testing of piping and fittings has been completed prior to installing insulation.

3.3 INSTALLATION

- A. Install all insulation materials and accessories in accordance with manufacturer's published instructions and recognized industry practices to ensure that it will serve its intended purpose.
- B. Install insulation on piping subsequent to installation of heat tracing, painting, and acceptance tests.
- C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit over all piping surfaces.

- D. Maintain the integrity of factory-applied vapor barrier jacketing on all pipe insulation, protecting it against puncture, tears or other damage. All staples used on cold pipe insulation shall be coated with suitable sealant to maintain vapor barrier integrity.
- E. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- F. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.
- G. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- H. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.
- I. Apply multiple layers of insulation with longitudinal and end seams staggered.
- J. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- K. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- L. Keep insulation materials dry during application and finishing.
- M. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- N. Apply insulation with the least number of joints practical.
- O. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- P. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
- Q. Apply insulation continuously through hangers and around anchor attachments.
- R. For insulation application where vapor retarder is indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- S. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
- T. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

- U. Insulation Terminations: For insulation application where vapor retarder is indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- V. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
- W. Apply insulation with integral jackets as follows:
 - 1. Pull jacket tight and smooth.
 - 2. Circumferential Joints: Cover with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.
 - 3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder
 - 4. Vapor-Retarder Mastics: Where vapor retarder is indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings, at penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.
 - 5. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
 - a. Seal penetrations with vapor-retarder mastic
 - b. Apply insulation for exterior applications tightly joined to interior insulation ends.
 - c. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches below top of roof flashing.
 - d. Seal metal jacket to roof flashing with vapor-retarder mastic.
 - 6. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.
 - 7. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.
 - 8. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.
 - a. Fire stopping and fire-resistive joint sealers are specified in Division 7.
 - 9. Floor Penetrations: Apply insulation continuously through floor assembly.
 - a. For insulation with vapor retarder, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

- X. Insulation Installation of Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
 2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 feet to form a vapor stop between pipe insulation segments.
 3. For insulation with factory-applied jackets without integral vapor retarder, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
- Y. Insulation Installation on Pipe Flanges:
1. Apply preformed cellular-glass pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cellular-glass block insulation.
 4. Install jacket material with manufacturers recommended adhesive, overlapping seams at least 1 inch, and seal joints with vapor-retarder mastic.
- Z. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of molded cellular-glass insulation and match thickness to that of adjoining pipe. Fittings and fabricated segments shall be securely held in place with ½ inch x 0.20-inch type 3105 aluminum bands.
 - a. After segments have been banded, apply a tack coat of insulating mastic to the insulated fitting to produce a smooth surface.
 - b. After mastic is dry, apply a second coat of vapor barrier mastic. Neatly embed with 10 x 10 fiberglass cloth into the tack coat.
 - c. Overlap mastic and fiberglass cloth by 2 inches on adjoining sections of pipe insulation.
- AA. Insulation Installation on Valves:
1. Install preformed two-piece factory molded cellular-glass insulation to valve body, match adjoining pipe insulation thickness. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. Install insulation to flanges as specified for flange insulation application.
 - a. After segments have been banded, apply a tack coat of insulating mastic to the insulated fitting to produce a smooth surface.
 - b. After mastic is dry, apply a second coat of vapor barrier mastic. Neatly embed with 10 x 10 fiberglass cloth into the tack coat.

- c. Overlap mastic and fiberglass cloth by 2 inches on adjoining sections of pipe insulation.

BB. PVC Cover:

1. Provide factory molded covers for all fittings, elbows and flanges.

3.4 FIELD-APPLIED JACKET APPLICATION

- A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.
 - a. Apply jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 - b. Embed 10 x 10 fiberglass cloth between two 0.062-inch-thick coats of jacket manufacturer's recommended adhesive.
 - c. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.
- B. Apply foil and paper jackets where indicated.
 - a. Draw jacket material smooth and tight.
 - b. Apply lap or joint strips with the same material as jacket.
 - c. Secure jacket to insulation with manufacturer's recommended adhesive.
 - d. Apply jackets with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints. Where vapor retarder is indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder mastic to ends of insulation at intervals of 15 feet to form a vapor stop between pipe insulation segments.
 - e. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-retarder mastic.

3.5 CHILLED WATER, HOT WATER, CONDENSATE DRAIN AND MISCELLANEOUS PIPING SYSTEMS

- A. Location: Indoor, conditioned spaces - return air plenums, air handling unit rooms
- B. Insulation Type:
 1. Heating Water and Condensate Piping: **Fiberglass**
 2. Chilled Water Piping: **Phenolic Foam**
- C. Support Inserts: At each support point, install a hard section of cellular glass (two halves) around entire circumference of piping, same thickness as adjacent insulation, to prevent compression at support bearing area. Sealed and finished to match the adjoining insulation. Cellular glass length shall overhang a minimum of 2" on both sides of the saddle. Refer to 3.5, E for saddle length requirements.
- D. Provide formed 16 ga. galvanized sheet-metal saddles with flared edges for protection of vapor retarder jacket and insulation. Saddles shall be short ribbed to secure saddle inside

hanger, and prevention of saddle movement. Pipe saddles shall be secured on both ends with aluminum banding with a thickness of 0.20, 3/4" width and joined with 3/4" aluminum wing seals.

- E. Provide formed 16 ga. galvanized sheet-metal saddles as follows:
 - 1. Insert and saddle lengths:
 - a. 1-1/2 inch through 2-1/2-inch pipe - 10 inches Long
 - b. 3 inch through 6-inch pipe - 12 inches Long
 - c. 8 inch through 10-inch pipe - 16 inch Long
 - d. 12 inches and larger pipe - 22 inches Long
- F. Installation on Piping: All piping must be clean and dry at time of installation. Seal laps on jacket with adhesive. Provide 3-inch butt strips at each joint between sections and seal with adhesive.
- G. Provide vapor retarder on all cold-water piping. Install a sealed vapor stop every 15 feet.

3.6 CHILLED WATER, HOT WATER, CONDENSATION DRAIN AND MISCELLANEOUS PIPING SYSTEMS

- A. Location: Outdoor, un-conditioned spaces (non-return air plenums) and ventilated spaces. Shall include but not limited to: boiler rooms, non-return air plenum mechanical rooms, chiller rooms, and pump rooms.
- B. Insulation Type:
 - 1. Condensate Piping: **Fiberglass**
 - 2. Chilled Water and Heating Water Piping: **Phenolic Foam**
- C. Cellular Glass Installation:
 - 1. The insulation shall be applied to piping with all joints tightly butted. Joints may be rubbed slightly to achieve a tight fit. Seal all joints full depth with sealant. Insulation shall be secured with strips of fiber reinforced tape on 12-inch centers. The tape strips shall overlap by 50 percent.
 - 2. Apply asphalt mastic and 6 x 6 mesh fabric in accordance with manufacturer's recommended procedures.
 - 3. Aluminum jacketing shall be applied over the vapor retarder mastic with all laps positioned to shed water. All laps should overlap a minimum of 2 inches. Bands shall be spaced no greater than 12 inches on center.
 - 4. After asphalt mastic application, fittings shall be covered with prefabricated metal fitting covers supplied by aluminum jacketing supplier.
- D. Support Inserts: At each support point, install a hard section of cellular glass (two halves) around entire circumference of piping, same thickness as adjacent insulation, to prevent compression at support bearing area. Sealed and finished to match the adjoining insulation.
- E. Provide formed 14 ga. galvanized sheet-metal saddles with flared edges for protection of vapor retarder jacket and insulation. Saddles shall be short ribbed to secure saddle inside hanger, and prevention of saddle movement. Pipe saddles shall be secured on both ends

with aluminum banding with a thickness of 0.20, $\frac{3}{4}$ " width and joined with $\frac{3}{4}$ " aluminum wing seals.

- F. Provide formed 14 ga. galvanized sheet-metal saddles as follows:
 - 1. Insert and saddle lengths:
 - a. 1-1/2 inch through 2-1/2-inch pipe - 10 inches Long
 - b. 3 inch through 6-inch pipe - 12 inches Long
 - c. 8 inch through 10-inch pipe - 16 inch Long
 - d. 12 inches and larger pipe - 22 inches Long
- G. Installation on Piping: All piping must be clean and dry at time of installation. Seal laps on jacket with adhesive and vapor retarder mastic. Provide 3-inch butt strips at each joint between sections and seal with adhesive.
- H. Provide vapor retarder on all cold-water piping. Install a sealed vapor stop every 15 feet.

3.7 ALUMINUM JACKET

- A. Install insulating materials per manufacturer's recommendations.
- B. Install aluminum jacketing per manufacturer's recommendations.
- C. Apply aluminum jacketing by lapping and sealing with caulking mastic and strapping with 1/2-inch x 0.20-inch Type 3105 aluminum bands on 12-inch centers.
- D. Use screws on vertical lines at circumferential joints. Space screws a maximum of 6 inches apart with a minimum of two screws per joint.
- E. Lap joints against weather so that water will run off lower edge.
- F. Use caulking mastic to seal circumferential laps on horizontal lines, longitudinal laps on vertical lines, and lap formed where aluminum jacketing meets mastic. Also seal any screws in jacketing.
- G. Prevent corrosion-causing galvanic action by ensuring that aluminum jacketing does not come in direct contact with other metals.
- H. Waterproof valve, flange, and fitting covers and irregular shapes with mastic.
- I. Paint mastic with one coat of aluminum paint. Paint exposed metal parts (i.e., uninsulated valves, flanges, and fittings) with one coat of aluminum paint.
- J. Pipe exposed in mechanical rooms and finished spaces less than 10 feet above finished floor shall have specified aluminum jacket for protection.
- K. All exterior pipes shall have specified aluminum jacket for protection.

3.8 PROTECTION

- A. Replace damaged aluminum jacketing and insulation, including insulation with vapor barrier damage and moisture-saturated insulation.

- B. The insulation contractor shall advise the general and / or the mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

3.9 INSULATION SCHEDULE

- A. Chilled water piping located within condition spaces.
 - 1. Insulation thickness (**Phenolic Foam**):
 - a. 1-1/2" thick insulation for: 1/2" through 2" pipe
 - b. 2" thick insulation for: 2-1/2" and larger pipe
- B. Chilled water and hot water piping located in un-conditioned or un-ventilated spaces and outdoors.
 - 1. Insulation thickness (**Phenolic Foam**):
 - a. 1-1/2" thick insulation for: 1/2" through 2" pipe
 - b. 2" thick insulation for: 2-1/2" and larger pipe
- C. Hot water piping located within conditioned spaces
 - 1. Insulation thickness: (**Fiberglass**):
 - a. 1-1/2" thick insulation for: 1/2" through 1-1/2" pipe
 - b. 2" thick insulation for: 2" and larger pipe
- D. Cold Condensate Drain Lines
 - 1. Insulation thickness: (**Fiberglass**):
 - a. 1" thick insulation for all pipe sizes and locations

END OF SECTION 23 07 19

SECTION 23 08 00 - COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.
- B. Related Sections:
 - 1. Section 019114 "General Commissioning Requirements" for general commissioning process requirements.

1.3 DEFINITIONS

- A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- B. CxA: Commissioning Authority.
- C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.
- D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 INFORMATIONAL SUBMITTALS

- A. Certificates of readiness.
- B. Certificates of completion of installation, prestart, and startup activities.

1.5 ALLOWANCES

- A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing are covered by the "Schedule of Allowances" Article in Section 012100 "Allowances."

1.6 UNIT PRICES

- A. Commissioning testing allowance may be adjusted up or down by the "List of Unit Prices" Article in Section 012200 "Unit Prices" when actual man-hours are computed at the end of commissioning testing.

1.7 CONTRACTOR'S RESPONSIBILITIES

- A. Perform commissioning tests at the direction of the CxA.
- B. Attend construction phase controls coordination meeting.

- C. Attend testing, adjusting, and balancing review and coordination meeting.
- D. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- E. Provide information requested by the CxA for final commissioning documentation.
- F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.8 CxA'S RESPONSIBILITIES

- A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
- B. Direct commissioning testing.
- C. Verify testing, adjusting, and balancing of Work are complete.
- D. Provide test data, inspection reports, and certificates in Systems Manual.

1.9 COMMISSIONING DOCUMENTATION

- A. Provide the following information to the CxA for inclusion in the commissioning plan:
 - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
 - 2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
 - 3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
 - 4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
 - 5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
 - 6. Test and inspection reports and certificates.
 - 7. Corrective action documents.
 - 8. Verification of testing, adjusting, and balancing reports.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

- A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- E. Inspect and verify the position of each device and interlock identified on checklists.
- F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 Testing AND BALANCING VERIFICATION

- A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.
- B. Notify the CxA at least [10] days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.
- C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.
 - 1. The CxA will notify testing and balancing Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
 - 2. The testing and balancing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
 - 3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
 - 4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- D. The CxA along with the HVAC&R Subcontractor, testing and balancing Contractor, and HVAC&R Instrumentation and Control Subcontractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.
- E. Tests will be performed using design conditions whenever possible.
- F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- G. The CxA may direct that set points be altered when simulating conditions is not practical.
- H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.4 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

- A. Boiler Testing and Acceptance Procedures: Testing requirements are specified in HVAC boiler Sections. Provide submittals, test data, inspector record, and boiler certification to the CxA.
- B. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Section 230993 "Sequence and Operations for HVAC Controls." Assist the CxA with preparation of testing plans.
- C. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in HVAC piping Sections. HVAC&R **Subcontractor** shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:
 - 1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test

section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.

2. Description of equipment for flushing operations.
 3. Minimum flushing water velocity.
 4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.
- D. Energy Supply System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of hot-water and solar systems and equipment at the direction of the CxA. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.
- E. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.
- F. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.
- G. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.
- H. Refer to plans and specifications for HVAC system type.

END OF SECTION 23 08 00

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

SECTION 23 09 23 - DIRECT DIGITAL CONTROLS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Heating and cooling piping:
 - 1. Control valves
 - 2. Flow meters
 - 3. Flow switches
 - 4. Press and temp sensor wells & sockets
 - 5. Temp sensor wells and sockets
- B. Duct accessories:
 - 1. Airflow stations
 - 2. BAS control dampers
 - 3. Terminal unit controls

1.3 PRODUCTS NOT FURNISHED OR INSTALLED BUT INTEGRATED WITH THE WORK OF THIS SECTION

- A. Communications with Third Party Equipment:
 - 1. Any additional integral control systems included with the products integrated with the work of this section shall be furnished with a BACnet interface for integration into the Direct Digital Control System described in this section (reference sequence of operations and points list for specifics). Those systems include:
 - a. Boilers
 - b. Chillers
 - c. Cooling Towers
 - d. Switchgear
 - e. Variable Speed Drives
 - f. Computer Room Units (MDF)
 - g. Rooftop Units

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

1.4 RELATED SECTIONS

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents.
- B. The following sections constitute related work:
 - 1. Division 01- General
 - 2. Division 23 – Mechanical
 - 3. Division 26 – Electrical

1.5 DESCRIPTION

- A. **Integration into existing control system: All new control system components including, but not limited to, direct digital controllers, central processing units, control software, etc., shall be seamlessly integrated to the existing Unify control system. It shall be the responsibility of the contractor to ensure all new equipment provided is compatible with the exiting control system. The contractor shall provide all software and hardware upgrades, whether existing or new, as required to complete the integration.**
- B. **Onboard/factory-provided controllers are not acceptable for packaged equipment. All packaged equipment shall be provided with full BACnet integration capabilities such that the BAS has full control and monitoring capabilities as described in this section. No exceptions.**
- C. **All new hydronic equipment shall be integrated into the existing Unify system. Dry contacts are to be provided from all new hydronic units to existing control system serving the central plant such that plant is energized when new equipment sends a cooling/heating call and plant is de-energized when new units de-energize. New units shall not de-energize/override control of the plant when existing units are in operation.**
- D. General: The control system shall consist of a complete BAS system with a high-speed, peer-to-peer network of DDC controllers and a web-based operator interface. Depict each mechanical system and building floor plan by a point-and-click graphics. A web server with a network interface card shall gather data from this system and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface. If individual software seat licenses or keys are required provide a minimum of 4 additional licenses to accommodate multiple owner operators.
- E. If manufacture offers a web-based BAS platform, the installing contractor shall provide the new web-based software and software updates required for this project. Additionally, the installing contractor shall provide all computer related components (BAS web server – reference specifications for hardware requirements) for the new software platform to function in a peer-to-peer environment.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

- F. The system shall directly control HVAC equipment as specified in Sequences of Operation. Each zone controller shall provide occupied and unoccupied modes of operation by individual zone. Furnish energy conservation features such as optimal start and stop, night setback, request-based logic, and demand level adjustment of setpoints.
- G. System shall use the BACnet protocol for communication to the operator workstation or web server and for communication between control modules. Schedules, setpoints, trends, and alarms specified shall be BACnet objects.

1.6 APPROVED CONTROL SYSTEMS

- A. The following are approved control system suppliers, manufacturers, and product lines:

- 1. Refer to specification section 01 23 00, Alternate Numbers 1A and 1B.**

1.7 QUALITY ASSURANCE

- A. Installer and Manufacturer Qualifications

- 1. Installer shall have an established working relationship with Control System Manufacturer for a period of 10 years or greater. If the distributorship has not had duration of more than 10 years, the contractor will not be approved without the written approval prior to bid date (no exceptions).
- 2. Installer shall have successfully completed Control System Manufacturer's control system training. Upon request, Installer shall present record of completed training including course outlines.
- 3. BAS Graphics shall be Three Dimensional Thermographic.
- 4. BAS provider shall warranty controllers for 1 years.
- 5. BAS Provider shall provide lifetime training for the lifecycle of the facility to the owner at no additional cost.

1.8 CODES AND STANDARDS

- A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authority's codes and ordinances for these plans and specifications. At a minimum, the installation shall comply with current editions in effect 30 days prior to receipt of bids of the following codes:

- 1. National Electric Code (NEC)
- 2. International Energy Conservation Code (IECC)
- 3. International Building Code (IBC)
- 4. Uniform Mechanical Code (UMC)
- 5. ASHRAE Standard 135-2016: BACnet - A Data Communication Protocol for Building Automation and Control Networks

1.9 SYSTEM PERFORMANCE

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

- A. Performance Standards. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator workstation (server and browser for web-based systems).
1. Graphic Display. A graphic with 20 dynamic points shall display with current data within 10 seconds.
 2. Graphic Refresh. A graphic with 20 dynamic points shall update with current data within 8 seconds and shall automatically refresh every 15 seconds.
 3. Configuration and Tuning Screens. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 seconds.
 4. Object Command. Devices shall react to command of a binary object within 2 seconds. Devices shall begin reacting to command of an analog object within 2 seconds.
 5. Alarm Response Time. An object that goes into alarm shall be annunciated at the workstation within 15 seconds.
 6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 seconds. Select execution times consistent with the mechanical process under control.
 7. Performance. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per second. Select execution times consistent with the mechanical process under control.
 8. Multiple Alarm Annunciation. Each workstation on the network shall receive alarms within 5 seconds of other workstations.
 9. Reporting Accuracy. System shall report values with minimum end-to-end accuracy listed in Table 1.

Control Stability and Accuracy. Control loops shall maintain measured variable at set point within tolerances listed in Table 2.

Table1
Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±2°F
Ducted Air	±2°F
Outside Air	±2°F
Dew Point	±3°F
Water Temperature	±2°F
Delta-T	±0.25°F
Relative Humidity	±5% RH
Water Flow	±2% of full scale
Airflow (terminal)	±10% of full scale (see Note 1)

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

Airflow (measuring stations)	±5% of full scale
Airflow (pressurized spaces)	±3% of full scale
Air Pressure (ducts)	±0.1 in. w.g.
Air Pressure (space)	±0.01 in. w.g.
Water Pressure	±2% of full scale (see Note 2)
Electrical (A, V, W, Power Factor)	±1% of reading (see Note 3)
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO ₂)	±50 ppm

Note 1: 10% - 100% of scale

Note 2: For both absolute and differential pressure

Note 3: Not including utility-supplied meters

Table 2
Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±0.2 in. w.g. ±0.01 in. w.g.	0-6 in. w.g. -0.1 to 0.1 in. w.g.
Airflow	±10% of full scale	
Space Temperature	±2.0°F	
Duct Temperature	±3°F	
Humidity	±5% RH	
Fluid Pressure	±1.5 psi ±1.0 in. w.g.	1-150 psi 0-50 in. w.g. differential

1.10 SUBMITTALS

A. Product Requirements: Provide one electronic copy and 4 hard copies of shop drawings and other submittals on hardware, software, and equipment to be installed or furnished. Begin no work until submittals have been approved for conformity with design intent. If requested, provide drawings as AutoCAD 2017 and 4 prints of each drawing on 8.5 x 11 paper and 1 electronic copy of each drawing. When manufacturer's cut sheets apply to a product series rather than a specific product, **clearly indicate applicable data by highlighting** or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work. Submittal approval does not relieve Contractor of responsibility to supply sufficient quantities to complete work. Provide submittals on the following:

1. Direct Digital Control System Hardware
 - a. Complete bill of materials indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.
 - b. Manufacturer's description and technical data such as performance curves, product specifications, and installation and maintenance instructions for items listed below and for relevant items not listed below:
 1. Direct digital controllers (controller panels)
 2. Transducers and transmitters

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

3. Sensors (include accuracy data)
 4. Actuators
 5. Valves
 6. Dampers
 7. Relays and switches
 8. Control panels
 9. Power supplies
 10. Batteries
 11. Operator interface equipment
 12. Wiring
 - c. Wiring diagrams and layouts for each control panel. Show termination numbers.
 - d. Floor plan schematic diagrams indicating field sensor and controller locations.
 - e. Riser diagrams showing control network layout, communication protocol, and wire types.
2. Central System Hardware and Software
- a. Complete bill of material indicating quantity, manufacturer, model number, and relevant technical data of equipment used.
 - b. Manufacturer's description and technical data such as product specifications and installation and maintenance instructions for items listed below and for relevant items furnished under this contract not listed below:
 1. Central Processing Unit (CPU) or web server
 2. Monitors
 3. Keyboards
 4. Power supplies
 5. Battery backups
 6. Interface equipment between CPU or server and control panels
 7. Operating System software
 8. Operator interface software

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

9. Color graphic software
10. Third-party software
- c. Schematic diagrams of control, communication, and power wiring for central system installation. Show interface wiring to control system.
- d. Network riser diagrams of wiring between central control unit and control panels.
3. Controlled Systems
 - a. Schematic diagram of each controlled system. Label control points with point names. Graphically show locations of control elements.
 - b. Schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic, use the same name.
 - c. Instrumentation list (Bill of Materials) for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.
 - d. Complete description of control system operation including sequences of operation. Include and reference schematic diagram of controlled system. List I/O points and software points specified. Indicate alarmed and trended points.
4. Description of process, report formats, and checklists to be used in Section 23 09 23 Article 3.15 (Control System Demonstration and Acceptance).
- B. Schedules
 1. Within two months of contract award, provide schedule of work indicating:
 - a. Intended sequence of work items
 - b. Start date of each work item
 - c. Duration of each work item
 - d. Planned delivery dates for ordered material and equipment and expected lead times
 - e. Milestones indicating possible restraints on work by other trades or situations
 2. Monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated schedule of work.
- C. Project Record Documents. Submit 8 copies of record (as-built) documents upon completion of installation for approval prior to final completion. Submittal shall consist of:

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

1. Project Record Drawings. As-built versions of submittal shop drawings provided as AutoCAD 2017 and 6 prints of each drawing on 8 ½" x 11" paper.
2. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements of (Control System Demonstration and Acceptance).
3. Operation and Maintenance (O&M) Manual. Printed, electronic, or online help documentation of the following:
 - a. As-built versions of submittal product data.
 - b. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
 - c. Operator's manual with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.
 - d. Programming manual or set of manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
 - e. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.
 - f. Documentation of programs created using custom programming language including setpoints, tuning parameters, and object database. Electronic copies of programs shall meet this requirement if control logic, setpoints, tuning parameters, and objects can be viewed using furnished programming tools.
 - g. Graphic files, programs, and database on magnetic or optical media.
 - h. List of recommended spare parts with part numbers and suppliers.
 - i. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
 - j. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation or web server software, and graphics software.
 - k. Licenses, guarantees, and warranty documents for equipment and systems.
 - l. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

- D. Training Materials: The contractor shall provide training to owner personnel in a laboratory classroom environment. Each student shall be provided with a dedicated computer workstation utilizing a simulated BAS software platform that is installed for this project. The instructors shall have CEU accreditation for all training courses offered. Provide documentation for this requirement in the initial BAS submittal. If contractor does not have CEU instructor or offer these courses locally include cost for tuition, travel and boarding to send students to manufacturer training facility. The owner shall receive free training for the life of the system.
1. Operator Overview – Consists of general system navigation, scheduling functions, setpoint modifications and parameter adjustments.
 2. Advanced Topics Overview – Detailed analysis of trend setup/configuration, trend historian, alarm setup, alarm actions (email, printing, etc.), point renaming, and detailed analysis of equipment parameters.
 3. Program/Logic Manipulation – Modify system programs as needed for additions and modifications.
 4. Graphic Manipulation – Modify system graphics as needed for additions and modifications.
 5. Hardware Troubleshooting – Classroom setup shall have HVAC mock-up systems. Operators shall be able to interact with this live system through the BAS utilized for this project. Class will provide students the ability to identify and repair common problems regularly encountered.
 6. Software Troubleshooting - Classroom setup shall have HVAC mock-up systems. Operators shall be able to interact with this live system through the BAS utilized for this project. Class will provide students the ability to identify and repair common issues that can be utilized via software modifications.
 7. Central Plant Operation – At a minimum the instructor shall thoroughly explain different types of central plant equipment and proper system modifications that can be made to enhance system performance and energy savings.
 8. HVAC System Training – Objective of this class is to provide basic HVAC system knowledge of various types of systems including types of air side distribution and water side distribution. Topics such as thermodynamics, psychometrics, de-humidification, and demand control ventilation shall be thoroughly explained.

1.11 WARRANTY

- A. Warrant work as follows:
1. Warrant materials for specified control system and peripheral control devices free from defects for a period of **1 years** after certificate of substantial completion. Warrant all labor for a period of **1 year** after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request. Additionally, contractor shall offer 24/7 after-hours support to include alarm monitoring and associated dispatch service.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

2. Provide graphic modifications for a period of 3 years from date of substantial completion. This shall include room number and equipment modifications as requested by the owner.
3. Provide telephone support free to the owner for a period of 3 years after substantial completion. This service includes technical support for all BAS equipment and shall include troubleshooting and problem resolution via the telephone or web services. Service shall be available during the hours of 7am to 5pm Monday – Friday.
4. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.
5. Provide updates to operator workstation or web server software, project-specific software, graphic software, database software, and firmware that resolve Contractor or Owner identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.
6. Exception: Contractor shall not be required to warranty existing devices except those that have been rebuilt or repaired during installation.

1.12 OWNERSHIP OF PROPRIETARY MATERIAL

- A. Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:
 1. Graphics
 2. Record drawings
 3. Database
 4. Application programming code
 5. Documentation

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts shall be available for at least five years after completion of this contract.

2.2 COMMUNICATION

- A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ASHRAE/ANSI Standard 135-2016, BACnet.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

- B. Use existing Ethernet backbone for network segments marked "existing" on project drawings.
- C. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.
- D. Internetwork operator interface and value passing shall be transparent to internetwork architecture.
 - 1. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, and control algorithms shall be viewable and editable from each internetwork controller.
 - 2. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute control strategies specified in Sequence of Operations. An authorized operator shall be able to edit cross-controller links by typing a standard object address or by using a point-and-click interface.
- E. Controllers with real-time clocks shall use the BACnet Time Synchronization service. System shall automatically synchronize system clocks daily from an operator-designated controller via the internetwork. If applicable, system shall automatically adjust for daylight saving and standard time.
- F. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.
- G. System shall support Web services data exchange with any other system that complies with XML (extensible markup language) and SOAP (simple object access protocol) standards specified by the Web Services Interoperability Organization (WS-I) Basic Profile 1.0 or higher. Web services support shall as a minimum be provided at the workstation or web server level and shall enable the system to both read and write data.
 - 1. System shall support Web services read data requests by retrieving requested trend data or point values (I/O hardware points, analog value software points, or binary value software points) from any system controller or from the trend history database.
 - 2. System shall support Web services write data request to each analog and binary object that can be edited through the system operator interface by downloading a numeric value to the specified object.
 - 3. For read or write requests, the system shall require username and password authentication and shall support SSL (Secure Socket Layer) or equivalent data encryption.

2.3 OPERATOR INTERFACE

- A. Operator Interface. Web server shall reside on high-speed network with building controllers. Each standard browser connected to server shall be able to access all

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system information. Existing manufacturer's BAS web server and workstation can be utilized. In addition to the primary operator interface, the system shall include a secondary interface compatible with a locally available commercial wireless network and viewable on a commercially available wireless device such as a Wireless Access Protocol (WAP) enabled cellular telephone or personal digital assistant (PDA). This secondary interface may be text-based and shall provide a summary of the most important data. As a minimum, the following capabilities shall be provided through this interface:

1. An operator authentication system that requires an operator to log in before viewing or editing any data, and which can be configured to limit the privileges of an individual operator.
 2. The ability to view and acknowledge any alarm in the system. Alarms or links to alarms shall be provided on a contiguous list so the operator can quickly view all alarms.
 3. A summary page or pages for each piece of equipment in the system. This page shall include the current values of all critical I/O points and shall allow the operator to lock binary points on or off and to lock analog points to any value within their range.
 4. Navigation links that allow the operator to quickly navigate from the home screen to any piece of equipment in the system, and then return to the home screen. These links may be arranged in a hierarchical fashion, such as navigating from the home screen to a particular building, then to a specific floor in the building, and then to a specific room or piece of equipment.
- B. Communication. Web server or workstation and controllers shall communicate using BACnet protocol. Web server or workstation and control network backbone shall communicate using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing as specified in ASHRAE/ANSI 135-2016, BACnet Annex J.
- C. Hardware. If providing a new server, each workstation or web server shall consist of the following:
1. Hardware Base. Industry-standard hardware shall meet or exceed DDC system manufacturer's recommended specifications and shall meet response times specified in Section 23 09 23 Paragraph 1.8. Hard disk shall have sufficient memory to store system software, one year of data for trended points specified in Sequences of Operation, and a system database at least twice the size of the existing database at system acceptance. Configure computers and network connections if multiple computers are required to meet specified memory and performance. Web server shall be Compaq Rack Mounted Server (or equal) with a minimum of:
 - a. Dual Processor Intel Pentium 3.66 GHz processor
 - b. 1 GB RAM
 - c. 80 GB hard disk providing data at 100 MB/sec
 - d. RAID 5 Configuration

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

- e. 128x CD-ROM drive
 - f. Most Current Windows Server Operating System
 - g. Serial, parallel, and network communication ports and cables required for proper system operation.
2. If providing a server, the server shall support one or more the following database types:
- a. SQL Server 2012 R2
 - b. PostgreSQL
 - c. MySQL
 - d. MS Access
- D. Operator Functions. Operator interface shall allow each authorized operator to execute the following functions as a minimum:
- 1. Log In and Log Out. System shall require username and password to log in to operator interface.
 - 2. Point-and-click Navigation. Operator interface shall be graphically based and shall allow operators to access graphics for equipment and geographic areas using point-and-click navigation.
 - 3. View and Adjust Equipment Properties. Operators shall be able to view controlled equipment status and to adjust operating parameters such as setpoints, PID gains, on and off controls, and sensor calibration.
 - 4. View and Adjust Operating Schedules. Operators shall be able to view scheduled operating hours of each schedulable piece of equipment on a weekly or monthly calendar-based graphical schedule display, to select and adjust each schedule and time period, and to simultaneously schedule related equipment. System shall clearly show exception schedules and holidays on the schedule display.
 - 5. View and Respond to Alarms. Operators shall be able to view a list of currently active system alarms, to acknowledge each alarm, and to clear (delete) unneeded alarms.
 - 6. View and Configure Trends. Operators shall be able to view a trend graph of each trended point and to edit graph configuration to display a specific time period or data range. Operator shall be able to create custom trend graphs to display on the same page data from multiple trended points.
 - 7. View and Configure Reports. Operators shall be able to run preconfigured reports, to view report results, and to customize report configuration to show data of interest.
 - 8. Manage Control System Hardware. Operators shall be able to view controller status, to restart (reboot) each controller, and to download new control software to each controller.
 - 9. Manage Operator Access. Typically, only a few operators are authorized to manage operator access. Authorized operators shall be able to view a list of

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

operators with system access and of functions they can perform while logged in. Operators shall be able to add operators, to delete operators, and to edit operator function authorization. Operator shall be able to authorize each operator function separately.

- E. System Software.
1. Operating System: Web server or workstation shall have an industry-standard professional-grade operating system. Acceptable systems include Microsoft Windows XP Pro, Red Hat Linux, or Sun Solaris.
 2. System Graphics: Operator interface shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone setpoint. Graphics shall
 - a. Functionality: Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point-and-click navigation between zones or equipment, and to edit setpoints and other specified parameters.
 - b. Animation: Graphics shall be able to animate by displaying different image files for changed object status.
 - c. Alarm Indication: Indicate areas or equipment in an alarm condition using color or other visual indicator.
 - d. Format. Graphics shall be saved in an industry-standard format such as BMP, JPEG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in (such as HTML and JavaScript) or shall require widely available no-cost plug-ins (such as Active-X and Macromedia Flash).
- F. System Tools. System shall provide the following functionality to authorized operators as an integral part of the operator interface or as stand-alone software programs. If furnished as part of the interface, the tool shall be available from each workstation or web browser interface. If furnished as a stand-alone program, software shall be installable on standard IBM-compatible PCs with no limit on the number of copies that can be installed under the system license.
1. Automatic System Database Configuration. Each workstation or web server shall store on its hard disk a copy of the current system database, including controller firmware and software. Stored database shall be automatically updated with each system configuration or controller firmware or software change.
 2. Controller Memory Download. Operators shall be able to download memory from the system database to each controller.
 3. System Configuration. Operators shall be able to configure the system.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

4. Online Help. Context-sensitive online help for each tool shall assist operators in operating and editing the system.
5. Security. System shall require a username and password to view, edit, add, or delete data.
 - a. Operator Access. Each username and password combination shall define accessible viewing, editing, adding, and deleting functions in each system application, editor, and object. Authorized operators shall be able to vary and deny each operator's accessible functions based on equipment or geographic location.
 - b. Automatic Log Out. Automatically log out each operator if no keyboard or mouse activity is detected. Operators shall be able to adjust automatic log out delay.
 - c. Encrypted Security Data. Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.
6. System Diagnostics. System shall automatically monitor controller and I/O point operation. System shall annunciate controller failure and I/O point locking (manual overriding to a fixed value).
7. Alarm Processing. System input and status objects shall be configurable to alarm on departing from and on returning to normal state. Operator shall be able to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states, and alarm reactions for each system object. Configure and enable alarm points as specified in Section 23 09 93. Alarms shall be BACnet alarm objects and shall use BACnet alarm services.
8. Alarm Messages. Alarm messages shall use an English language descriptor without acronyms or mnemonics to describe alarm source, location, and nature.
9. Alarm Reactions. Operator shall be able to configure (by object) actions workstation or web server shall initiate on receipt of each alarm. As a minimum, workstation or web server shall be able to log, print, start programs, display messages, send e-mail, send page, and audibly annunciate.
10. Alarm Maintenance. Operators shall be able to view system alarms and changes of state chronologically, to acknowledge and delete alarms, and to archive closed alarms to the workstation or web server hard disk from each workstation or web browser interface.
11. Trend Configuration. Operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk. The contractor shall configure all physical control points and software control points to accumulate trend data. Analog values shall be configured utilizing time-based intervals and digital values shall be configured for COV. Provide at a minimum of 250 samples per control point. If data can be stored locally at the controller level this information shall be archived at the central server or all BAS workstations.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

12. Object and Property Status and Control. Operator shall be able to view, and to edit if applicable, the status of each system object and property by menu, on graphics, or through custom programs.
13. Reports and Logs. Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.
14. Standard Reports. Furnish the following standard system reports:
 - a. Objects. System objects and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.
 - b. Alarm Summary. Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.
 - c. Logs. System shall log the following to a database or text file and shall retain data for an adjustable period:
 1. Alarm History.
 2. Trend Data. Operator shall be able to select trends to be logged.
 3. Operator Activity. At a minimum, system shall log operator log in and log out, control parameter changes, schedule changes, and alarm acknowledgment and deletion. System shall date and time stamp logged activity.
15. Custom Reports. Operator shall be able to create custom reports that retrieve data, including archived trend data, from the system, that analyze data using common algebraic calculations, and that present results in tabular or graphical format. Reports shall be launched from the operator interface.
16. Graphics Generation. Graphically based tools and documentation shall allow Operator to edit system graphics, to create graphics, and to integrate graphics into the system. Operator shall be able to add analog and binary values, dynamic text, static text, and animation files to a background graphic using a mouse.
17. Graphics Library. Complete library of standard HVAC equipment graphics shall include equipment such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. Library shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. Library graphic file format shall be compatible with graphics generation tools.
18. Custom Application Programming. Operator shall be able to create, edit, debug, and download custom programs. System shall be fully operable while custom programs are edited, compiled, and downloaded. Programming language shall have the following features:
 - a. Language. Language shall be graphically based or English language oriented. If graphically based, language shall use function blocks arranged in a logic diagram that clearly shows control logic flow. Function blocks shall directly provide functions listed below, and operators shall be able to create custom or compound function blocks. If

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

English language oriented, language shall be based on the syntax of BASIC, FORTRAN, C, or PASCAL, and shall allow for free-form programming that is not column-oriented or "fill-in-the-blanks."

- b. Programming Environment. Tool shall provide a full-screen, cursor-and-mouse-driven programming environment that incorporates word processing features such as cut and paste. Operators shall be able to insert, add, modify, and delete custom programming code, and to copy blocks of code to a file library for reuse in other control programs.
 - c. Independent Program Modules. Operator shall be able to develop independently executing program modules that can disable, enable and exchange data with other program modules.
 - d. Debugging and Simulation. Operator shall be able to step through the program observing intermediate values and results. Operator shall be able to adjust input variables to simulate actual operating conditions. Operator shall be able to adjust each step's time increment to observe operation of delays, integrators, and other time-sensitive control logic. Debugger shall provide error messages for syntax and for execution errors.
 - e. Conditional Statements. Operator shall be able to program conditional logic using compound Boolean (AND, OR, and NOT) and relational (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
 - f. Mathematical Functions. Language shall support floating-point addition, subtraction, multiplication, division, and square root operations, as well as absolute value calculation and programmatic selection of minimum and maximum values from a list of values.
 - g. Variables: Operator shall be able to use variable values in program conditional statements and mathematical functions.
 - 1. Time Variables. Operator shall be able to use predefined variables to represent time of day, day of the week, month of the year, and date. Other predefined variables or simple control logic shall provide elapsed time in seconds, minutes, hours, and days. Operator shall be able to start, stop, and reset elapsed time variables using the program language.
 - 2. System Variables. Operator shall be able to use predefined variables to represent status and results of Controller Software and shall be able to enable, disable, and change setpoints of Controller Software as described in Controller Software section.
19. BACnet. Web server or workstation shall have demonstrated interoperability during at least one BMA Interoperability Workshop and shall substantially conform to BACnet Operator Workstation (B-OWS) device profile as specified in ASHRAE/ANSI 135-2016, BACnet Annex L.

2.4 CONTROLLER SOFTWARE

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

- A. Building and energy management application software shall reside and operate in system controllers. Applications shall be editable through operator workstation, web browser interface, or engineering workstation.
- B. System Security. See Paragraph 2.3.F.5 (Security) and Paragraph 2.3.F.14.c.3 (Operator Activity).
- C. Scheduling. See Paragraph 2.3.D.4 (View and Adjust Operating Schedules). System shall provide the following schedule options as a minimum:
 - 1. Weekly. Provide separate schedules for each day of the week. Each schedule shall be able to include up to 5 occupied periods (5 start-stop pairs or 10 events).
 - 2. Exception. Operator shall be able to designate an exception schedule for each of the next 365 days. After an exception schedule has executed, system shall discard and replace exception schedule with standard schedule for that day of the week.
 - 3. Holiday. Operator shall be able to define 24 special or holiday schedules of varying length on a scheduling calendar that repeats each year.
- D. System Coordination. Operator shall be able to group related equipment based on function and location and to use these groups for scheduling and other applications.
- E. Binary and Analog Alarms. See Paragraph 2.3.F.7 (Alarm Processing).
- F. Alarm Reporting. See Paragraph 2.3.F.9 (Alarm Reactions).
- G. Remote Communication. System shall automatically contact operator workstation or server on receipt of critical alarms. If no network connection is available, system shall use a modem connection.
- H. Maintenance Management. System shall generate maintenance alarms when equipment exceeds adjustable runtime, equipment starts, or performance limits. Configure and enable maintenance alarms as specified in Section 23 09 93.
- I. Sequencing. Application software shall sequence chillers, boilers, and pumps as specified in Section 23 09 93.
- J. PID Control. System shall provide direct- and reverse-acting PID (proportional-integral-derivative) algorithms. Each algorithm shall have anti-windup and selectable controlled variable, setpoint, and PID gains. Each algorithm shall calculate a time-varying analog value that can be used to position an output or to stage a series of outputs.
- K. Staggered Start. System shall stagger controlled equipment restart after power outage. Operator shall be able to adjust equipment restart order and time delay between equipment restarts.
- L. Energy Calculations.
 - 1. System shall accumulate and convert instantaneous power (kW) or flow rates (gpm) to energy usage data.
 - 2. System shall calculate a sliding-window average (rolling average). Operator shall be able to adjust window interval to 15 minutes, 30 minutes, or 60 minutes.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

3. System shall calculate a fixed-window average. Window interval start shall be defined by utility meter digital input signal to synchronize system's and utility's fixed-window averages.
- M. Anti-Short Cycling. Binary output objects shall be protected from short cycling by means of adjustable minimum on-time and off-time settings.
- N. On and Off Control with Differential. System shall provide direct- and reverse-acting on and off algorithms with adjustable differential to cycle a binary output based on a controlled variable and setpoint.
- O. Runtime Totalization. System shall provide an algorithm that can totalize runtime for each binary input and output. Operator shall be able to enable runtime alarm based on exceeded adjustable runtime limit. Configure and enable runtime totalization and alarms as specified.

2.5 CONTROLLERS

- A. General. Provide Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), and Smart Actuators (SA) as required to achieve performance specified in Section 23 09 23 Article 1.8 (System Performance).
- B. BACnet.
 1. Building Controllers (BCs). Each BC shall have demonstrated interoperability during at least one BMA Interoperability Workshop and shall substantially conform to BACnet Building Controller (B-BC) device profile as specified in ASHRAE/ANSI 135-2016, BACnet Annex L.
 2. Advanced Application Controllers (AACs). Each AAC shall conform to BACnet Advanced Application Controller (B-AAC) device profile as specified in ASHRAE/ANSI 135-2016, BACnet Annex L and shall be listed as a certified B-AAC in the BACnet Testing Laboratories (BTL) Product Listing.
 3. Application Specific Controllers (ASCs). Each ASC shall conform to BACnet Application Specific Controller (B-ASC) device profile as specified in ASHRAE/ANSI 135-2016, BACnet Annex L and shall be listed as a certified B-ASC in the BACnet Testing Laboratories (BTL) Product Listing.
 4. Smart Actuators (SAs). Each SA shall conform to BACnet Smart Actuator (B-SA) device profile as specified in ASHRAE/ANSI 135-2016, BACnet Annex L and shall be listed as a certified B-SA in the BACnet Testing Laboratories (BTL) Product Listing.
 5. BACnet Communication.
 - a. Each BC shall reside on or be connected to a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

- b. BACnet routing shall be performed by BCs or other BACnet device routers as necessary to connect BCs to networks of AACs and ASCs.
 - c. Each AAC and ASC shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
 - d. Each SA shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
- C. Communication.
- 1. Service Port. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal. Connection shall be extended to space temperature sensor ports where shown on drawings.
 - 2. Signal Management. BC and ASC operating systems shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and to allow for central monitoring and alarms.
 - 3. Data Sharing. Each BC and AAC shall share data as required with each networked BC and AAC.
 - 4. Stand-Alone Operation. Each piece of equipment specified in Sequences of Operation shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network.
- D. Environment. Controller hardware shall be suitable for anticipated ambient conditions.
- 1. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at -20°F to 140°F.
 - 2. Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 32°F to 120°F.
- E. Real-Time Clock. Controllers that perform scheduling shall have a real-time clock.
- F. Serviceability.
- 1. Controllers shall have diagnostic LEDs for power, communication, and processor.
 - 2. Wires shall be connected to a field-removable modular terminal strip or to a termination card connected by a ribbon cable.
 - 3. Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.
- G. Memory.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

1. Controller memory shall support operating system, database, and programming requirements.
 2. Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.
 3. Each ASC and SA shall use nonvolatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.
- H. Immunity to Power and Noise. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft.).
- I. Transformer. ASC power supply shall be fused or current limiting and shall be rated at a minimum of 125% of ASC power consumption.

2.6 INPUT AND OUTPUT INTERFACE

- A. General. Hard-wire input and output points to BCs, AACs, ASCs, or SAs.
- B. Protection. Shorting an input or output point to itself, to another point, or to ground shall cause no controller damage. Input or output point contact with up to 24 V for any duration shall cause no controller damage.
- C. Binary Inputs. Binary inputs shall monitor the on and off signal from a remote device. Binary inputs shall provide a wetting current of at least 12 mA and shall be protected against contact bounce and noise. Binary inputs shall sense dry contact closure without application of power external to the controller.
- D. Pulse Accumulation Inputs. Pulse accumulation inputs shall conform to binary input requirements and shall accumulate up to 10 pulses per second.
- E. Analog Inputs. Analog inputs shall monitor low-voltage (0-10 Vdc), current (4-20 mA), or resistance (thermistor or RTD) signals. Analog inputs shall be compatible with and field configurable to commonly available sensing devices.
- F. Binary Outputs. Binary outputs shall send a pulsed low-voltage signal for pulse width modulation control or an on-or-off signal for on and off control. Building Controller binary outputs shall have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.
- G. Analog Outputs. Analog outputs shall send a modulating 0-10 Vdc or 4-20 mA signal as required to properly control output devices. Each Building Controller analog output shall have a two-position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analog outputs shall not drift more than 0.4% of range annually.
- H. Tri-State Outputs. Control three-point floating electronic actuators without feedback with tri-state outputs (two coordinated binary outputs). Tri-State outputs may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

- I. Pulse-Width Modulation. Control actuators designed for pulse-width modulation with a single binary output that cycle with variable on and off times as determined by the application software. Pulse-width modulation may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.
- J. Universal Inputs and Outputs. Inputs and outputs that can be designated as either binary or analog in software shall conform to the provisions of this section that are appropriate for their designated use.

2.7 POWER SUPPLIES AND LINE FILTERING

- A. Power Supplies. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.
 - 1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand 150% current overload for at least three seconds without trip-out or failure.
 - a. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
 - b. Line voltage units shall be UL recognized and CSA listed.
- B. Power Line Filtering.
 - 1. Provide internal or external transient voltage and surge suppression for workstations and controllers. Surge protection shall have:
 - a. Dielectric strength of 1000 V minimum
 - b. Response time of 10 nanoseconds or less
 - c. Transverse mode noise attenuation of 65 dB or greater
 - d. Common mode noise attenuation of 150 dB or greater at 40-100 Hz

2.8 AUXILIARY CONTROL DEVICES

- A. Motorized Control Dampers.
 - 1. Type. Control dampers shall have linear flow characteristics and shall be parallel- or opposed-blade type as specified below or as scheduled on drawings.
 - a. Outdoor and return air mixing dampers and face-and-bypass dampers shall be parallel-blade and shall direct airstreams toward each other.
 - b. Other modulating dampers shall be opposed-blade.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

- c. Two-position shutoff dampers shall be parallel or opposed-blade with blade and side seals.
 2. Frame. Damper frames shall 13-gauge galvanized steel channel or 1/8 in. extruded aluminum with reinforced corner bracing.
 3. Blades. Damper blades shall not exceed 8 inches in width or 48 inches in length. Blades shall be suitable for medium velocity (2000 fpm) performance. Blades shall be not less than 16 gauge.
 4. Shaft Bearings. Damper shaft bearings shall be as recommended by manufacturer for application, oil impregnated sintered bronze, or better.
 5. Seals. Blade edges and frame top and bottom shall have replaceable seals of butyl rubber or neoprene. Side seals shall be spring-loaded stainless steel. Blade seals shall leak no more than (10 cfm per ft²) at (4 in. w.g.) differential pressure. Blades shall be airfoil type suitable for wide-open face velocity of (1500 fpm).
 6. Sections. Damper sections shall not exceed 48 in. - 60 in. Each section shall have at least one damper actuator.
 7. Linkages. Dampers shall have exposed linkages.
- B. Electric Damper and Valve Actuators.
 1. Stall Protection. Mechanical or electronic stall protection shall prevent actuator damage throughout the actuator's rotation.
 2. Spring-return Mechanism. Actuators used for power-failure and safety applications shall have an internal mechanical spring-return mechanism or an uninterruptible power supply (UPS).
 3. Signal and Range. Proportional actuators shall accept a 0-10 Vdc or a 0-20 mA control signal and shall have a 2-10 Vdc or 4-20 mA operating range.
 4. Wiring. 24 Vac and 24 Vdc actuators shall operate on Class 2 wiring.
 5. Manual Positioning. Operators shall be able to manually position each actuator when the actuator is not powered. Non-spring-return actuators shall have an external manual gear release. Spring-return actuators with more than 60 inch -lb torque capacity shall have a manual crank.
 6. Acceptable Manufacturers:
 - a. Belimo
- C. Control Valves.
 1. General. Select body and trim materials in accordance with manufacturer's recommendations for design conditions and service shown.
 2. Type. Provide two or three-way control valves for two-position or modulating service as shown.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

3. Water Valves.
 - a. Valves providing two-position service shall be quick opening. Two-way valves shall have replaceable disc or ball.
 - b. Close-off (Differential) Pressure Rating. Valve actuator and trim shall provide the following minimum close-off pressure ratings.
 1. Two-way: 100% of total system (pump) head.
 2. Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
 - c. Ports. Valves providing modulating service shall have equal percentage ports.
 - d. Sizing.
 1. Two-position service: line size.
 2. Two-way modulating service: select pressure drop equal to the greatest of twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 35 kPa (5 psi).
 3. Three-way modulating service: select pressure drop equal to the smaller of twice the pressure drop through the coil exchanger (load) or 35 kPa (5 psi).
 4. Two-way and three-way modulating valve shall be one or two sizes smaller than the pipe size.
 - e. Fail Position. Water valves shall fail normally open or closed as follows unless otherwise specified.
 1. Water zone valves: normally closed.
 2. Heating coils in air handlers: normally closed.
 3. Chilled water control valves: normally open.
 4. Other applications: as scheduled or as required by sequences of operation.
 - f. Acceptable Valve and Actuator Manufacturers:
 1. Belimo

D. Binary Temperature Devices.

1. Low-Voltage Space Thermostats. Low-voltage space thermostats shall be 24 V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed setpoint adjustment, 55°F-85°F setpoint range, 2°F maximum differential, and vented ABS plastic cover.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

2. Line-Voltage Space Thermostats. Line-voltage space thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, 55°F-85°F setpoint range, 2°F maximum differential, and vented ABS plastic cover.
 3. Low-Limit Thermostats. Low-limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 20 ft long. Element shall sense temperature in each 1 ft section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only.
- E. Temperature Sensors.
1. Type. Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.
 2. Duct Sensors. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 5 ft in length per 10 ft² of duct cross-section.
 3. Immersion Sensors. Provide immersion sensors with a separable stainless steel well. Well pressure rating shall be consistent with system pressure it will be immersed in. Well shall withstand pipe design flow velocities.
 4. Space Sensors: Space sensors shall be stainless steel flush plate mounted type.
 5. Differential Sensors. Provide matched sensors for differential temperature measurement.
- F. Humidity Sensors.
1. Duct and room sensors shall have a sensing range of 20%-80%.
 2. Duct sensors shall have a sampling chamber.
 3. Outdoor air humidity sensors shall have a sensing range of 20%-95% RH and shall be suitable for ambient conditions of 40°F-170°F.
 4. Humidity sensors shall not drift more than 1% of full scale annually.
- G. Flow Switches. Flow-proving switches shall be thermal dispersion type (IFM U 40100 or approved equal) or differential pressure type (air or water service). Switches shall be UL listed, SPDT snap-acting, and pilot duty rated (125 VA minimum).
1. Thermal dispersion type switches shall have relay output, wire break output and temperature output.
 2. Differential pressure switches shall have scale range and differential suitable for intended application and NEMA 4 enclosure unless otherwise specified.
- H. Relays.
1. Control Relays. Control relays shall be plug-in type, UL listed, and shall have dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

2. Time Delay Relays. Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable $\pm 100\%$ from setpoint shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.
- I. Override Timers.
 1. Unless implemented in control software, override timers shall be spring-wound line voltage, UL Listed, with contact rating and configuration required by application. Provide 0–6-hour calibrated dial unless otherwise specified. Flush mount timer on local control panel face or where shown.
- J. Current Transmitters.
 1. AC current transmitters shall be self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4-20 mA two-wire output. Full-scale unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment. Unit accuracy shall be $\pm 1\%$ full-scale at 500-ohm maximum burden.
 2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.
 3. Unit shall be split-core type for clamp-on installation on existing wiring.
- K. Current Transformers.
 1. AC current transformers shall be UL/CSA recognized and shall be completely encased (except for terminals) in approved plastic material.
 2. Transformers shall be available in various current ratios and shall be selected for $\pm 1\%$ accuracy at 5 A full-scale output.
 3. Use fixed-core transformers for new wiring installation and split-core transformers for existing wiring installation.
- L. Voltage Transmitters.
 1. AC voltage transmitters shall be self-powered single-loop (two-wire) type, 4-20 mA output with zero and span adjustment.
 2. Adjustable full-scale unit ranges shall be 100-130 Vac, 200-250 Vac, 250-330 Vac, and 400-600 Vac. Unit accuracy shall be $\pm 1\%$ full-scale at 500-ohm maximum burden.
 3. Transmitters shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized at 600 Vac rating.
- M. Voltage Transformers.
 1. AC voltage transformers shall be UL/CSA recognized, 600 Vac rated, and shall have built-in fuse protection.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

2. Transformers shall be suitable for ambient temperatures of 4°C-55°C (40°F-130°F) and shall provide $\pm 0.5\%$ accuracy at 24 Vac and 5 VA load.
 3. Windings (except for terminals) shall be completely enclosed with metal or plastic.
- N. Power Monitors.
1. Power monitors shall be three-phase type and shall have three-phase disconnect and shorting switch assembly, UL listed voltage transformers, and UL listed split-core current transformers.
 2. Power monitors shall provide selectable output: rate pulse for kWh reading or 4-20 mA for kW reading. Power monitors shall operate with 5 A current inputs and maximum error of $\pm 2\%$ at 1.0 power factor or $\pm 2.5\%$ at 0.5 power factor.
- O. Current Switches.
1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system output requirements.
- P. Pressure Transducers.
1. Transducers shall have linear output signal and field-adjustable zero and span.
 2. Continuous operating conditions of positive or negative pressure 50% greater than calibrated span shall not damage transducer sensing elements.
 3. Water pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Transducer shall have 4-20 mA output, suitable mounting provisions, and block and bleed valves.
 4. Water differential pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Over-range limit (differential pressure) and maximum static pressure shall be 2000 kPa (300 psi.) Transducer shall have 4-20 mA output, suitable mounting provisions, and 5-valve manifold.
- Q. Differential Pressure Switches. Differential pressure switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum) and shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.
- R. Pressure-Electric (PE) Switches. PE switches shall be UL listed, pilot duty rated (125 VA minimum) or motor control rated, metal or neoprene diaphragm actuated, operating pressure rated for 0-175 kPa (0-25 psig), with calibrated scale minimum setpoint range of 14-125 kPa (2-18 psig).
1. Provide one- or two-stage switch action (SPDT, DPST, or DPDT) as required by application.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

2. Switches shall be open type (panel-mounted). Exception: Switches shall be enclosed type for remote installation. Enclosed type shall be NEMA 1 unless otherwise specified.
 3. Each pneumatic signal line to PE switches shall have permanent indicating gauge.
- S. Local Control Panels.
1. Indoor control panels shall be fully enclosed NEMA 1 construction with hinged door key-lock latch and removable sub-panels. A common key shall open each control panel and sub-panel.
 2. Prewire internal and face-mounted device connections with color-coded stranded conductors tie-wrapped or neatly installed in plastic troughs. Field connection terminals shall be UL listed for 600 V service, individually identified per control and interlock drawings, with adequate clearance for field wiring.
 3. Each local panel shall have a control power source power switch (on-off) with overcurrent protection.

2.9 WIRING AND RACEWAYS

- A. General. Provide copper wiring, plenum cable, and raceways as specified in applicable sections of Division 26.
- B. Insulated wire shall use copper conductors and shall be UL listed for 90°C (200°F) minimum service.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Thoroughly examine project plans for control device and equipment locations. Report discrepancies, conflicts, or omissions to Architect or Engineer for resolution before starting rough-in work.
- B. Inspect site to verify that equipment can be installed as shown. Report discrepancies, conflicts, or omissions to Engineer for resolution before starting rough-in work.
- C. Examine drawings and specifications for work of others. Report inadequate headroom or space conditions or other discrepancies to Engineer and obtain written instructions for changes necessary to accommodate Section 23 09 23 work with work of others. Controls Contractor shall perform at his expense necessary changes in specified work caused by failure or neglect to report discrepancies.

3.2 PROTECTION

- A. Controls Contractor shall protect against and be liable for damage to work and to material caused by Contractor's work or employees.
- B. Controls Contractor shall be responsible for work and equipment until inspected, tested, and accepted. Protect material not immediately installed. Close open ends of work with

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.3 COORDINATION

- A. Site.
 - 1. Assist in coordinating space conditions to accommodate the work of each trade where work will be installed near or will interfere with work of other trades. If installation without coordination causes interference with work of other trades, Contractor shall correct conditions without extra charge.
 - 2. Coordinate and schedule work with other work in the same area and with work dependent upon other work to facilitate mutual progress.
- B. Submittals. See Section 23 09 23 Article 1.9 (Submittals).
- C. Test and Balance.
 - 1. Provide Test and Balance Contractor a single set of necessary tools to interface to control system for testing and balancing.
 - 2. Train Test and Balance Contractor to use control system interface tools.
 - 3. Provide a qualified technician to assist with testing and balancing the first 20 terminal units.
 - 4. Test and Balance Contractor shall return tools undamaged and in working condition at completion of testing and balancing.
- D. Life Safety.
 - 1. Duct smoke detectors required for air handler shutdown are provided and wired under Division 26.
 - 2. Smoke dampers and actuators required for duct smoke isolation are provided under Division 23 and wired by Division 26.
 - 3. Fire and smoke dampers and actuators required for fire-rated walls are provided under Division 23. Fire and smoke damper control is provided under Division 26.
- E. Coordination with Other Controls. Integrate with and coordinate controls and control devices furnished or installed by others as follows.
 - 1. Communication media and equipment shall be provided as specified in Section 23 09 23 Article 2.2 (Communication).
 - 2. Each supplier of a control's product shall configure, program, start up, and test that product to meet the sequences of operation described regardless of where within the contract documents those products are described.
 - 3. Coordinate and resolve incompatibility issues that arise between control products provided under this section and those provided under other sections or divisions of this specification.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

4. Controls Contractor shall be responsible for integration of control products provided by multiple suppliers regardless of where integration is described within the contract documents.

3.4 GENERAL WORKMANSHIP

- A. Install equipment, piping, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.
- B. Provide sufficient slack and flexible connections to allow for piping and equipment vibration isolation.
- C. Install equipment in readily accessible locations as defined by National Electrical Code (NEC) Chapter 1 Article 100 Part A.
- D. Verify wiring integrity to ensure continuity and freedom from shorts and ground faults.
- E. Equipment, installation, and wiring shall comply with industry specifications and standards and local codes for performance, reliability, and compatibility.

3.5 FIELD QUALITY CONTROL

- A. Commissioning and start-up of the BAS system shall be performed factory certified employees of the BAS contractor or manufacturer. Under no instances shall electrical subcontractors perform this work.
- B. Work, materials, and equipment shall comply with rules and regulations of applicable local, state, and federal codes and ordinances as identified in Section 23 09 23 Article 1.7 (Codes and Standards).
- C. Continually monitor field installation for code compliance and workmanship quality.
- D. Contractor shall arrange for work inspection by local or state authorities having jurisdiction over the work.

3.6 WIRING

- A. To differentiate BAS wiring from that of other trades, all cable except for underground will have a **yellow outer jacket** (no exceptions).
- B. Division 26 contractor shall supply a dedicated 120vac power to a junction box in each mechanical room for use by the BMCS.
- C. A Conduit fill based on plenum 18-gauge 2 conductor:
 1. 1/2 inch - No more than 4 conductors.
 2. 3/4 inch - No more than 8 conductors.
 3. 1 inch - No more than 12 conductors.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

- D. Control and interlock wiring and installation shall comply with national and local electrical codes, Division 26, and manufacturer's recommendations. Where the requirements of Section 23 09 23 differ from Division 26, Section 23 09 23 shall take precedence.
- E. All wires whether control network or device wire shall be marked with Brady-type markers.
- F. NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway as specified by NEC and Division 26.
- G. Low-voltage wiring shall meet NEC Class 2 requirements. Sub-fuse low-voltage power circuits as required to meet Class 2 current limit.
- H. NEC Class 2 (current-limited) wires not in raceway but in concealed and accessible locations such as return air plenums shall be UL listed for the intended application.
- I. Install wiring in raceway where subject to mechanical damage and at levels below 10ft. in mechanical, electrical, or service rooms.
- J. Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).
- K. Install Class 1 and Class 2 wiring in separate raceways. Boxes and panels containing high-voltage wiring and equipment shall not be used for low-voltage wiring except for the purpose of interfacing the two through relays and transformers.
- L. Do not install wiring in raceway containing tubing.
- M. Run exposed Class 2 wiring parallel to a surface or perpendicular to it and tie neatly at (5 ft) intervals.
- N. Contractor shall install all low voltage communication wiring as per all TIA/EIA communication cabling standards. All cabling shall be installed in dedicated cabling support such as j-hook, d-rings, or saddles. All supports shall be supported directly from building structure. Do not support cabling or supports from ceiling grid wire, conduit, ductwork, piping, or other system cabling. All cabling must be installed in independent support for that given system and may not share supports or run-in same conduit or support. All cabling shall be supported every 5'-0" from approved cabling support method. Contractor shall bundle all system cabling and label all wiring for system they serve. All cabling passing thru walls shall require dedicated conduit sleeves with bushing to protect cabling during installation. Contractor shall provide 1 meter service loops at all device termination locations and 3-meter service loops at all head end termination locations. All low voltage HVAC control cabling shall be yellow in color unless specified otherwise. Do not use ductwork, electrical raceways, piping, or ceiling suspension systems to support or anchor cables.
- O. Secure raceways with raceway clamps fastened to structure and spaced according to code requirements. Raceways and pull boxes shall not be hung on or attached to ductwork, electrical raceways, piping, or ceiling suspension systems.
- P. Size raceway and select wire size and type in accordance with manufacturer's recommendations and NEC requirements.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

- Q. Include one pull string in each raceway 2.5 cm (1 in.) or larger.
- R. Use color-coded conductors throughout.
- S. Locate control and status relays in designated enclosures only. Do not install control and status relays in packaged equipment control panel enclosures containing Class 1 starters.
- T. Conceal raceways except within mechanical, electrical, or service rooms. Maintain minimum clearance of 15 cm (6 in.) between raceway and high-temperature equipment such as steam pipes or flues.
- U. Adhere to requirements in Division 26 where raceway crosses building expansion joints.
- V. Install insulated bushings on raceway ends and enclosure openings. Seal top ends of vertical raceways.
- W. Terminate control and interlock wiring related to the work of this section. Maintain at the job site updated (as-built) wiring diagrams that identify terminations.
- X. Flexible metal raceways and liquid-tight flexible metal raceways shall not exceed 1 m (3 ft.) in length and shall be supported at each end. Do not use flexible metal raceway less than ½ in. electrical trade size.
- Y. Install raceway rigidly, support adequately, ream at both ends, and leave clean and free of obstructions. Join raceway sections with couplings and according to code. Make terminations in boxes with fittings. Make terminations not in boxes with bushings.

3.7 COMMUNICATION WIRING

- A. Communication wiring shall be low-voltage Class 2 wiring and shall comply with Article 3.7 (Wiring).
- B. Install communication wiring in separate raceways and enclosures from other Class 2 wiring.
- C. During installation do not exceed maximum cable pulling, tension, or bend radius specified by the cable manufacturer.
- D. Verify entire network's integrity following cable installation using appropriate tests for each cable.
- E. Install lightning arrestor according to manufacturer's recommendations between cable and ground where a cable enters or exits a building.
- F. Each run of communication wiring shall be a continuous length without splices when that length is commercially available. Runs longer than commercially available lengths shall have as few splices as possible using commercially available lengths.
- G. Label communication wiring to indicate origination and destination.
- H. Ground coaxial cable according to NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

3.8 FIBER OPTIC CABLE

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

- A. During installation do not exceed maximum pulling tensions specified by cable manufacturer. Post-installation residual cable tension shall be within cable manufacturer's specifications.
- B. Install cabling and associated components according to manufacturers' instructions. Do not exceed minimum cable and unjacketed fiber bend radii specified by cable manufacturer.

3.9 INSTALLATION OF SENSORS

- A. Install sensors according to manufacturer's recommendations.
- B. Mount sensors rigidly and adequately for operating environment.
- C. Install room temperature sensors on concealed junction boxes properly supported by wall framing.
- D. Air seal wires attached to sensors in their raceways or in the wall to prevent sensor readings from being affected by air transmitted from other areas.
- E. Use averaging sensors in mixing plenums and hot and cold decks. Install averaging sensors in a serpentine manner vertically across duct. Support each bend with a capillary clip.
- F. Install mixing plenum low-limit sensors in a serpentine manner horizontally across duct. Support each bend with a capillary clip. Provide 1 ft. of sensing element for each 1 ft. ² of coil area.
- G. Install pipe-mounted temperature sensors in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells.
- H. Install outdoor air temperature sensors on north wall at designated location with sun shield.
- I. Differential Air Static Pressure.
 - 1. Supply Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.
 - 2. Return Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.
 - 3. Building Static Pressure. Pipe pressure sensor's low-pressure port to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe high-pressure port to a location behind a thermostat cover.
 - 4. Piping to pressure transducer pressure ports shall contain a capped test port adjacent to transducer.
 - 5. Pressure transducers, except those controlling VAV boxes, shall be located in control panels, not on monitored equipment or on ductwork. Mount transducers in a vibration-free location accessible for service without use of ladders or special equipment.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

- 6. Mount gauge tees adjacent to air and water differential pressure taps. Install shut-off valves before tee for water gauges.
- J. Smoke detectors, freezestats, high-pressure cut-offs, and other safety switches shall be hard-wired to de-energize equipment as described in the sequence of operation. Switches shall require manual reset. Provide contacts that allow DDC software to monitor safety switch status.

3.10 FLOW SWITCH INSTALLATION

- A. Adjust flow switch according to manufacturer's instructions.

3.11 ACTUATORS

- A. General. Mount actuators and adapters according to manufacturer's recommendations.
- B. Electric and Electronic Damper Actuators. Mount actuators directly on damper shaft or jackshaft unless shown as a linkage installation. Link actuators according to manufacturer's recommendations.
 - 1. For low-leakage dampers with seals, mount actuator with a minimum 5° travel available for damper seal tightening.
 - 2. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten linkage.
 - 3. Check operation of damper-actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 - 4. Provide necessary mounting hardware and linkages for actuator installation.

3.12 IDENTIFICATION OF HARDWARE AND WIRING

- A. Label wiring and cabling, including that within factory-fabricated panels, with control system address or termination number at each end within 5 cm (2 in.) of termination.
- B. Label pneumatic tubing at each end within 5 cm (2 in.) of termination with a descriptive identifier.
- C. Permanently label or code each point of field terminal strips to show instrument or item served.
- D. Label control panels with minimum 1 cm (½ in.) letters on laminated plastic nameplates.
- E. Label each control component with a permanent label. Label plug-in components such that label remains stationary during component replacement.
- F. Label valves with nameplates.
- G. Manufacturers' nameplates and UL or CSA labels shall be visible and legible after equipment is installed.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

- H. Label identifiers shall match record documents.

3.13 PROGRAMMING

- A. Point Naming. Name points as shown on the equipment points list provided with each Sequence of Operation. Where multiple points with the same name reside in the same controller, each point name may be customized with its associated Program Object number. For example, "Zone Temp 1" for Zone 1, "Zone Temp 2" for Zone 2.
- B. All DDC programming shall be accomplished through graphical programming, line code is unacceptable
- C. Software Programming. Programming shall provide actions for each possible situation. Graphic- or parameter-based programs shall be documented.
 - 1. Application Programming. Provide application programming that adheres to sequences of operation specified in Section 23 09 93. Program documentation or comment statements shall reflect language used in sequences of operation.
 - 2. System Programming. Provide system programming necessary for system operation.
- D. Operator Interface.
 - 1. Standard Graphics. Provide graphics as specified in Section 23 09 23 Article 2.3 Paragraph E.2 (System Graphics). Show on each equipment graphic input and output points and relevant calculated points such as indicated on the applicable Points List located in the Sequence of Operation. Point information on graphics shall dynamically update.
 - 2. Install, initialize, start up, and troubleshoot operator interface software and functions (including operating system software, operator interface database, and third-party software installation and integration required for successful operator interface operation) as described in Section 23 09 23.
 - 3. DDC screen graphic room numbers shall be based on final room graphics package. Obtain Architect/Owner approval of final room numbers prior to programming.

3.14 CONTROL SYSTEM CHECKOUT AND TESTING

- A. Startup Testing. Complete startup testing to verify operational control system before notifying Owner of system demonstration. Provide Owner with schedule for startup testing. Owner may have representative present during any or all startup testing.
 - 1. Calibrate and prepare for service each instrument, control, and accessory equipment furnished under Section 23 09 23.
 - 2. Verify that control wiring is properly connected and free of shorts and ground faults. Verify that terminations are tight.
 - 3. Enable control systems and verify each input device's calibration. Calibrate each device according to manufacturer's recommendations.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

4. Verify that binary output devices such as relays, solenoid valves, two-position actuators and control valves, and magnetic starters, operate properly and that normal positions are correct.
5. Verify that analog output devices such as I/Ps and actuators are functional, that start and span are correct, and that direction and normal positions are correct. Check control valves and automatic dampers to ensure proper action and closure. Make necessary adjustments to valve stem and damper blade travel.
6. Prepare a log documenting startup testing of each input and output device, with technician's initials certifying each device has been tested and calibrated.
7. Verify that system operates according to sequences of operation. Simulate and observe each operational mode by overriding and varying inputs and schedules. Tune PID loops and each control routine that requires tuning.
8. Alarms and Interlocks.
 - a. Check each alarm with an appropriate signal at a value that will trip the alarm.
 - b. Trip interlocks using field contacts to check logic and to ensure that actuators fail in the proper direction.
 - c. Test interlock actions by simulating alarm conditions to check initiating value of variable and interlock action.

3.15 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

- A. Demonstration. Prior to acceptance, perform the following performance tests to demonstrate system operation and compliance with specification after and in addition to tests specified in Article 3.15 (Control System Checkout and Testing). Provide Engineer with log documenting completion of startup tests.
 1. Preliminary Review: At least 7 days prior to on-site demonstration, provide read-only username and password to Engineer for preliminary system review to be performed remotely. Engineer will review to verify all systems are connected and communicating and all points are reading properly, and graphics are complete. The Engineer will provide a report of any deficiencies. The contractor shall correct all deficiencies prior to on-site demonstration.
 2. On-site Demonstration: Engineer, Owner, contractor(s) and any/all factory authorized equipment representatives shall be present to perform, observe and review system demonstration. Notify Engineer/Architect at least 10 days before system demonstration is scheduled.
 - a. Demonstration shall follow process submitted and approved under Section 23 09 23 Article 1.9 (Submittals). Complete approved checklists and forms for each system as part of system demonstration.
 - b. Demonstrate actual field operation of each sequence of operation as specified in Section 23 09 93. Provide at least two persons equipped with two-way communication. Demonstrate calibration and response of any

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

- input and output points requested by Engineer. Provide and operate test equipment required to prove proper system operation.
- c. Demonstrate compliance with sequences of operation through each operational mode.
 - d. Demonstrate complete operation of operator interface.
 - e. Demonstrate each of the following.
 - f. DDC loop response. Supply graphical trend data output showing each DDC loop's response to a setpoint change representing an actuator position change of at least 25% of full range. Trend sampling rate shall be from 10 seconds to 3 minutes, depending on loop speed. Each sample's trend data shall show setpoint, actuator position, and controlled variable values. Engineer will require further tuning of each loop that displays unreasonably under- or over-damped control.
 - g. Demand limiting. Supply trend data output showing demand-limiting algorithm action. Trend data shall document action sampled each minute over at least a 30-minute period and shall show building kW, demand-limiting setpoint, and status of setpoints and other affected equipment parameters.
 - h. Building fire alarm system interface.
 - i. Trend logs for each system. Trend data shall indicate setpoints, operating points, valve positions, and other data as specified in the points list provided with each sequence of operation in Section 23 09 93. Each log shall cover three 48-hour periods and shall have a sample frequency not less than 10 minutes or as specified on its points list. Logs shall be accessible through system's operator interface and shall be retrievable for use in other software programs as specified in Section 23 09 23 Article 2.3 Paragraph F.11 (Trend Configuration).
3. Tests that fail to demonstrate proper system operation shall be repeated after Contractor makes necessary repairs or revisions to hardware or software to successfully complete each test.
- B. Acceptance.
1. After tests described in this specification are performed to the satisfaction of both Engineer and Owner, Engineer will accept control system as meeting completion requirements. Engineer may exempt tests from completion requirements that cannot be performed due to circumstances beyond Contractor's control. Engineer will provide written statement of each exempted test. Exempted tests shall be performed as part of warranty.
 2. System shall not be accepted until completed demonstration forms and checklists are submitted and approved as required in Section 23 09 23 Article 1.9 (Submittals).

3.16 CLEANING

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

- A. Each day clean up debris resulting from work. Remove packaging material as soon as its contents have been removed. Collect waste and place in designated location.
- B. On completion of work in each area, clean work debris and equipment. Keep areas free from dust, dirt, and debris.
- C. On completion of work, check equipment furnished under this section for paint damage. Repair damaged factory-finished paint to match adjacent areas. Replace deformed cabinets and enclosures with new material and repaint to match adjacent areas.

END OF SECTION 23 09 23

SECTION 23 09 93 - SEQUENCES OF OPERATION FOR HVAC CONTROLS

GENERAL:

- The BAS contractor shall provide all points listed under “Equipment Control Points” as well as any points required to accomplish the sequences of operation listed below. Refer to Specification 23 09 23 for input/output device specifications. Refer to contract drawings for additional items that may not be included in this specification. At the 11 month walk-thru, BAS contractor shall provide an additional DDC demonstration (in addition to the demonstration before substantial completion).
- BAS contractor shall schedule and participate in a pre-construction integration meeting with all vendors providing BACnet/Modbus or other equipment that is being integrated to the BAS. Sample graphics shall be submitted for owner review. The meeting is a requirement and shall include but not limited to:
 - Communications Requirements (MSTP/IP)
 - Points (Read/Write)
 - Connection Requirements (CAT5/6, 2-wire, 4-wire)
 - Coordinate Communication speeds when devices are MSTP.
 - Coordinate or Establish Device Instance Numbering System
 - Coordinate final points list(s) with owner/engineer
- Building automation systems sub-contractor shall provide and install step down transformers in each mechanical room and run low voltage communication wiring power loops to serve low voltage actuators installed at each Air Terminal Unit.
- All BAS exposed control wiring below the ceiling and especially outdoors (rigid) shall be in conduit; furnished and installed by bas subcontractor.
- No portion of the total contract will be declared substantially complete until the graphics and automatic temperature control system has been demonstrated to be complete and functioning as intended. The BAS system will be complete and functioning as intended when all of the space temperatures are maintained at plus or minus two degrees of set point.
- Provide dehumidification control in gym.
- BAS shall BACnet interface to all equipment provided with on-board controls. See schedule on mechanical plans.
- Add to equipment schedule – Any BACnet interfaced equipment must come with an onboard controller that is BTL listed. The BACnet controller must make all BACnet points available to the BMS.
- Controller manufacturer for BACnet controlled equipment must provide onsite dedicated resources for the setup of the integration to BMS.
- The controls contractor shall provide and install Needlepoint Bipolar Ionization (NPBI) devices for all = RTUs manufactured by Global Plasma Solutions (GPS). For RTUs taller than 4 feet, a second iMOD device must be provided and installed in the RTU for desired ion output. For RTUs, an on/off switch and transformer must be installed and connect to the nearest 120V circuit. A NEMA 4 outdoor rated box must be provided for all RTUs. All wiring in mechanical rooms must be run in new conduit with flex cabling to the unit. No MC cables acceptable.
- **Integration into existing control system: All new control system components including, but not limited to, direct digital controllers, central processing units, control software, etc., shall**

be seamlessly integrated to the existing Unify control system. It shall be the responsibility of the contractor to ensure all new equipment provided is compatible with the exiting control system. The contractor shall provide all software and hardware upgrades, whether existing or new, as required to complete the integration.

- **Onboard/factory-provided controllers are not acceptable for packaged equipment. All packaged equipment shall be provided with full BACnet integration capabilities such that the BAS has full control and monitoring capabilities as described in this section. No exceptions.**
- **All new hydronic equipment shall be integrated into the existing Unify system. Dry contacts are to be provided from all new hydronic units to existing control system serving the central plant such that plant is energized when new equipment sends a cooling/heating call and plant is de-energized when new units de-energize. New units shall not de-energize/override control of the plant when existing units are in operation.**

1. CHILLED WATER SYSTEM – PRIMARY / SECONDARY PUMPING

Central plant consists of existing chillers with dedicated primary chilled water pumps and secondary chilled water pumps for primary/secondary pumping system. New secondary chilled water pump shall be installed such that it may operate independently of the existing system.

Equipment Control Points:

Plant CHW flow – AI
Building CHW differential pressure – AI
SCHP pump status– DI
Chiller start/stop – DO
SCHP pump start/stop – DO
SCHP pump speed control – AO

Chilled Water System Activation

Existing plant controls shall remain in place. All new hydronic equipment shall be integrated into the existing Unify system. Dry contacts are to be provided from all new hydronic units to existing control system serving the central plant such that plant is energized when new equipment sends a cooling call and plant is de-energized when new units de-energize. New units shall not de-energize/override control of the plant when existing units are in operation.

Secondary Chilled Water Pump Control

The new secondary pump shall be requested to run from the equipment being served. When the chilled water system is active, the secondary chilled water pump (SCHP) shall be enabled. When the SCHP is commanded to run, a current switch shall prove status to the BAS, which shall alarm at the central site if the switch is not made within 20 seconds (adjustable). If the pump indicates a bad status alarm the BAS shall discontinue the start signal to the SCHP.

A new differential pressure sensor across the building chilled water supply and return lines for the new secondary system shall monitor building differential pressure across the mains. The BAS shall modulate the speed of the operating secondary chilled water pump to maintain the building chilled water differential pressure at setpoint (adjustable).

The BAS shall monitor the position of all the chilled water valves of the units that the new secondary pump serves and the new differential pressure setpoint shall be reset based on achieving a target valve position of 90%. There shall be a dead band of 5% to prevent hunting of the reset program. The chilled water flow shall not change by more than 10 percent per minute. The target valve position, the reset time, the dead band, and the rate of change values shall be operator adjustable.

Chilled Water Decoupled Loop

When the chilled water system is active, decoupled loop flow and temperature will be monitored and trended by the BAS. If the decoupled loop temperature is greater than chilled water supply by 10°F (adjustable), and the building supply temperature is greater than setpoint by 3°F (adjustable) for 30 minutes the plant shall increment to the next available state.

Freeze Protection

When the outdoor air temperature drops to 35°F (adjustable) or below, the BAS shall open the chilled water valves for flow through the coils for freeze protection and the secondary chilled water pump system shall be activated to run until the low ambient temperature ceases to exist.

2. HEATING WATER SYSTEM

The central plant consists of existing boilers with dedicated primary hot water pumps. A new variable flow hot water pump shall be installed such that it may operate independently of the existing system.

Equipment Control Points:

HW Pump status (each pump) – DI
Boiler system enable – DO
HW pump start/stop (each pump) – DO
HW Pump speed control (each pump) – AO
Hot Water differential Pressure – AI

Heating Water System Activation

Existing plant controls shall remain in place. All new hydronic equipment shall be integrated into the existing Unify system. Dry contacts are to be provided from all new hydronic units to existing control system serving the central plant such that plant is energized when new equipment sends a heating call and plant is de-energized when new units de-energize. New units shall not de-energize/override control of the plant when existing units are in operation.

Heating Water Pump Control

The new pump shall be requested to run from the equipment being served. When the heating water system is active, the heating water pump shall be enabled. When the heating water pump is commanded to run, a current switch shall prove status to the BAS, which shall alarm at the central site if the switch is not made within 20 seconds (adjustable). If the pump indicates a bad status alarm the BAS shall discontinue the start signal to the heating water pump.

Differential Pressure Control

A new differential pressure sensor across the building heating water supply and return lines shall monitor building differential pressure across the mains. The BAS shall modulate the speed of the new heating water pump to maintain the building heating water differential pressure at setpoint (adjustable - final setpoint determined by TAB contractor).

The BAS shall monitor the position of all the heating water valves and the new differential pressure setpoint shall be reset based on achieving a target valve position of 90%. There shall be a dead band of 5% to prevent hunting of the reset program. The heating water flow shall not change by more than 10 percent per minute. The target valve position, the reset time, the dead band, and the rate of change values shall be operator adjustable.

Freeze Protection

When the outdoor air temperature drops to 35°F (adjustable) or below, the BAS shall open the hot water valves to flow through the coils for freeze protection. The hot water system shall be activated to run and the building HW supply set point shall be set to 100°F (adjustable) while running the boiler only until the low ambient temperature ceases to exist or the building start-up time arrives.

3. SINGLE ZONE VAV PACKAGED RTU WITH GAS HEAT & DEMAND CONTROL VENTILATION (RTU-L1)

Equipment Control Points

Space Temperature – AI
Space Humidity – AI
Space CO₂ - AI
Supply Air Temperature – AI
Gas Heat Capacity – AI
RTU Alarm Status – DI
RTU Fan Status – Current Switch - DI
DX Cooling Percent Capacity – AI
Hot Gas Reheat Capacity – AI
RTU Start/Stop – DO

Zone Occupancy

The BAS will have an occupancy/vacancy schedule, occupied heating/cooling set points and unoccupied heating/cooling set points assigned to it. As the occupancy time approaches, an optimum start/stop program will calculate a start time based on current space temperature versus the occupied heating or cooling set point, assigned recovery rate, and outside air temperature -- all variables are operator assignable from the central site. The BAS program shall have the ability to learn its recovery rate whenever the operator enables the learning feature.

Unit Control

When the calculated start time arrives, the B.A.S. will send a signal to the RTU controller to enable the unit. A fan airflow proving switch will prove status to the RTU controller and will alarm at the central site if the switch is not made within 60 seconds (operator adjustable). There will also be a 60 second (operator adjustable) de-bounce time to prevent nuisance alarms from a bouncing switch.

Temperature Control

A wall mounted space temperature sensor shall monitor the air temperature in the space. The B.A.S. will output separate signals to enable the DX Cooling and GAS heat to maintain the space temperature within its operator adjustable heating and cooling set points.

Space Humidity Control

A humidity sensor shall monitor the humidity in the space. When humidity is above setpoint, the refrigeration capacity shall modulate to maintain the evaporator coil temperature setpoint of 50°F (adj.), and the hot gas reheat valve shall be modulated to maintain the cooling and heating setpoint.

Demand Control Ventilation

When the unit is running in the occupied mode, the O.A. damper control shall open. A CO₂ sensor mounted in space shall monitor the CO₂ level. The B.A.S. shall modulate the outdoor air damper from its minimum position to its maximum position as required to maintain the CO₂ level at between 850 ppm and 1,000 ppm (all adjustable). The OA dampers minimum and maximum positions shall be determined with the T.A.B. contractor to be the positions that allow the scheduled minimum and maximum OA CFM.

The outside air damper shall remain closed during a scheduled occupancy time based on a global command from a shelter in place (building shutdown) button activation or based on a summer mode schedule.

Equipment off Conditions

When the RTU is de-energized, the supply fan shall de-energize and the OA damper shall be fully closed. In the event of a power loss or system reset the OA damper shall close.

Bipolar Ionization

The BAS shall monitor the alarm contact on the bipolar ionization device and alarm at the central site upon receiving a signal.

4. SINGLE ZONE VAV PACKAGED RTU WITH GAS HEAT (RTU-J1 & RTU-K1)

Equipment Control Points

Space Temperature – AI
Space Humidity – AI
Supply Air Temperature – AI
Gas Heat Capacity – AI
RTU Alarm Status – DI
RTU Fan Status – Current Switch - DI
DX Cooling Percent Capacity – AI
Hot Gas Reheat Capacity – AI
RTU Start/Stop – DO

Zone Occupancy

The BAS will have an occupancy/vacancy schedule, occupied heating/cooling set points and unoccupied heating/cooling set points assigned to it. As the occupancy time approaches, an optimum start/stop program will calculate a start time based on current space temperature versus the occupied heating or cooling set point, assigned recovery rate, and outside air temperature -- all variables are operator assignable from the central site. The BAS program shall have the ability to learn its recovery rate whenever the operator enables the learning feature.

Unit Control

When the calculated start time arrives, the B.A.S. will send a signal to the RTU controller to enable the unit. A fan airflow proving switch will prove status to the RTU controller and will alarm at the central site if the switch is not made within 60 seconds (operator adjustable). There will also be a 60 second (operator adjustable) de-bounce time to prevent nuisance alarms from a bouncing switch.

Temperature Control

A wall mounted space temperature sensor shall monitor the air temperature in the space. The B.A.S. will output separate signals to enable the DX Cooling and GAS heat to maintain the space temperature within its operator adjustable heating and cooling set points.

Space Humidity Control

A humidity sensor shall monitor the humidity in the space. When humidity is above setpoint, the refrigeration capacity shall modulate to maintain the evaporator coil temperature setpoint of 50°F (adj.), and the hot gas reheat valve shall be modulated to maintain the cooling and heating setpoint.

Equipment off Conditions

When the RTU is de-energized, the supply fan shall de-energize and the OA damper shall be fully closed. In the event of a power loss or system reset the OA damper shall close.

Bipolar Ionization

The BAS shall monitor the alarm contact on the bipolar ionization device and alarm at the central site upon receiving a signal.

5. VARIABLE AIR VOLUME - PACKAGED ROOFTOP (RTU-S1, RTU-S2, RTU-S3)

All controls devices external to units shall be provided by the RTU manufacturer and installed by the controls contractor.

The Rooftop units shall have a factory furnished controller with BACnet card. The BAS contractor shall furnish and install remote sensors and shall provide and install a BACnet interface and wiring.

The BAS contractor shall coordinate with the unit manufacturer to ensure device compatibility with factory controller and sequences of operation meet specifications and to also discover and incorporate all available control points. RTU manufacturer shall verify software provided with the factory controller matches sequences of operation. The RTU manufacturer and the BAS contractor shall both commission the unit and verify operation. RTU shall be able to have all equipment control points available via BAS and **shall have read and write capability**.

Equipment Control Points

Supply Air Temperature – AI

Supply Air Temperature Cooling & Heating Setpoints – (2) AO (BACnet via BAS)

Space Carbon dioxide – AI (BACnet via BAS)

Space Carbon Dioxide (CO2) Minimum & Maximum Setpoints – (2) AO (BACnet via BAS)

Supply Duct Static Pressure – AI

Supply Duct Static Pressure Setpoint – AO (BACnet via BAS)

Evaporator Coil Temperature – AI

Evaporator Coil Temperature Setpoint – AO (BACnet via BAS)

Unit Status – DI

Fan Status (Supply and Exhaust) – DI

Outside air damper – AO (BACnet via BAS)

Fan VFD Speed – AO (BACnet via BAS)

DX Cooling Capacity – AI

Static pressure high limit - DI

Unit Start/Stop – DO (Hardwired by BAS)

Zone Occupancy

Each rooftop unit shall have an occupancy / vacancy schedule, occupied heating / cooling setpoints assigned to it by the BAS. Each rooftop unit shall be enabled by the BAS based on the programmed occupancy schedule. When the unit is enabled, the outside air damper shall fully open and the supply fan shall be enabled.

Fan Control

A fan airflow proving switch shall prove status to the unit controller and shall alarm at the central site if the switch is not made within 60 seconds.

Air Volume Control

While the rooftop unit is active, the BAS shall maintain the duct static pressure setpoint at 1.5" w.g. (adjustable, final setpoint to be determined by TAB contractor) by modulating the speed of the supply fan through a variable speed drive (VSD). A static pressure sensor mounted two-thirds down the longest duct run shall monitor the duct static pressure. A manual-reset static pressure high limit switch shall monitor the static pressure of the supply duct. If the duct static pressure rises above 3.0" w.g. (locally adjustable) the rooftop unit shall be de-energized via hard-wire interlock to the VFD safety circuit. The BAS shall monitor the high static limit switch and shall display an alarm at the central site. The static pressure high limit switch must be manually reset.

Demand Control Ventilation

When the RTU is scheduled to run, the OA damper shall modulate from a minimum position to the maximum position based on the space carbon dioxide level. If the level is 700 PPM the damper shall be at its minimum. If the level is 1,000 PPM the damper shall be at its maximum. All values adjustable.

Economizer Operation

Economizer operation is enabled when the Outdoor Air (OA) drybulb, wetbulb, or dewpoint temperature falls below the Economizer Enable Setpoint by 1°F and if the Outdoor Temperature is at least 5°F below the Return Air Temperature (if that value is available). Economizer operation is disabled when the OA temperature rises 1°F above the Economizer Enable Setpoint. The Economizer acts as the 1st stage of cooling and controls to the Active Supply Air Cooling Setpoint.

An Economizer Minimum Position can be programmed into the controller. During Economizer Operation, the economizer will modulate between this minimum position and 100%. If the economizer reaches 100% and the Supply Air Temperature is still above setpoint, mechanical cooling is then allowed to stage up while the economizer is held at the full open position. Any time cooling stages are currently running, and the economizer becomes enabled, it will immediately open to 100%. During Heat and Vent Modes, the Economizer will remain at its minimum position. During Unoccupied Mode, the Economizer can be used for night setback free cooling; otherwise it will remain closed.

Equipment off Conditions

When the unit is de-energized, the cooling and heating stages shall remain off and the outside air damper shall be fully closed.

6. SINGLE DUCT VAV AIR HANDLING UNITS WITH DEMAND CONTROL VENTILATION (AHU-B1, AHU-B2)

Equipment Control Points

Supply air temperature – AI
Discharge air temperature (each coil) – AI
Supply air duct static pressure – AI
Fan status – DI
High Static pressure limit – DI
Fan start/stop – DO
Fan speed control – AO
Chilled water valve control - AO
OA damper control – AO

AHU Activation

Each Single Duct variable air volume air handler shall be activated by a time-of-day schedule and shall broadcast an occupancy command to the associated terminal units.

Fan Control

When the air handler is scheduled to run, the B.A.S. controller will send signal to the air handler inverter, which will energize the fan. A current switch will prove status to the Building Automation System (BAS) and alarm the central site if the switch is not made within 20 seconds (operator adjustable). There will also be a 10 second (operator adjustable) de-bounce time to prevent nuisance alarms from a bouncing switch. A run request will be sent to the Chilled Water System when the air-handling unit is active, and cooling is required.

Cold Deck Temperature Control

When the air handling unit is in occupied mode and cooling is required, the BAS shall send a request for cooling to the chiller plant and shall modulate the chilled water control valve to maintain leaving air temperature setpoint (55 °F, adjustable). The BAS shall have the ability to reset the leaving air temperature based on cooling request. When there are no cooling requests, the leaving air temperature setpoint shall reset up to a maximum of 58 °F (adjustable). When 2 (adjustable) or more cooling requests are present, the leaving air temperature setpoint shall reset down to 52 °F (adjustable). The reset shall not exceed more than 0.2 °F (adjustable) every 3 minutes (adjustable).

Air Volume Control

While the air handling unit is active, the BAS shall maintain the duct static pressure setpoint at 1.5" w.g. (adjustable, final setpoint to be determined by TAB contractor) by modulating the speed of the supply fan through a variable speed drive (VSD). A static pressure sensor mounted two-thirds down the longest duct run shall monitor the duct static pressure. A manual-reset static pressure high limit switch shall monitor the static pressure of the supply duct. If the duct static pressure rises above 3.0" w.g. (locally adjustable) the air handling unit shall be de-energized via hard-wire interlock to the VFD safety circuit. The BAS shall monitor the high static limit switch and shall display an alarm at the central site. The static pressure high limit switch must be manually reset.

The static pressure shall reset to achieve a target damper setpoint of 85% with a 5% dead-band. Static pressure shall reset by not more than 0.2" W.C. every 3 minutes. Static pressure shall be a minimum of 0.5" W.C.

Demand Control Ventilation

When the air handler is running in the occupied mode, the O.A. damper control shall be enabled and a request to run shall be sent to the OAHU that supplies the unit with outside air. A CO₂ sensor mounted in various spaces (see series fan powered box sequence) shall monitor the CO₂ level in the spaces. The B.A.S. shall select the highest level or average (user adjustable from settings page) to modulate the OA damper. The B.A.S. shall modulate the outdoor air damper from its minimum position to its maximum position as required to maintain the CO₂ level at between 850 ppm and 1,000 ppm (all adjustable). The OA dampers minimum and maximum positions shall be determined with the T.A.B. contractor to be the positions that allow the scheduled minimum and maximum OA CFM.

The outside air damper shall remain closed, and the OAHU shall remain off even during a scheduled occupancy time based on a global command from a shelter in place (building shutdown) button activation or based on a summer mode schedule.

Unoccupied Control

The AHU shall monitor the space temperature sensors and give the ability to select the high/low or average of the accumulation. If the space temperature reaches the operator adjustable unoccupied setpoints of 55°F (adjustable) heating and 95°F (adjustable) cooling, the required equipment shall be started and run to maintain the space temperature within the setpoints. All values are operator adjustable.

Associated Equipment

During the occupied time period, a request to run shall be sent to the corresponding exhaust fans and OAHU. The exhaust fans associated with the air handler shall be energized only during the occupied time period. The OAHU's & exhaust fans shall remain off, even during a scheduled occupancy time based on a global command from a shelter in place (building shutdown) button activation or based on an outdoor air shutdown schedule.

Equipment off Conditions

When the air handling unit is de-energized, the cooling valve shall be closed, the outside air damper shall be closed, and any associated exhaust fans and OAHUs shall be de-energized.

7. CONSTANT VOLUME OUTDOOR AIR HANDLING UNITS (OAHU-B1, OAHU-B2)

Equipment Control Points

Discharge air temperature – AI
Discharge CHW coil air temperature – AI
Discharge preheat HW coil air temperature – AI
Fan status – DI
Static pressure high limit – DI (and hardwire interlock)
CHW valve control – AO
Pre-heat valve control – AO
Fan speed control – AO
Fan start/stop – DO
OA damper with end switch – DO
Freeze stat – DI

Unit Activation

When an outdoor air handling unit fan is requested to run by an air handler it serves, the BAS shall open the outdoor air damper. When the damper is fully open, the actuators' internal end switch shall

close, completing the VSD safety interlock circuit. The BAS shall send a start signal to the VSD to energize the fan. A current switch shall prove status to the BAS and shall alarm at the central site if the switch is not made within 10 seconds (adjustable).

Temperature Control

When the outdoor air handling unit is active, and heating is required a duct mounted temperature sensor mounted downstream of the preheat coil shall modulate the preheat water control valve actuator to maintain discharge air temperature setpoint of 50°F (adjustable). If cooling is required a duct mounted temperature sensor mounted in the unit's supply air stream shall monitor the unit's supply air temperature and modulate the chilled water control valve actuator to maintain the discharge air temperature setpoint of 55°F (adjustable).

Freeze Protection

A manual reset freeze stat shall be mounted in the discharge air stream of the heating coil. The normally closed contacts of the switch shall be wired in series with the VSD safety interlock circuit so that, when activated, the VSD will shut down the fan. Upon sensing a low limit condition, the BAS shall open the HW and CHW control valves, close the outdoor air damper, energize the hot water pump and boiler (see heating water sequence of operation), and alarm at the central site.

Equipment Off Conditions

When the outdoor air handling unit is off, its chilled water valve, heating water valve and outdoor air damper shall be closed.

8. SERIES FAN-POWERED AIR TERMINAL UNITS (CVB) – HOT WATER RE-HEAT

Equipment Control Points

Space temperature – AI
Discharge temperature - AI
Cold deck flow – AI
Cooling damper – FM
Fan start/stop – DO
Hot water motorized control valve – FM

Zone Occupancy

Each CVB shall have an occupancy/vacancy schedule, occupied heating/cooling setpoints and unoccupied heating/cooling setpoints assigned to it. As the occupancy time approaches, an optimum start/stop program shall calculate a start time based on current space temperature verses the occupied heating or cooling setpoint, assigned recovery rate, and outdoor air temperature - all variables are operator assignable from the central site. The CVB Box control program shall have the ability to learn its recovery rate whenever the operator enables the learning feature.

When the CVB Boxes calculated start, time arrives its fan shall be energized and continue to run until the unoccupied period arrives.

Temperature Control

When the zone becomes active, the CVB controller shall determine, based on the space temperature, whether heating or cooling is required. If cooling is required, the cooling air damper shall be modulated open to its operator adjustable maximum cooling CFM setpoint and a run signal shall be sent to the unit serving the CVB. As the space temperature returns to setpoint, the CVB cooling air damper shall modulate to its operator adjustable minimum cooling CFM setpoint. If heating is required, the cooling air damper shall remain at its operator adjustable minimum CFM setpoint and the hot water reheat valve shall modulate to maintain the heating setpoint.

Unoccupied Control

During the unoccupied time period, the CVB cooling damper shall be closed (operator adjustable) and its fan shall be de-energized. If the space temperature reaches the operator adjustable unoccupied setpoints of 55°F heating and 95°F cooling, the required equipment shall be started and run to

maintain the space temperature within the setpoints.

9. SERIES FAN POWERED AIR TERMINAL UNIT (CVB) – WITH ELECTRIC HEAT

Equipment Control Points

Space temperature – AI

Discharge temperature - AI

Cold deck flow – AI

Fan Start/stop – DO

Infrared Occupancy Sensor Status - DI

Cooling damper – FM

Electric Heat – DO (qty to match equipment)

Space CO₂ (where applicable, Combo Space and CO₂ sensor) – AI

Zone Occupancy

The parent AHU shall have an occupancy schedule assigned to it. Upon occupancy the AHU shall broadcast an occupancy signal to the terminal unit.

When the CVB Boxes calculated start time arrives its internal fan motor shall be energized and continue to run until the unoccupied period arrives.

CO₂ Readings

The CO₂ levels shall be measured in the spaces and broadcast to the applicable parent AHU. See AHU sequences for Demand Control Ventilation control.

Occupied/Vacancy

Each terminal unit will monitor the status input on the infrared occupancy sensor in the classrooms. The sensors shall be provided by the BAS. During an occupied state if the local occupancy sensor detects an unoccupied room the BAS will enter the occupied vacant state. In this mode of operation, the zone setpoints will be adjusted outward by 3°F (adjustable) heating and 3°F (adjustable) cooling.

Temperature Control

When the zone becomes active, the CVB controller shall determine, based on the space temperature, whether heating or cooling is required. If cooling is required, the cooling air damper shall be modulated open to its operator adjustable maximum cooling CFM setpoint and a run signal shall be sent to the air handling unit serving the CVB. As the space temperature returns to setpoint, the CVB cooling air damper shall modulate to its operator adjustable minimum cooling CFM setpoint.

The cooling damper actuator shall use a stepper motor so its position can be accurately tracked for display on the CVB graphic and collected by the air-handling unit serving the CVB to reset the air handling unit static pressure setpoint.

When heating is required, the CVB terminal damper will be maintained at its adjustable minimum heating CFM setpoint, and the electric heating strip will be modulated to maintain the space temperature.

Unoccupied Control

During the unoccupied time period, the CVB cooling damper shall be closed (operator adjustable) and its fan shall be de-energized. If the space temperature reaches the operator adjustable unoccupied heating setpoints of 55°F, the terminal fan shall be enabled and shall modulate the electric heat strip to maintain the space temperature within setpoint. If the space temperature reaches the operator adjustable unoccupied cooling setpoint of 95°F, the required equipment shall be started and run to maintain the space temperature within the setpoints. See AHU for unoccupied sequence of operation.

10. COOLING ONLY VAV AIR TERMINAL UNITS

Equipment Control Points

Space temperature – AI
Discharge air temperature - AI
Cold deck flow - AI
Cooling damper – FM (floating motor)

Zone Occupancy

The parent AHU shall have an occupancy schedule assigned to it. Upon occupancy the AHU shall broadcast an occupancy signal to the terminal unit.

Temperature Control

When the zone becomes active, the VAV controller shall determine based on the space temperature, if cooling is required. If cooling is required, the cooling air damper shall be modulated open to its maximum cooling CFM setpoint (adjustable) and a run request shall be sent to the air handling unit serving the VAV. As the space temperature returns to setpoint, the VAV cooling air damper shall modulate to its operator adjustable minimum cooling CFM setpoint (30% of maximum).

Unoccupied Control

During the unoccupied time period, the VAV cooling damper shall be closed (adjustable). If the space temperature reaches the operator adjustable unoccupied setpoint of 95°F cooling, the required equipment shall be started and run to maintain the space temperature within the setpoints.

11. MINI-SPLIT-SYSTEM AIR CONDITIONERS (IDF / MDF / ELECTRICAL ROOMS)

The split systems shall have a factory furnished controller. The BAS contractor shall furnish and install a BACnet interface and wiring. The BAS contractor shall coordinate with the unit manufacturer to ensure device compatibility with factory controller and sequences of operation meet specifications. Units shall be able to have all equipment control points available via BAS and **shall have read and write capability.**

Equipment Control Points

Space temperature – AI
Discharge air temperature – AI
Fan status – DI
Cooling – DO (qty. to match equipment)
Fan start/stop – DO

Zone Occupancy

Each unit shall have an occupancy/vacancy schedule, occupied heating/cooling setpoints and unoccupied heating/cooling setpoints assigned to it. As the occupancy time approaches, an optimum start/stop program shall calculate a start time based on current space temperature versus the occupied heating or cooling setpoint, assigned recovery rate, and outside air temperature -- all variables are operator assignable from the central site.

Fan Control

When the calculated start time arrives, the BAS shall energize the fan. A current switch shall prove status to the BAS and shall alarm at the central site if the switch is not made within 40 seconds (adjustable).

Space Temperature Control

A temperature sensor shall monitor the air temperature in the space. The BAS shall stage the cooling and heating, in sequence, to maintain the space temperature within setpoint.

Unoccupied Control

During the unoccupied time period, if the space temperature reaches the unoccupied heating or cooling setpoints (55°F heating and 95°F cooling, adjustable) the required equipment shall be started and run as normal to maintain the space temperature within these setpoints.

Equipment off Conditions

When the unit is off, the dx cooling and associated exhaust fan shall be off.

12. GENERAL EXHAUST

Equipment Control Points

Exhaust fan status – Current switch - DI

Exhaust fan enable – DO (interlocked to damper)

Interlock all general exhaust fans to run with outside air handling equipment serving the same area and run only during the occupied mode with their OA Dampers open. The EF shall be provided with OA dampers built into the curb adapter and shall be powered and operate from same circuit powering the fans. Dampers and actuators to be provided by the EF manufacture. The exhaust fans shall remain off even during the scheduled occupancy time based on a global command from a shelter in place (building shutdown) button or based on a summer mode schedule.

13. TWO-SPEED EXHAUST FANS – SCIENCE LAB PURGE

Equipment Control Points

Purge Buttons – DI

Fan Status – DI

Fan Start/Stop – DO

Damper – DO

The BAS shall have an occupancy/vacancy schedule. Fan shall energize and run in low speed during occupancy schedule and only run with their exhaust dampers open. BAS shall monitor the fan status. Motorized dampers and actuators provided and installed by the BAS contractor and necessary interlock wiring to allow damper to open / close whenever the exhaust fan is ON / OFF.

The fan shall be activated to higher speed by a mushroom style momentary pushbutton, provided by the controls contractor. Pushbutton location shall be verified with owner and architect prior to installation. When the pushbutton is pressed, the fan shall be activated to higher speed for 15 minutes (adjustable) and return to normal speed after 15 minutes (adjustable). Pressing and holding the pushbutton for 5 seconds (adjustable), shall cancel the purge sequence.

14. ELECTRIC UNIT HEATERS

Electric unit heaters shall be controlled by a factory furnished thermostat. BAS contractor shall install and wire thermostat.

15. COOL-DOWN CONTROL

ON-OFF: Prior to the start of the occupied mode, all air handling units shall be started and be controlled as specified except that the outside air dampers shall remain closed, and the exhaust fans shall be OFF. The duration of the cool-down cycle shall be regulated by the BAS optimum start/stop routine. The cool-down cycle shall continue until all space temperatures are at or below the setpoint. Cool-down cycle shall not be initiated when outside air temperature is less than 80°F.

16. WARM-UP CONTROL

ON-OFF: Prior to the start of the occupied mode, all air handling units shall be started and be controlled as specified except that the outside air dampers shall remain closed, and the exhaust fans shall be OFF. The duration of the warm-up cycle shall be regulated by the BAS optimum start/stop routine. The warm-up cycle shall continue until all space temperatures are at or above the setpoint. Warm-up cycle shall not be initiated when outside air temperature is greater than 70°F.

17. STAGGER START (ENERGY OPTIMIZATION)

In conjunction with Optimal Start, the BAS shall initiate a stagger start sequence to ensure multiple pieces of equipment do not start at the same time (refer to Humble ISD Maintenance department).

18. OPTIMAL STOP

The BAS shall initiate an Optimal Stop algorithm as the end of the schedule time period approaches. The optimal stop algorithm shall utilize the reduction in outside air, plant request, and setpoint relaxation. Outside air shutdown shall have a maximum shut-off time of 60 minutes (adjustable) prior to the end of time period. Plant request shutdown shall have a maximum shut-off time of 10 minutes (adjustable) prior to the end of time period. Setpoint relaxation shall have a maximum limit of 3°F over 45 minutes (adjustable).

One hour prior to end of schedule, the outside air shall shutdown and the setpoint relaxation shall reset 1°F (adjustable) every 15 minutes (adjustable). The equipment shall monitor the rate of change in the zones to determine when the plant request can be eliminated to finish the day without an impact to the zone temperatures.

19. SUMMER / CUSTODIAL MODE

The BAS shall give the operator the ability to initiate a custodial mode while the building is in occupied mode. Custodial mode shall have the ability to have a weekly schedule. When custodial mode is initiated, zone setpoint shall relax by 3°F and the outside air shall be disabled.

20. EXTERIOR LIGHTING CONTROL

Equipment Control Points

Lighting contactor enable/disable - DO
Lighting controllers

The BAS contractor shall provide separate outputs for each contactor indicated on the electrical drawings. Each contactor shall be able to be controlled via operator defined schedule independently or in groups defined by the operator. Provide a photocell for monitoring by the BAS. Exterior lighting shall be turned off if the photocell senses light levels above a pre-determined limit.

Contractor shall program to allow the operator to select whether the system utilizes a boundary schedule and sunrise/sunset calculations. If the exterior lights are scheduled to operate, the operator shall have the option to select to enable them for an adjustable time period before or after sunset and disable for an adjustable time period before or after sunrise.

Controller shall have on-board HOA switch per owner standard requirements.

Exterior backlit signage to be integrated to existing BAS. Signage to be interlocked with parking lot lighting control.

21. SCIENCE EXHAUST SYSTEM

Equipment Control Points

Exhaust fan status – Current switch - DI

Exhaust fan start/stop – DO
Exhaust valve damper – floating motor
Lab exhaust fan speed – AO
Exhaust valve flow – AI (via velocity sensor)
Lab exhaust duct differential pressure – AI
Lab exhaust duct velocity – AI (via velocity sensor)
Bypass Damper Control – AO

Lab Exhaust Valve System

The lab exhaust valve (EV) system will become active with any fume hood activation. When the system is activated, a run signal will be sent to the associated exhaust fan's variable speed drive, which will start the fan. If the minimum exhaust fan cfm (determined by fan manufacturer) is not maintained by one EV then BAS shall modulate the bypass damper at the fan to maintain minimum exhaust fan cfm. The BAS control module will receive an input from a cross flow sensor in the EV and will modulate its internal damper to control at setpoint.

Exhaust valves that serve the fume hoods shall be energized when the local hood switch (toggle/sash) is engaged. Once the switch is activated, the controller shall modulate the terminal unit to maintain the scheduled airflow for the fume hood.

The BAS control module will also receive an input from a static pressure sensor in the main exhaust duct. The pressure setpoint will be set (during the test and balance process) to maintain the required flow from each EV it serves. A velocity sensor mounted in the main exhaust duct will also monitor the total flow for the entire exhaust system.

Unoccupied Control

During the unoccupied time period, the EV dampers will be closed (adjustable), and the exhaust fans will be off.

22. MOTORIZED DAMPERS

Equipment Control Points

Damper open/close – DO

When the associated unit is in occupied mode, the BAS controller shall open the motorized damper (located in plenum below roof). Damper, actuators and wiring provided and installed by BAS.

END OF SECTION 23 09 93

SECTION 23 21 13 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
 - 1. Hot water heating piping.
 - 2. Chilled water piping.
 - 3. Condenser water piping.
 - 4. Glycol cooling water piping.
 - 5. Make-up water piping.
 - 6. Condensate-drain piping.
 - 7. Blowdown drain piping.
 - 8. Air-vent piping.
- B. Related Sections include the following:
 - 1. Section 23 21 23 "Hydronic Pumps" for pumps, motors, and accessories for Hydronic piping.

1.3 DEFINITIONS

- A. PTFE: Polytetrafluoroethylene.

1.4 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be 150 PSI pressure class unless otherwise noted or required by project conditions.

1.5 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Provide flanges, union, and couplings at locations requiring servicing.
- B. Provide unions, flanges, and couplings downstream of valves and at equipment or apparatus connections.
- C. Provide non-conducting dielectric connections whenever jointing dissimilar metals in open systems.
- D. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

1.6 ACTION SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: For each type of the following:

1. Plastic pipe and fittings with solvent cement.
 2. RTRP and RTRF with adhesive.
 3. Pressure-seal fittings.
- C. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops. The Pipe shop drawings shall be superimposed on the architectural backgrounds.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Field quality-control test reports.
- C. Product Data: Submit data on pipe materials and fittings. Submit manufacturers catalog information.
- D. Design Data: Indicate pipe sizes. Indicate pipe sizing methods. Indicate calculations used.
- E. Test Reports: Indicate results of refrigerant leak test and acid test.
- F. Welders' Certificate: Include welders' certification of compliance with ASME Section IX.

1.8 QUALITY ASSURANCE

- A. All pipe and accessories shall be of United States domestic manufacture.
- B. Installer Qualifications:
 1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
- C. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- E. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- F. Perform Work in accordance with ASME B31.5 code for installation of piping systems and ASME Section IX for welding materials and procedures.

- G. Maintain one copy of each document on site.
- H. Design piping systems under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. In accordance with Division 1 - General Requirements.
- B. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system Protect.
- D. Contractor shall adequately protect piping from damage after delivery to the project. Piping shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- E. Do not deliver piping to the project site until progress of construction has reached the stage where piping is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.10 WELDING

- A. Welding Procedures: Conform to latest recommendations of American Welding Society and Code for Pressure Piping, ANSI B31.1, and current edition. Welding and stress relieving procedures shall conform to Appendix, Section VI, and "Standard Qualifications for Welding Procedures, Welders and Welding Operators."
- B. Locations for Welding: Welding shall not be permitted within occupied area of the building. When the building or a portion of the building is in use as a permanent occupancy welding shall be permitted only in areas physically separated from occupied spaces by fire rated or non-combustible walls to deck or on completely gutted and unoccupied floors.
- C. Fire Protection and Smoke Venting: The Contractor shall provide all manpower and equipment required to protect the building structure and site occupants, other Contractors, etc., from hazards and to remove welding fumes from the building conform to the latest requirements of NFPA 51B.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type K (ASTM B 88M, Type B).
- B. Wrought-Copper Fittings: ASME B16.22.
 - 1. Housing: Ductile Iron.

2. Gasket: EPDM, Grade EHP
3. Pipe Sizes 2" and larger
4. Tools: Manufacturer's grooving tools.
5. Minimum 300-psig working-pressure rating at 250 deg F.

C. Copper or Bronze Pressure-Seal Fittings:

1. Housing: Copper.
2. O-Rings and Pipe Stops: EPDM.
3. Pipe Sizes 2" and down
4. Tools: Manufacturer's special tools.
5. Minimum 200-psig (1379-kPa) working-pressure rating at 250 deg F.

D. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A53 Electric Resistance Weld (ERW), Type E, Grade B, Schedule 40 black steel with plain ends; application as indicated in Part 3 "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 250.
- F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 1. Material Group: 1.1.
 2. End Connections: Butt welding.
 3. Facings: Raised face.
- H. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.3 PLASTIC PIPE AND FITTINGS

- A. CPVC Plastic Pipe: ASTM F 441/F 441M, Schedule 80, plain ends as indicated in Part 3 "Piping Applications" Article.
- B. CPVC Plastic Pipe Fittings: Socket-type pipe fittings; ASTM F 439 for Schedule 80 pipe.
- C. PVC Plastic Pipe: ASTM D 1785, Schedule 80, plain ends as indicated in Part 3 "Piping Applications" Article.
- D. PVC Plastic Pipe Fittings: Socket-type pipe fitting; ASTM D 2467 for Schedule 80 pipe.

2.4 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BA9-1, silver alloy for joining copper with bronze or steel.
- F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- G. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM F 493.
 - a. CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - a. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- H. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.5 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Charlotte Pipe and Foundry Company.
 - b. IPEX Inc.
 - c. KBi.
 - 2. CPVC one-piece fitting with one threaded brass or copper insert and one Schedule 80 solvent-cement-joint end.
- B. Plastic-to-Metal Transition Unions:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Charlotte Pipe and Foundry Company.
 - b. IPEX Inc.
 - c. KBi.
 - d. NIBCO INC.
 - 2. MSS SP-107, CPVC union. Include brass or copper end, Schedule 80 solvent-cement-joint end, rubber gasket, and threaded union.

2.6 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. Jomar International Ltd.
 - e. Matco-Norca, Inc.
 - f. McDonald, A. Y. Mfg. Co.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - h. Wilkins; a Zurn company.
 - 2. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 150 psig minimum at 180 deg F.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Matco-Norca, Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - e. Wilkins; a Zurn company.

 2. Description:
 - a. Standard: ASSE 1079.
 - b. Factory-fabricated, bolted, companion-flange assembly.
 - c. Pressure Rating: 150 psig minimum at 180 deg F.
 - d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.

 2. Description:
 - a. Non-conducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or Phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.
- E. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elster Perfection.
 - b. Matco-Norca, Inc.
 - c. Precision Plumbing Products, Inc.
 - d. Victaulic Company.

 2. Description:
 - a. Standard: IAPMO PS 66
 - b. Electroplated steel nipple. Complying with ASTM F 1545.
 - c. Pressure Rating: 300 psig 225 deg F.
 - d. End Connections: Male threaded or grooved.
 - e. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Hot water heating, chilled water, and condenser water, above ground, NPS 2 and smaller, shall be the following:
 - 1. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- B. Hot water heating, chilled water, and condenser water above ground, NPS 2-1/2 and larger, shall be one of the following:
 - 1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
- C. Glycol cooling-water piping, above ground, NPS 2 and smaller, shall be one of the following:
 - 1. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
 - 2. Schedule 80 CPVC plastic pipe and fittings and solvent-welded joints.
- D. Glycol cooling-water piping, above ground, NPS 2-1/2 and larger, shall be any of the following:
 - 1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
 - 2. Schedule 80 CPVC plastic pipe and fittings and solvent-welded joints.
- E. Chlorinated pool heating-water piping, shall be the following:
 - 1. Schedule 80 CPVC plastic pipe and fittings and solvent-welded joints.
- F. Makeup-water piping installed aboveground shall be the following:
 - 1. ASTM B 88, Type K (ASTM B 88M, Type B) drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
- G. Condensate-Drain Piping: ASTM B 88, Type L (ASTM B 88M, Type B) hard drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
- H. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blow-down drain is installed.
- I. Air-Vent Piping:
 - 1. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

3.2 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to Section 23 05 23 "General-Duty Valves for HVAC Piping."
- Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- S. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Section 23 05 16 "Expansion Fittings and Loops for HVAC Piping."
- U. Install lateral bracing with pipe hangers and supports to prevent swaying.
- V. Identify piping as specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."

- W. Install sleeves for piping penetrations of walls, ceilings, and floors.
- X. Install mechanical sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for mechanical sleeve seals specified in Section 23 05 29 - "Hangers and Supports for HVAC Piping and Equipment".
- Y. Sleeve pipe passing through partitions, walls, and floors. Refer to Section 23 05 29 - "Hangers and Supports for HVAC Piping and Equipment".
- Z. Provide access doors where valves and fittings are not accessible.
- AA. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- BB. Provide unions or flanges and isolation valves at each connection to a piece of equipment or control valve; accessory which requires removal for maintenance. Screwed unions should be used for two (2) inches IPS and smaller. Locate joints where they can be accessed for repair. Screw or flanged joints shall not be permitted above inaccessible ceilings or in chases.
- CC. All piping shall be installed to eliminate traps and pockets. Where air pockets or water trap cannot be avoided, provide means for drainage with valved hose connections for water trap and air vents for air pockets. Provide drain valves at low points of the system.
- DD. For pipe inside building, install parallel to lines of building, close to columns and walls vertical pipe shall be truly vertical. Spring or forcing piping into place will not be permitted. Install pipe to prevent strain on equipment connections.
- EE. Provide adequate access to all equipment, motorized valves, instruments, controls, and access panels.
- FF. Allow easy draining of water piping, with drain valves at low points.

3.3 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- F. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- H. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- J. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 3. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
 4. PVC Non-pressure Piping: Join according to ASTM D 2855.
- K. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.
- L. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

3.4 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Section 230519 "Meters and Gages for HVAC Piping."

3.5 FIELD QUALITY CONTROL

- A. Prepare Hydronic piping according to ASME B31.9 and as follows:
 1. Leave joints, including welds, un-insulated and exposed for examination during test.
 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.

3. Flush Hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on Hydronic piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 3. Isolate expansion tanks and determine that Hydronic system is full of water.
 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 5. After hydrostatic test pressure has been applied for at least one hour, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components and repeat hydrostatic test until there are no leaks.
 6. Prepare written report of testing.
- C. Perform the following before operating the system:
1. Open manual valves fully.
 2. Inspect pumps for proper rotation.
 3. Set makeup pressure-reducing valves for required system pressure.
 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 5. Set temperature controls so all coils are calling for full flow.
 6. Inspect and set operating temperatures of Hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
 7. Verify lubrication of motors and bearings.

END OF SECTION 23 21 13

SECTION 23 21 23 - HYDRONIC PUMPS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. In-line circulators
 - 2. End-Suction Base Mounted Pumps
 - 3. Split-Coupled Vertical In-line pumps
 - 4. Automatic Condensate Pump Units
- B. Related Sections:
 - 1. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment - Mechanical Vibration Control: Product requirements for vibration isolators required with pumps.

1.3 REFERENCES

- A. Underwriters Laboratories Inc.:
 - 1. UL 778 - Motor Operated Water Pumps.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide pumps electrical characteristics in accordance with Division 26 and schedules on Drawings.

1.5 SUBMITTALS

- A. Submit in accordance with Division 1 and Section 23 05 00.
- B. Provide line-by-line specification review annotated to certify compliance or deviation.
- C. Product Data: Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Provide parallel pump curves indicating the non-overloaded motor horsepower for single pump operation when applicable. Include NPSH curve with operating point plotted when applicable. Include electrical characteristics and connection requirements. Submit also, manufacturer model number, dimensions, service sizes, and finishes.
- D. Shop Drawings: For each pump.
 - 1. Show pump layout and connections.
 - 2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
 - 3. Include diagrams for power, signal, and control wiring.

- E. Manufacturer's Installation Instructions: Submit application, selection, and hookup configuration with pipe and accessory elevations. Submit hanging and support requirements and recommendations.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.6 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Division 1, General Requirements.
- B. Operation and Maintenance Data: Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.

1.7 WARRANTY

- A. Furnish one (1) year manufacturer parts and labor warranty for pumps. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up will not be acceptable.

1.8 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor.
 - 1. Furnish one (1) set of mechanical seals for each pump installed.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Pumps shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect

the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.11 PUMP IDENTIFICATION REQUIREMENTS

- A. Furnish each pump with a durable, deep etched, .025" thick, factory installed aluminum identification plate, permanently mounted with the following information:
- Unit identification as indicated within Contract Documents.
 - Serial Number.
 - Model Number.
 - Flow rate (GPM) and head (ft. H2O).
 - Motor Horsepower.
 - RPM
 - Power Supply: Volts / PH / Amps.
 - Sales Order #.
 - Date of unit manufactured.
- B. For chilled water pumps, in addition to the base mounted identification tag provide an additional identification tag shipped loose for contractor to install on external rigid insulation board.

PART 2 – PRODUCTS

2.1 IN-LINE CIRCULATORS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Taco
 2. Armstrong
 3. Bell and Gossett
- B. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 175 psig maximum working pressure.
- C. Casing: Cast iron, with flanged pump connections.
- D. Impeller: Cast bronze, dynamically balanced and keyed to shaft.
- E. Bearings: Two, oil lubricated bronze sleeves.
- F. Shaft: Stainless steel with copper or bronze sleeve, integral thrust collar.
- G. Seal: Carbon rotating against stationary ceramic seat, 212 degrees Fahrenheit maximum continuous operating temperature.
- H. Drive: Flexible coupling.
- I. Motor: Single speed and rigidly mounted to pump casing.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.2 END-SUCTION BASE MOUNTED PUMPS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 1. Pentair - Aurora
 2. Armstrong - 4030
 3. Bell and Gossett
- B. Type: Horizontal shaft, single stage, direct connected, radial or horizontal split casing, for 175 psig maximum working pressure.
- C. Casing: Cast iron, with suction and discharge gage ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.
- D. Impeller: Bronze, fully enclosed, dynamically balanced, and keyed to shaft.
- E. Bearings: Grease or permanently lubricated roller or ball bearings. Bearings shall have 40,000-hour minimum life.
- F. Shaft: 416 stainless steel with stainless steel shaft sleeve.
- G. Seal: Carbon seat rotating against stationary silicon carbide seat, 225 degrees Fahrenheit maximum continuous operating temperature.
- H. Drive: Flexible coupling with OSHA approved coupling guard.
- I. Baseplate: Cast iron or fabricated steel with integral drain rim.
- J. Motor: Single speed and rigidly mounted to pump casing.
 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - a. Enclosure: Outdoors: Totally enclosed, fan cooled (TEFC).
 - b. Enclosure: Indoors: Open Drip Proof (ODP).
 - c. Efficiency: Premium efficient.
 - d. NEMA Design: MG-1.
 - e. Service Factor: 1.15.

2.3 "SPLIT-COUPLED" VERTICAL IN-LINE PUMPS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 1. Pentair - Aurora
 2. Armstrong - 4300
 3. Bell and Gossett

- B. Type: Vertical shaft, single stage, direct connected, radial split casing, for 175 psig maximum working pressure.
- C. Casing: Cast iron, with suction and discharge gage ports, renewable bronze casing wearing rings, seal flush connections with factory installed seal flush line, recessed cast iron drain pan with threaded connection for field piping to drain, flanged suction and discharge.
- D. Impeller: 316 stainless steel, fully enclosed, dynamically balanced, and keyed to shaft.
- E. Bearings: Grease or permanently lubricated roller or ball bearings. Bearings shall have 40,000-hour minimum life.
- F. Shaft: 416 stainless steel with stainless steel shaft sleeve.
- G. Mechanical Seals: Stainless steel multi-spring outside balanced type with a Viton secondary seal, carbon rotating face and Silicon Carbide stationary seat. Provide 316 stainless steel gland plate with factory installed flush line with manual vent, 225 degrees Fahrenheit maximum continuous operating temperature.
- H. Drive: Axially split, spacer type rigid coupling constructed of high tensile aluminum bar with OSHA approved coupling guard.
- I. Motor: Single speed and rigidly mounted to pump casing.
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - a. Enclosure: Outdoors: Totally enclosed, fan cooled (TEFC).
 - b. Enclosure: Indoors: Open Drip Proof (ODP).
 - c. Efficiency: Premium efficient.
 - d. NEMA Design: MG-1.
 - e. Service Factor: 1.15.

2.4 AUTOMATIC CONDENSATE PUMP UNITS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Beckett Corporation
 - 2. Hartell Pumps
 - 3. Little Giant Pump Co.
 - 4. Mepco, LLC.
- B. Description: Packaged units with corrosion-resistant pump, plastic tank with cover, and automatic controls. Include factory or field-installed check valve and a 72-inch minimum, electrical power cord with plug.

2.5 PUMP SUCTION DIFFUSER

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Pentair - Aurora
 - 2. Armstrong

3. Bell and Gossett
 4. American Wheatly
-
- B. Angle pattern, with flanged outlet and inlet connections; grooved connections shall not be acceptable.
 - C. 175-psig pressure rating, ductile-iron body and end cap, pump-inlet fitting.
 - D. Removable stainless steel fine mesh startup and 1/8" perforated stainless-steel star shaped permanent strainers.
 - E. Stainless-steel straightening guide vanes.
 - F. Drain plug, blow-down tapping in bottom, gage tapping on side.
 - G. Factory-fabricated adjustable foot support.
 - H. Permanent magnet located in flow stream removable for cleaning.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Provide pumps to operate at specified system fluid temperatures and scheduled capacities. Pumps shall operate without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories. Provide no less than the minimum as required by the manufacturer.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping
- D. Equipment Mounting: Install base-mounted pumps on cast-in-place concrete equipment bases.
 1. Coordinate sizes and locations of concrete bases with actual equipment provided.

2. Construct bases to withstand, without damage to equipment, seismic force required by code.
 3. Construct concrete bases 4 high and extend base not less than 6 inches in all directions beyond the maximum dimensions of base-mounted pumps unless otherwise indicated or unless required for seismic-anchor support.
 4. Install base mounted pumps on concrete inertia base "RBMK" with spring isolators. Refer to section 23 05 48.
- E. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and spring hangers of size required to support weight of in-line pumps.
1. Comply with requirements for seismic-restraint devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."
 2. Comply with requirements for hangers and supports specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."
- F. Install long radius reducing elbows or reducers between pump and piping. Support piping adjacent to pump so no weight is carried on pump casings. For close coupled, split coupled vertical in-line or base mounted pumps; install supports under elbows on pump suction and discharge line sizes four (4) inches and over.
- G. Provide air cock and drain connection on horizontal pump casings.
- H. Provide drains for bases and seals. Route to floor drain.
- I. Lubricate pumps before start-up according to manufacturer's instructions.

3.3 ALIGNMENT – APPLIES TO END-SUCTION PUMPS

- A. Alignment Service shall be performed by a factory authorized direct service technician. Alignment work shall not be performed by installing mechanical contractor.
- B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.
- C. Comply with pump and coupling manufacturers' written instructions.
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 CONNECTIONS

- A. Coordinate piping installations and specialty arrangements with Drawings and with requirements specified in piping systems. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to pump, allow space for service and maintenance.
- C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- E. Discharge side of pumps install Victaulic Vic-300 non-slam check valve, Victaulic Vic-300 combination shut-off butterfly valve and throttling valve with memory stop.
- F. Suction side of pumps install Victaulic Series 731 suction diffuser with type 304 stainless steel strainer and Victaulic Vic-300 shut-off butterfly valve on suction side of pumps.
- G. Discharge side of pumps install flexible connector (for end-suction pumps), non-slam check valve, combination shut-off butterfly valve and throttling valve with memory stop, and thermometer.
- H. Suction side of pumps install suction diffuser with type 304 stainless steel strainer, flexible pipe connector (for end-suction pumps) shut-off butterfly valve on suction side of pumps and thermometer.
- I. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping or install single gage with multiple-input selector valve.

3.5 STARTUP SERVICE

- A. Start up service shall be performed by a factory authorized direct service technician. Start up work shall not be performed by installing mechanical contractor.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - a. Check piping connections for tightness.
 - b. Clean strainers on suction piping.
 - c. Perform the following startup checks for each pump before starting:
 - 1. Verify bearing lubrication.
 - 2. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - 3. Verify that pump is rotating in the correct direction.
 - d. Prime pump by opening suction valves and closing drains and prepare pump for operation.
 - e. Start motor.
 - f. Open discharge valve slowly.

3.6 DEMONSTRATION

- A. Demonstration shall be performed by a factory authorized direct service technician. Demonstration shall not be performed by installing mechanical contractor.

1. Train owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.
2. Provide documentation of owner training in close out submittal.

END OF SECTION 23 21 23

SECTION 23 22 00 - CONDENSATE PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This section Includes: Pipe and pipe fitting materials, joining methods and pipe insulation for the following systems:
 - 1. Condensate equipment drains and overflows.
- B. Related Sections:
 - 1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports and fire stopping for placement by this section.

1.3 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B16.3 - Malleable Iron Threaded Fittings.
 - 2. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 - 3. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - 4. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
 - 5. ASME B31.1 – Power Piping.
 - 6. ASME B31.5 - Refrigeration Piping.
 - 7. ASME B31.9 - Building Services Piping.
 - 8. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.
- B. ASTM International (ASTM):
 - 1. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 2. ASTM A234 - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 - 3. ASTM A536 – Standard Specification for Ductile Iron Castings.
 - 4. ASTM B32 - Standard Specification for Solder Metal.

5. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- C. American Welding Society:
1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
 2. AWS D1.1 - Structural Welding Code - Steel.

1.4 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Provide flanges, union, and couplings at locations requiring servicing.
- B. Provide unions, flanges, and couplings downstream of valves and at equipment or apparatus connections.
- C. Provide non-conducting dielectric connections whenever jointing dissimilar metals in open systems.
- D. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

1.5 ACTION SUBMITTALS

- A. Submit in accordance with Division 1 - General Requirements.
- B. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, and sizes. Indicate schematic layout of refrigeration system, including equipment, critical dimensions, and sizes.
- C. Product Data: Submit data on pipe materials and fittings. Submit manufacturers catalog information.
- D. Design Data: Indicate pipe sizes. Indicate pipe sizing methods. Indicate calculations used.
- E. Test Reports: Indicate results of refrigerant leak test and acid test.
- F. Welders' Certificate: Include welders' certification of compliance with ASME Section IX.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Welding certificates.
- C. Field quality-control test reports.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
- B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- E. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years experience.
- F. Installer: Company specializing in performing Work of this section with minimum three (3) years experience approved by manufacturer.
- G. Design piping systems under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.
- H. All pipe and accessories shall be of United States domestic manufacture.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. In accordance with Division 1 - General Requirements.
- B. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system Protect.
- D. Contractor shall adequately protect material from damage after delivery to the project. Piping shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- E. Do not deliver Piping to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 WELDING

- A. Welding Procedures: Conform to latest recommendations of American Welding Society and Code for Pressure Piping, ANSI B31.1, and current edition. Welding and stress relieving procedures shall conform to Appendix, Section VI, and "Standard Qualifications for Welding Procedures, Welders and Welding Operators."
- B. Locations for Welding: Welding shall not be permitted within occupied area of the building. When the building or a portion of the building is in use as a permanent occupancy welding shall be permitted only in areas physically separated from occupied spaces by fire rated or non-combustible walls to deck or on completely gutted and unoccupied floors.
- C. Fire Protection and Smoke Venting: The Contractor shall provide all manpower and equipment required to protect the building structure and site occupants, other Contractors, etc., from hazards and to remove welding fumes from the building conform to the latest requirements of NFPA 51B.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B).
- B. Wrought-Copper Fittings: ASME B16.22.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. S. P. Fittings; a division of Star Pipe Products.
- C. Copper or Bronze Pressure-Seal Fittings:
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Stadler-Viega.
 - 2. Housing: Copper.
 - 3. O-Rings and Pipe Stops: EPDM.
 - 4. Tools: Manufacturer's special tools.
 - 5. Minimum 200-psig (1379-kPa) working-pressure rating at 250 deg F (121 deg C).
- D. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, Seamless galvanized steel with plain ends; schedule 40, 0.375-inch wall.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125.

- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150.
- E. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

2.3 JOINING MATERIALS

- A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- B. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- C. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Hart Industries International, Inc.
 - c. Jomar International Ltd.
 - d. Matco-Norca, Inc.
 - e. McDonald, A. Y. Mfg. Co.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - g. Wilkins; a Zurn company.
 - 2. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 125 psig minimum at 180 deg F.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.

2.5 PIPING INSULATION

- A. High density factory molded fiberglass insulation with factory applied all service, and reinforced vapor retarder jacket. Provide with a factory applied pressure sensitive tape closure system and matching butt strips. 1" thick for all pipe sizes and locations.
 - 1. Thermal conductivity "k" of 0.23 of Btu-in / hr-sq.ft. Degree F at 75-degree mean temperature.
 - 2. Maximum jacket permeance shall be 0.02.

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville.
 - b. Owens Corning
 - c. Knauf.
 - d. CertainTeed
- C. Aluminum Jacket: General Requirements: Provide aluminum jacketing for all condensate drain piping located outdoors.
 - a. Jacket for piping shall be 0.016-inch-thick type 3105 aluminum with factory applied one mil polykraft moisture barrier.
 - b. Fitting covers shall be factory made 0.024-inch type 1100 aluminum to match pipe covering.

PART 3 - EXECUTION

3.1 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- F. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- G. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.
- H. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

3.2 PIPING INSTALLATION

- A. Route piping parallel to building structure and maintain gradient.

- B. Install piping to conserve building space, and not interfere with use of space.
- C. Sleeve pipe passing through partitions, walls, and floors. Refer to Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- D. Install piping free of sags and bends.
- E. Install piping to allow application of insulation.

3.3 INSULATION INSTALLATION

- A. Ensure that all pipe and fitting surfaces over which insulation is to be installed are clean and dry.
- B. Ensure that insulation is clean, dry and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation.
- C. Ensure that pressure testing of piping and fittings has been completed prior to installing insulation.
- D. Install all insulation materials and accessories in accordance with manufacturer's published instructions and recognized industry practices to ensure that it will serve its intended purpose.
- E. Install insulation on piping subsequent to installation of heat tracing, painting, and acceptance tests.
- F. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit over all piping surfaces.
- G. Maintain the integrity of factory-applied vapor barrier jacketing on all pipe insulation, protecting it against puncture, tears, or other damage. All staples used on cold pipe insulation shall be coated with suitable sealant to maintain vapor barrier integrity.
- H. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- I. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- J. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.
- K. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- L. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- M. Keep insulation materials dry during application and finishing.

- N. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- O. Apply insulation with the least number of joints practical.
- P. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
- Q. Apply insulation continuously through hangers and around anchor attachments.
- R. For insulation application where vapor retarder are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- S. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
- T. Insulation Terminations: For insulation application where vapor retarder is indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

END OF SECTION 23 22 00

SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Refrigerant piping.
2. Refrigerant Insulation.
3. Unions, flanges, and couplings.
4. Refrigerant moisture and liquid indicators.
5. Valves.
6. Refrigerant strainers.
7. Refrigerant pressure regulators.
8. Refrigerant pressure relief valves.
9. Refrigerant filter-driers.
10. Refrigerant solenoid valves.
11. Refrigerant expansion valves.
12. Electronic expansion valves.
13. Refrigerant receivers.

- B. Related Sections:

1. Section 31 00 00 - Earthwork: Earthwork for backfill in trenches.
2. Section 31 23 16.13 – Trenching and Backfilling: Execution requirements for trenching and backfilling required by this section.
3. Section 07 84 00 - Firestopping: and Fire Safing Product requirements for firestopping for placement by this section.
4. Section 08 31 13 - Access Doors: Access doors for concealed valves and accessories.
5. Section 09 91 00 - Painting and Staining: Product requirements for painting for placement by this section.

6. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports and sleeves for placement by this section.
7. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for Vibration Isolation for placement by this section.
8. Section 23 05 53 - Identification for HVAC Piping and Equipment: Product requirements for pipe identification for placement by this section.
9. Section 23 07 19 - HVAC Piping Insulation: Product requirements for Piping Insulation for placement by this section.
10. Section 23 21 13 - Hydronic Piping: Piping materials for refrigerant systems.

1.3 REFERENCES

- A. Air-Conditioning and Refrigeration Institute:
 1. ARI 495 - Refrigerant Liquid Receivers.
 2. ARI 710 - Liquid-Line Driers.
 3. ARI 730 - Flow-Capacity Rating and Application of Suction-Line Filters and Filter Dryers.
 4. ARI 750 - Thermostatic Refrigerant Expansion Valves.
 5. ARI 760 - Solenoid Valves for Use with Volatile Refrigerants.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 1. ASHRAE 15 - Safety Code for Mechanical Refrigeration.
- C. American Society of Mechanical Engineers:
 1. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 2. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
 3. ASME B31.5 - Refrigeration Piping.
 4. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.
- D. ASTM International (ASTM):
 1. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 2. ASTM A234 - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 3. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

4. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
 5. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.
- E. American Welding Society:
1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
 2. AWS D1.1 - Structural Welding Code - Steel.
- F. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- G. Underwriters Laboratories Inc.:
1. UL 429 - Electrically Operated Valves.

1.4 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-407C:
1. Suction Lines for Air-Conditioning Applications: 230 psig.
 2. Suction Lines for Heat-Pump Applications: 380 psig.
 3. Hot-Gas and Liquid Lines: 380 psig.
- B. Line Test Pressure for Refrigerant R-410A:
1. Suction Lines for Air-Conditioning Applications: 300 psig.
 2. Suction Lines for Heat-Pump Applications: 535 psig.
 3. Hot-Gas and Liquid Lines: 535 psig.

1.5 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.
- B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves or equipment.
- C. Provide pipe hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- D. Provide receivers sized to accommodate pump down charge.
- E. Flexible Connectors: Use at or near compressors where piping configuration does not absorb vibration.

1.6 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Submit in Accordance with Division 1 - General Requirements.
- C. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by highlighting or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show specific pertinent performance data and quantities appropriate to scope of work.
- D. Shop Drawings: Indicate layout of refrigeration piping system, including equipment, critical dimensions, and sizes.
- E. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories.
 - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 - 3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
 - 4. Refrigerant Specialties: Submit manufacturers catalog information including capacity, component sizes, rough-in requirements, and service sizes for the following:
 - a. Refrigerant moisture and liquid indicators.
 - b. Refrigerant strainers.
 - c. Refrigerant pressure regulators.
 - d. Refrigerant pressure relief valves.
 - e. Refrigerant filter-driers.
 - f. Refrigerant solenoid valves.
 - g. Refrigerant expansion valves.
 - h. Electronic expansion valves.
- F. Test Reports: Indicate results of piping system pressure test.
- G. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures and isolation.
- H. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- I. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.7 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of valves, equipment, and refrigerant accessories.
- B. Operation and Maintenance Data: Submit instructions for installation and changing components, spare parts lists, exploded assembly views.

1.8 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years experience.
- B. Fabricator or Installer: Company specializing in performing Work of this section with minimum three (3) years experience approved by manufacturer.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. In accordance with Division 1- General Requirements.
- B. Dehydrate and charge refrigeration components including piping and receivers, seal prior to shipment. Maintain seal until connected into system.
- C. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.
- F. Contractor shall adequately protect material from damage after delivery to the project. Piping shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- G. Do not deliver Piping to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.11 WARRANTY

- A. Furnish five (5) year manufacturer warranty for valves excluding packing.

1.12 MAINTENANCE MATERIALS

- A. Furnish two (2) refrigerant oil test kits each containing everything required for conducting one test.

1.13 EXTRA MATERIALS

- A. Furnish two (2) packing kits for each size and valve type.
- B. Furnish two (2) refrigerant filter-dryer cartridges of each type.

PART 2 - PRODUCTS

2.1 REFRIGERANT PIPING

- A. Copper Tubing: ASTM B 280, Nitrogenized Type L - ACR hard drawn.
 - 1. Wrought-copper Fittings: ASME B16.22.
 - 2. Brazing Filler Metals: AWS A5.8. BCuP: minimum 15% silver (Ag), 5% phosphorous (P), and balance copper (Cu).
 - 3. Final product composition shall be 99% pure copper and lead free.
 - 4. Provide in 10 ft. and 20 ft. straight tube lengths.
 - 5. **Bendable pipe of any kind shall not be accepted.**

2.2 UNIONS, FLANGES, AND COUPLINGS

- A. Two (2) inches and Smaller:
 - 1. Copper Pipe: Bronze, soldered joints.
- B. 2-1/2 inches and Larger:
 - 1. Copper Piping: Bronze
 - 2. Gaskets: 1/16-inch-thick preformed neoprene.
- C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.3 REFRIGERANT MOISTURE AND LIQUID INDICATORS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Alco Controls Div, Emerson Electric Co.
 - 2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division

3. Sporlan Valve Co.

B. Indicators:

1. Port: Single, UL listed.
2. Body: Brass, solder ends.
3. Sight glass: Color-coded paper moisture indicator with removable element cartridge and plastic cap.
4. Maximum working pressure: 500 psig
5. Maximum working temperature: 200 degrees Fahrenheit.

2.4 VALVES

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Alco Controls Div, Emerson Electric Co.
2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
3. Sporlan Valve Co.

B. Diaphragm Packless Valves:

1. UL listed, globe or angle pattern, forged brass body and bonnet solder or flared ends.
2. Phosphor bronze and stainless-steel diaphragms, rising stem and hand wheel.
3. Stainless steel spring, nylon seats, disc with positive back seating.
4. Maximum working pressure: 500 psig
5. Maximum working temperature: 275 degrees Fahrenheit.

C. Packed Angle Valves:

1. Forged brass, solder ends.
2. Forged brass seal caps with copper gasket, rising stem and seat with back seating, molded stem packing.
3. Maximum working pressure: 500 psig
4. Maximum working temperature: 275 degrees Fahrenheit.

D. Ball Valves:

1. Two piece bolted forged brass body with Teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals, soldered ends.
2. Maximum working pressure: 500 psig and

3. Maximum working temperature: 300 degrees Fahrenheit.
- E. Service Valves:
1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, solder ends.
 2. Maximum working pressure: 500 psig.
- F. Refrigerant Check Valves:
1. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - a. Alco Controls Div, Emerson Electric Co.
 - b. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
 - c. Sporlan Valve Co.
 2. Globe Type:
 - a. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless-steel spring, Teflon seat disc.
 - b. Maximum working pressure: 500 psig.
 - c. Maximum working temperature: 300 degrees Fahrenheit.
 3. Straight Through Type:
 - a. Spring, neoprene seat.
 - b. Maximum working pressure: 500 psig.
 - c. Maximum working temperature: 250 degrees Fahrenheit.

2.5 REFRIGERANT STRAINERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
1. Alco Controls Div, Emerson Electric Co.
 2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
 3. Sporlan Valve Co. Model.
- B. Straight Line or Angle Line Type:
1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless-steel wire or monel reinforced with brass.
 2. Maximum working pressure: 430 psig.

2.6 REFRIGERANT PRESSURE REGULATORS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Alco Controls Div, Emerson Electric Co.
 - 2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
 - 3. Sporlan Valve Co.
- B. Brass body, stainless steel diaphragm, pilot operated with remote pressure pilot, adjustable over 0 to 80 psig range, for maximum working pressure of 450 psig.

2.7 REFRIGERANT PRESSURE RELIEF VALVES

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Alco Controls Div, Emerson Electric Co.
 - 2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division.
 - 3. Sporlan Valve Co.
- B. Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB; setting selected to ASHRAE 15.

2.8 REFRIGERANT FILTER-DRIERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Alco Controls Div, Emerson Electric Co.
 - 2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
 - 3. Sporlan Valve Co.
- B. Replaceable Cartridge Angle Type:
 - 1. Shell: ARI 710, UL listed, steel, removable cap, for maximum working pressure of 500 psig, and wrought copper fittings for solder end connections.
 - 2. Filter Cartridge: Pleated media with integral end rings, stainless steel support.
 - 3. Filter/Dryer Cartridge: Pleated media with solid core sieve with activated alumin to provide micronic filtration.
 - 4. Wax Removal Cartridge: Molded bonded core of activated charcoal with integral gaskets.
- C. Permanent Straight Through Type:

1. ARI 710, UL listed, steel shell with molded desiccant filter core, for maximum working pressure of 500 psig.
2. Permanent filter element shall be molded felt core surrounded by a desiccant for removal of acids and moisture for refrigerant vapor.

2.9 REFRIGERANT SOLENOID VALVES

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 1. Alco Controls Div, Emerson Electric Co.
 2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
 3. Sporlan Valve Co.
- B. Valve: ARI 760, pilot operated, copper or brass body and internal parts, synthetic seat, stainless steel stem and plunger assembly, integral strainer, solder ends; for maximum working pressure of 500 psig. Stem designed to allow manual operation in case of coil failure.
- C. Coil Assembly: UL listed, replaceable with molded electromagnetic coil, moisture, and fungus proof, with surge protector and color-coded lead wires, integral junction box.

2.10 REFRIGERANT EXPANSION VALVES

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 1. Alco Controls Div, Emerson Electric Co.
 2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
 3. Sporlan Valve Co.
- B. Angle or Straight Through Type: ARI 750; design suitable for refrigerant, brass body, internal or external equalizer, bleed hole, adjustable superheat setting, replaceable inlet strainer, with replaceable capillary tube and remote sensing bulb and remote bulb well.
- C. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum ten (10) degrees Fahrenheit superheat. Select to avoid being undersized at full load and oversized at part load.

2.11 REFRIGERANT PIPING INSULATION

- A. Insulate suction lines. Liquid lines are not required to be insulated, except where they are installed adjacent and clamped to suction lines, where both liquid and suction lines shall be insulated as a unit.
 1. Do not install insulation until system testing has been completed and all leaks have been eliminated.
 2. Insulation shall be Armaflex Ultra pipe insulation. Provide 1-inch insulation thickness. All seams and joints shall be adhered and sealed using Armaflex 520

adhesive. All fittings shall be insulated with same insulation thickness as straight pipe.

3. **Exposed refrigerant liquid and suction piping (located indoors and/or outdoors)**: shall be insulated and include two (2) coats of WB Armaflex Finish. In addition, liquid and suction lines shall be provided with aluminum jacketing; provide 0.016-inch Type 3105 on all exterior insulated piping. Fitting covers shall be 0.024-inch Type 1100 aluminum. Jacketing and fitting covers shall be banded with 0.20-inch Type 3105, 1/2-inch-wide banding with 0.32-inch Type 5005 wing seals on 12-inch centers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.2 INSTALLATION

- A. Route piping parallel to building structure and maintain gradient.
- B. Install piping to conserve building space, and not interfere with use of space.
- C. Group piping whenever practical at common elevations.
- D. Sleeve pipe passing through partitions, walls, and floors. Refer to Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- E. Install pipe identification in accordance with Section 23 05 53 - Identification for HVAC Piping and Equipment.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Arrange refrigeration piping to return oil to compressor. Provide traps and loops in piping, and where necessary provide double risers. Slope horizontal piping 0.40 percent in direction of flow.
- H. Provide access where valves and fittings are not exposed.
- I. Flood refrigerant piping system with nitrogen when brazing.
- J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- K. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Section 09 91 00.

- L. Install valves with stems upright or horizontal, not inverted.
- M. Provide replaceable cartridge filter-dryers, with isolation valves and bypass with valve.
- N. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
- O. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.
- P. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.
- Q. Provide electrical connection to solenoid valves.
- R. Fully charge completed system with refrigerant after testing.
- S. Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.
- T. Install refrigerant piping in accordance with ASME B31.5.
- U. Install piping in as short and direct arrangement as possible to minimize pressure drop.
- V. Install piping with minimum number of joints using as few elbows and other fittings as possible.
- W. Arrange piping to allow normal inspection and servicing of compressor and other equipment. Install valves and specialties in accessible locations to allow for servicing and inspection.
- X. Provide adequate clearance between pipe and adjacent walls and hanger, or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full thickness insulation.
- Y. Install branch tie-in lines to parallel compressors equal length, and pipe identically and symmetrically.
- Z. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.
- AA. Slope refrigerant piping as follows:
 - 1. Install horizontal hot gas discharge piping with 1/2 inch per ten (10) feet downward slope away from the compressor.
 - 2. Install horizontal suction lines with 1/2 inch per ten (10) feet downward slope to the compressor, with no long traps or dead ends which may cause oil to separate from the suction gas and return to the compressor in damaging slugs.
 - 3. Install traps and double risers where indicated, and where required to entrain oil in vertical runs.
 - 4. Liquid runs

- BB. Use fittings for all changes in direction and all branch connections.
- CC. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- DD. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- EE. Conceal all pipe installation in walls, pipe chases, utility spaces, above ceilings, below grade floors, unless indicated to be exposed to view.
- FF. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with one (1) inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- GG. Locate groups of pipe parallel to each other, spaced to permit applying insulation and servicing or valves.
- HH. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than six (6) inches shall be steel; pipe sleeves six (6) inches and larger shall be sheet metal.
- II. Fire Barrier Penetrations: Seal pipe penetrations through fire rated wall, partitions, ceilings, and floors, maintain the fire rated integrity.
- JJ. Make reductions in pipe sizes using eccentric reducer fittings installed with the level side down.
- KK. Install strainers immediately ahead of each expansion valve, solenoid valve, hot gas bypass valve, compressor suction valve, and as required to protect refrigerant piping system components.
- LL. Install moisture / liquid indicators in liquid lines between filter / driers and thermostatic expansion valves and in liquid line to receiver.
 - 1. Install moisture / liquid indicators in lines larger than 2-1/8-inch OD, using a bypass line.
- MM. Install unions to allow removal of solenoid valves, pressure regulating valves, expansion valves, and at connections to compressors and evaporators.
- NN. Install flexible connectors at the inlet and discharge connection of compressors.

3.3 INSTALLATION - REFRIGERANT SPECIALTIES

- A. Refrigerant Liquid Indicators:
 - 1. Install line size liquid indicators in main liquid line downstream of condenser.
 - 2. When receiver is provided, install line size liquid indicators in liquid line downstream of receiver.
 - 3. Install line size liquid indicators downstream of liquid solenoid valves.

4. Install liquid indicator on leaving side of filter-driers.
- B. Refrigerant Valves:
1. Install service valves on compressor suction and discharge.
 2. Install gage taps at compressor inlet and outlet.
 3. Install gage taps at hot gas bypass regulators, inlet, and outlet.
 4. Install check valves on compressor discharge.
 5. Install check valves on condenser liquid lines on multiple condenser systems.
 6. Install refrigerant charging valve in liquid line between receiver shut-off valve and expansion valve.
- C. Strainers:
1. Install line size strainer upstream of each automatic valve.
 2. Where multiple expansion valves with integral strainers are used, install single main liquid-line strainer.
 3. On steel piping systems, install strainer in suction line.
 4. Install shut-off valves on each side of strainer.
- D. Install pressure relief valves on ASME receivers. Install relief valve discharge piping to terminate outdoors.
- E. Filter-Dryers:
1. Install permanent filter-dryers in low temperature systems.
 2. Install permanent filter-dryer in systems containing hermetic compressors.
 3. Install replaceable cartridge filter-dryer vertically in liquid line adjacent to receivers.
 4. Install replaceable cartridge filter-dryer upstream of each solenoid valve.
- F. Solenoid Valves:
1. Install in liquid line of systems operating with single pump-out or pump-down compressor control.
 2. Install in liquid line of single or multiple evaporator systems.
 3. Install in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into suction line when system shuts down.

3.4 PIPE JOINT CONSTRUCTION

- A. Brazed Joints: Comply with the procedures contained in the AWS: Brazing Manual".

1. WARNING: Some filler metals contain compounds which produce highly toxic fumes when heated. Avoid breathing fumes. Provide adequate ventilation.
 2. CAUTION: When solenoid valves are being installed, remove the coil to prevent damage. When sight glasses are being installed, remove the glass. Remove stems, seats, and packing of valves, and accessible internal parts of refrigerant specialties before brazing. Do not apply heat near the bulb of the expansion valve.
- B. Pressurize the pipe and fittings during brazing with nitrogen to prevent formation of harmful oxides.
- C. Heat joints using-acetylene torch. Heat to proper and uniform brazing temperature.

3.5 VALVE INSTALLTIONS - GENERAL

- A. General: Install refrigerant valves in accordance with manufacturer's instructions.
- B. Install globe valves on each side of strainers and driers, in liquid and suction lines at evaporators, and elsewhere as indicated.
- C. Install a full sized, 3-valve bypass around each drier.
- D. Install solenoid valves ahead of each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at the top.
1. Coordinate electrical requirements and connections.
- E. Thermostatic expansion valves may be mounted in any position, as close as possible to the evaporator.
1. Where refrigerant distributors are used, mount the distributor directly on the expansion valve outlet.
 2. Install the valve in such a location so that the diaphragm case is warmer than the bulb.
 3. Secure the bulb straps. Do not mount build in a trap or at the bottom of the line.
 4. Where external equalizer lines are required make the connection where it clearly reflect the pressure existing in the suction line at the bulb location.
- F. Install pressure regulating and relieving valves required by ASHRAE Standard 15.

3.6 EQUIPMENT CONNECTIONS

- A. Install piping adjacent to machine to allow servicing and maintenance.

3.7 FIELD QUALITY CONTROL

- A. Install, test, and perform corrective action of refrigerant piping in accordance with ASME Code B31.5, Chapter VI.
- B. Repair leaking joints using new materials and retest for leaks.

3.8 CLEANING

- A. Before installation of copper tubing other than Type ACR tubing, clean the tubing and fitting using following cleaning procedures:
 - 1. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through the tubing by means of a wire or an electrician's tape.
 - 2. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
 - 3. Draw a clean, lintless cloth saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint.
 - 4. Finally, draw a clean, dry, lintless cloth through the tube or pipe.

3.9 ADJUSTING AND CLEANING

- A. Verify actual evaporator applications and operating conditions and adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.
- B. Adjust controls and safeties. Replace damaged or malfunctioning controls and equipment with new materials and products.

3.10 SYSTEM CHARGING

- A. Charge system using the following procedure:
 - 1. Install core in filter dryer after leak test but before evacuation.
 - 2. Evacuate entire refrigerant system with a vacuum pump to 500 microns. When vacuum holds for a minimum of 24 hours, system is ready for charging.
 - 3. During excavation, apply heat to pockets, elbows, and low spots in piping.
 - 4. Break vacuum with refrigerant gas, allow pressure to build up to 2 psig.
 - 5. Charge system with a new filter-dryer core in charging line.
- B. Train Owner's maintenance personnel on procedures and schedules related to start-up and shut-down, trouble shooting, servicing, and preventive maintenance of refrigerant piping valves and refrigerant piping specialties.
- C. Review data in Operating and Maintenance Manuals.
- D. Schedule training with Owner with at least seven (7) days advance notice.

END OF SECTION 23 23 00

SECTION 23 25 19 – FLUSHING AND CLEANING OF HYDRONIC PIPING SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 GENERAL REQUIREMENTS

- A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.
- B. The Common Work Results for HVAC, Section 23 05 00, are included as a part of this Section as though written in full in this document.

1.3 SCOPE

- A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries.

1.4 DESCRIPTION OF WORK

- A. Work Included: Perform water analysis and provide all water cleaning products, holding reservoirs, equipment and labor for cleaning, and flushing to control water quality for each system.
- B. Testing Equipment and Reagents: Furnish suitable water flushing and cleaning equipment for each system, complete with apparatus and reagents necessary.

1.5 QUALITY ASSURANCE

- A. Qualifications: The Contractor for work under this Section shall have:
 - 1. A service department and qualified technical service representative located within a reasonable distance of the project site.

1.6 SUBMITTALS

- A. Test reports: Submit test reports certified by an officer of the firm on company letterheads, of samples of each treated water system specified. Comply with ASTM D 596 for reporting. Indicate the ASTM best methods for each test.

PART 2 – PRODUCTS

2.1 PROFESSIONAL FLUSHING AND CLEANING SERVICES PERFORMED BY:

- A. PurgeRite, a third-party flushing company will be used for flushing and cleaning of the HVAC related piping.

Website:
www.purgerite.com

Email:

sales@purgerite.com

Phone:

936-344-6210.

Address:

13805 N. Highway 75, Suite B

Willis, TX 77378

2.2 GENERAL

- A. Pre-Treatment: For new construction and/or renovations to existing hydronic systems, flush and clean all hydronic piping systems to remove and permit flushing of mill scale, oil, grease and other foreign matter. A school district supervisor is to be present to observe cleaning of hydronic piping systems. Systems shall not be started up until the piping has been cleaned.

2.3 FLUSHING AND CLEANING OF STEEL PIPING SYSTEM:

- A. After the mechanical contractor has tested the piping, it is to be flushed and cleaned for service. Provide a complete water flushing and cleaning of the closed loop chilled and hot water systems as specified herein. Systems must be commissioned as clean and meet water treatment specifications.
- B. All chilled and hot water piping and related equipment shall be thoroughly flushed out with pre-cleaning chemicals designed to remove deposits such as pipe dope, oils, loose rust, mill scale and other extraneous materials. Recommended dosages of pre-cleaner chemical products shall be furnished by water treatment supplier, added and circulated throughout the water systems. The water system shall then be diluted and final flushed thoroughly until no foreign matter is observed and total alkalinity of the water is equal to or better than that of the make-up water.
- C. All temporary connections required for flushing, cleaning, purging, and circulating shall be included. Provide suitable pipe bypasses at each coil and heat exchanger during the flushing and cleaning operation.
- D. Self-contained flush unit requirements will contain a pump or pumps connected that will meet or exceed the volume required to flush and purge the system at the required velocity rate through the largest pipe. Pump curve will be submitted along with other important documentation for the related equipment on the unit. This will include, at minimum, filtration, flow meter(s), pressure gauges, and unit description or picture. All operators will comply with all safety regulations of the project site. The flushing operation will be manned continuously during the flushing process.
- E. Flushing Procedure Guidelines:
1. Pre-flush: Bypass loops should be installed in front of any strainers and control valves at all equipment components. Coordinate with PurgeRite for proper sizing and placement of bypasses and flush ports.
 2. Install temporary strainer elements in front of pumps, tanks, solenoid valves, control valves, and other equipment where permanent strainers are not indicated that are not bypassed. Keep these strainers in service until the equipment has been tested, then remove either entire strainer or straining element only. Fit strainers with a line size blow-off valve. Strainers should be removed when a self-contained flush unit is used in conjunction with on board filtration.

3. Flush ports should be identified along with the type of high-pressure hose or piping that will be used to connect to the system. The water source should be identified and must be adequate to fill and make up water in a timely manner to the system during the flush process. A water dump location should be identified which as well is usually the sanitary.

F. Clear Water Flush

1. Fill the piping system with clean potable water. The first flush is a clear- water flush intended to circulate water through the system and force loose debris to low point drains and flush cart filtration system. This flush should be at minimum velocity throughout the system of 5 -7 ft. /sec throughout. Filtration should be at minimum, 50 microns. This flush shall continue until the system water is comparable to the make-up water. Iron content should be under 2.0 ppm.

G. Cleaning & Passivation

1. The second flush cycle is a combined flushing cycle where cleaning and passivation chemicals are introduced into the system to clean the oils and treat the inside wall of the piping system. This process will be monitored by the chemical treatment company to meet the chemical specifications of the water. The cleaning velocity should be between 3 to 5 ft. /sec throughout, and the circulation time will be based on the chemical testing, but will be at minimum, 24 hours.

H. Final Clear Water Flush

1. The system will be continuously flushed while discharging chemicals into the sanitary system as approved locally. As the existing treated water is being discharged, a freshwater make-up source will be utilized to ensure air is not introduced into the system. Continue to drain the system while adding domestic water to dilute the treated water. The chemical treatment company will monitor the outgoing water composition and compare the composition with the incoming water. Flush with fresh water until the conductivity is reduced to that of the make-up water and iron meets specifications. The final system water should be approved by the chemical treatment company. Filtration should be 5 microns.

I. Final Chemical Fill

1. Once the chemical treatment company has determined the system has been brought back to the correct composition, the chemical treatment company will inject the final chemicals into the system. Once the system is filled with the final chemicals it is important the water not be left stagnant.
2. Verify satisfactory completion of clean piping and a final flushing and chemical treatment report should be submitted by field personnel. The report should include at minimum, project name, date, location, parties involved, type of pipes treated, scope summary, flows, durations, and other relevant information.
3. Cleaning chemicals, procedure, water testing, reporting, and consultation must be provided by a qualified water treatment company specializing in this type of work.

2.4 FLUSHING AND CLEANING OF PEX, POLYPROPYLENE, OR HDPE PIPING SYSTEMS:

- A. After the mechanical contractor has tested the piping, it is to be flushed and cleaned for service. Provide a complete water flushing and cleaning of the piping as specified herein. Systems must be commissioned as clean.
- B. All temporary connections required for flushing, cleaning, purging, and circulating shall be included. Provide suitable pipe bypasses at any equipment or building during the flushing and cleaning operation.
- C. Self-contained flush unit requirements should contain a pump or pumps connected that will meet or exceed the volume required to flush and purge the system at the required velocity rate through the largest pipe. Pump curve will be submitted along with other important documentation for the related equipment on the unit. This will include at minimum, filtration, flow meter(s), pressure gauges, and unit description or picture. All operators will comply with all safety regulations of the project site. The flushing operation will be manned continuously during the flushing process.
- D. Flushing Procedure Guidelines

1. Pre- Flush:

Bypass loops should be installed at all equipment or building components. Strainers should be removed when a self-contained purge unit is used in conjunction with on board filtration. Flush ports should be identified along with the type of high-pressure hose or piping that will be used to connect to the system. The water source should be identified and must be adequate to fill and make up water in a timely manner to the system during the flush.

2. Clear Water Flush:

Fill the piping system with clean potable water. The first flush is a clear- water flush intended to circulate water through the system and force loose debris to low point drains and flush cart filtration system. This flush should be at minimum velocity throughout the system of 5 – 7 ft. /sec throughout. Filtration should be at minimum, 5 microns. Minimum duration should be calculated using a formula of 1 hour per 1000' of linear pipe and until system water is comparable to make up water source. The minimum circulation time should be 1 hour regardless of the length.

3. Final Chemical Fill

Once the chemical treatment company has determined the system has been brought back to the correct composition, the chemical treatment company will inject the final chemicals into the system if required. Once the system is filled with the final chemicals it is important the water is not left stagnant and to mix chemicals.

Verify satisfactory completion of clean piping and a final flushing report will be submitted by field personnel. The report will include at minimum, project name, date, location, parties involved, type of pipes treated, scope summary, flows, durations, and other relevant information.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS PREPARATION:

- A. General: After piping systems are erected and proven free of leaks, administer chemicals required for preparation treatment and flushing. Apply chemicals for the time period and

in the concentration recommended by the water treatment manufacturer for this portion of the work.

- B. Testing: Perform test procedures and submit a written final report (at each phase if applicable) of test conditions and results to the Contractor and Consulting Engineer. If test results are unsatisfactory, repeat preparation treatment as necessary to achieve test results approved by the Owner's insurance carrier and the Engineer.

END OF SECTION 23 25 19

SECTION 23 31 13 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Single-wall rectangular ducts and fittings.
 - 2. Single-wall round and Flat Oval ducts and fittings.
 - 3. Double-wall rectangular ducts and fittings.
 - 4. Double-wall round and Flat Oval ducts and fittings.
 - 5. Double-wall flat oval / round / rectangular outdoor ductwork.
 - 6. Insulated Flexible Ducts
 - 7. Sheet metal materials.
 - 8. Sealants and gaskets.
 - 9. Hangers and supports.
- B. Related Sections:
 - 1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
 - 2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
 - 3. Division 23 Section "Duct Insulation" for internal duct liner.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: For each type of the following products:
 - 1. Adhesives.
 - 2. Sealants and gaskets.

C. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. $\frac{1}{4}'' = 1'-0''$ Scale Duct layout drawings indicating sizes, configuration, liner material, static-pressure classes, and bottom of duct elevations. Duct shop drawings shall be superimposed on the architectural backgrounds with the reflected ceiling plans.
4. Dimensions of main duct runs from building grid lines.
5. Fittings.
6. Reinforcement and spacing.
7. Seam and joint construction.
8. Penetrations through fire-rated and other partitions.
9. Equipment installation based on equipment being used on Project.
10. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
11. Hangers and supports, including methods for duct and building attachment, and vibration isolation.

D. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.

- b. Air outlets and inlets.
- c. Speakers.
- d. Sprinklers.
- e. Access panels.
- f. Perimeter moldings.

B. Welding certificates.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports, AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports, and AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

- 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
- 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
- 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Open ends of ductwork shall be factory shrink wrapped air and watertight before shipment to jobsite.

B. Contractor shall adequately protect ductwork from damage after delivery to the project. Ductwork shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

C. Do not deliver ductwork to the project site until progress of construction has reached the stage where ductwork is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Envirotech Mechanical Systems
2. Gurry Mechanical L.P.
3. Letsos Company
4. Mason Road Sheet Metal Inc.
5. McCorvey Sheet Metal Works
6. Telkin Sheetmetal, Inc.
7. Tomball Sheet Metal Co.
8. MLN
9. Walsh & Albert
10. Grant Sheet Metal
11. Tennapel Sheet Metal
12. McGill AirFlow LLC.
13. Texas Duct Systems
14. South Texas Sheet Metal
15. Texas Air Duct Systems
16. SEMCO Incorporated
17. Lindab Inc.

- B. Fabricate ducts with indicated dimensions for the inner duct.
- C. Sheet Metal Connectors, Inc
- D. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- E. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- F. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- G. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND AND FLAT OVAL DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Envirotech Mechanical Systems
 2. Gurry Mechanical L.P.
 3. Letsos Company
 4. Mason Road Sheet Metal Inc.
 5. McCorvey Sheet Metal Works
 6. Telkin Sheetmetal, Inc.
 7. Tomball Sheet Metal Co.

8. MLN
9. Walsh & Albert
10. Grant Sheet Metal
11. Tennapel Sheet Metal
12. McGill AirFlow LLC.
13. Texas Duct Systems
14. South Texas Sheet Metal
15. Texas Air Duct Systems
16. SEMCO Incorporated
17. Lindab Inc.

- B. Fabricate ducts with indicated dimensions for the inner duct.
- C. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- D. Triple-Rib shall be acceptable for single wall spiral lockseam ducts: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- E. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- F. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- G. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Envirotech Mechanical Systems
 2. Gurry Mechanical L.P.

3. Letsos Company
 4. Mason Road Sheet Metal Inc.
 5. McCorvey Sheet Metal Works
 6. Telkin Sheetmetal, Inc.
 7. Tomball Sheet Metal Co.
 8. MLN
 9. Walsh & Albert
 10. Grant Sheet Metal
 11. Tennapel Sheet Metal
 12. McGill AirFlow LLC.
 13. Texas Duct Systems
 14. South Texas Sheet Metal
 15. Texas Air Duct Systems
 16. SEMCO Incorporated
 17. Lindab Inc.
- B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Maximum Thermal Conductivity: $K = 0.23$ at 75 deg. F mean temperature.
 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 3. Coat insulation with antimicrobial coating.
 4. Cover insulation with polyester film complying with UL 181, Class 1.
- G. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
1. Maximum Thermal Conductivity: $K = 0.23$ at 75 deg. F mean temperature.
- H. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.
- I. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular

Duct/Traverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- J. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Envirotech Mechanical Systems
 - 2. Gurry Mechanical L.P.
 - 3. Letsos Company
 - 4. Mason Road Sheet Metal Inc.
 - 5. McCorvey Sheet Metal Works
 - 6. Telkin Sheetmetal, Inc.
 - 7. Tomball Sheet Metal Co.
 - 8. MLN
 - 9. Walsh & Albert
 - 10. Grant Sheet Metal
 - 11. Tennapel Sheet Metal
 - 12. McGill AirFlow LLC.
 - 13. Texas Duct Systems
 - 14. South Texas Sheet Metal
 - 15. Texas Air Duct Systems
 - 16. SEMCO Incorporated
 - 17. Lindab Inc.
- B. Fabricate ducts with indicated dimensions for the inner duct.
- C. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.
- D. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
 - 1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - a. Transverse Joints in Ducts Larger Than 60 Inches Diameter: Flanged.
 - 2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 - b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.
- F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Maximum Thermal Conductivity: $K = 0.23$ at 75 deg F mean temperature.
 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 3. Coat insulation with antimicrobial coating.
 4. Cover insulation with polyester film complying with UL 181, Class 1.
- G. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
1. Maximum Thermal Conductivity: $K = 0.23$ at 75 deg F mean temperature.

2.5 DOUBLE-WALL FLAT OVAL / ROUND / RECTANGULAR OUTDOOR DUCTWORK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Envirotech Mechanical Systems
 2. Gurry Mechanical L.P.
 3. Letsos Company
 4. Mason Road Sheet Metal Inc.
 5. McCorvey Sheet Metal Works
 6. Telkin Sheetmetal, Inc.
 7. Tomball Sheet Metal Co.
 8. MLN
 9. Walsh & Albert
 10. Grant Sheet Metal
 11. Tennapel Sheet Metal
 12. McGill AirFlow LLC.
 13. Texas Duct Systems
 14. South Texas Sheet Metal
 15. Texas Air Duct Systems
 16. SEMCO Incorporated
 17. Lindab Inc.
 18. Linx.

- B. Fabricate ducts with indicated dimensions for the inner duct.
- C. Material:
 - 1. Outer Duct: 18-gauge epoxy coated galvanized duct.
 - 2. Material thickness constructed in accordance with latest SMACNA's HVAC Duct Construction Standards.
- D. Inner Duct: 20 gauge perforated galvanized duct.
- E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B.
 - 1. Minimum 2" insulation and R-value of 8 at 75°F mean ambient temperature.
 - 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 - 3. Coat insulation with antimicrobial coating.
- F. Exterior Coating / Finish.
 - 1. Epoxy coated exterior duct.
 - 2. Average thickness of 4 mils to meet or exceed 3,000-hour salt spray test per ASTM B17-97.
 - 3. Coordinate color with the architect and the owner.

2.6 INSULATED FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Thermaflex Type M-KE.
 - b. Atco
- B. Product Description: UL 181, Class 1, CPE fabric attached to helical wound spring galvanized steel wire; fiberglass insulation; aluminized vapor barrier film.
 - a. Pressure Rating: six (6) inches wg positive and four (4) inches wg negative.
 - b. Maximum Velocity: 4,000 fpm.
 - c. Temperature Range: -20 degrees Fahrenheit to 210 degrees Fahrenheit.
 - d. Thermal Resistance: Minimum R-6 installed.
 - e. Maximum flexible duct length shall not exceed 5'-0".
- C. Provide Flexible Duct Elbow Supports at each diffuser. Refer to "23 33 00 Air Duct Accessories"; 2.10 Flexible Duct Elbow Supports.

2.7 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90 (Z275).
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches.

2.8 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
 - 1. Application Method: Brush on.
 - 2. Solids Content: Minimum 65 percent.
 - 3. Shore A Hardness: Minimum 20.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. VOC: Maximum 75 g/L (less water).
 - 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 - 8. Service: Indoor or outdoor.
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- C. Flanged Joint Sealant: Comply with ASTM C 920.
 - 1. General: Single-component, acid-curing, silicone, elastomeric.
 - 2. Type: S.
 - 3. Grade: NS.
 - 4. Class: 25.
 - 5. Use: O.
 - 6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- E. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.9 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Duct straps shall be wrapped from the top cord of joists; straps wrapped from the bottom chord will not be accepted.
- E. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- F. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- G. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- H. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- I. Trapeze and Riser Supports:
 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.

- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
- M. Ductwork installed on the roof shall be installed and supported such that the roof may be maintained / repaired without the need to disassemble any ductwork.

3.2 REQUIREMENTS FOR DRYER EXHAUST DUCTS

- A. Dryer exhaust ducts for clothes dryers shall be smooth, rigid galvanized duct and shall terminate on the outside of the building and shall be equipped with a backdraft damper. Ducts shall not be connected or installed with sheet metal screws or other fasteners that will obstruct the exhaust flow. Clothes dryer exhaust ducts shall not be connected to a vent connector, vent, or chimney. Clothes dryer exhaust ducts shall not extend into or through ducts or plenums. Provide weather resistant stainless-steel wall cap at duct / wall penetration and a minimum 8" relief hood at roof penetration with roof curb, flashing and counter flashing.

3.3 REQUIREMENTS OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.4 ADDITIONAL REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

- A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease and sloped a minimum of 2 percent to drain grease back to the hood.
- B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches from bottom of duct.
- C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.5 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 - 5. For fastening of sheet metal support straps on each side of the duct, provide (2) two sheet metal screws on the side of the duct and (1) one on the bottom of the duct for a total of (6) six sheet metal screws for maximum fastening of strap to sheet metal duct.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum interval of 16 feet.

- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.7 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.8 PAINTING

- A. Paint all outdoor ductwork, exposed ductwork and exterior of metal ducts that are visible through cloud ceilings, registers, and grilles, etc. and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer; refer to paint manufacturer's instructions to prevent peeling. Coordinate final paint color with architect. Paint materials and application requirements are specified in Division 09 painting Sections.

3.9 DUCT STORAGE / CLEANING

- A. Ductwork shall be kept clean at all times. Ductwork stored on the job site shall be placed a minimum of 4" above the floor and shall be completely covered in plastic with no exposed ends. Installed ductwork shall be protected with plastic. Do not install the ductwork if the building is not "dried-in". If this is required, the entire lengths of duct shall be covered in plastic for protections. The Owner / Engineer shall periodically inspect that these procedures are followed. If deemed unacceptable, the Contractor shall be required to clean the duct system utilizing NADCA certified Contractor.
- B. The working area shall be clean, dry and the ductwork protected from dust. Protective coverings shall only be removed immediately before installation and inspected to determine if additional wipe down is necessary.

3.10 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
 - 1. All exposed ducts in spaces such as but not limited to: Gymnasiums, Natatoriums, Cafeteria's, Libraries, etc.: Double wall insulated round ductwork.
- B. Supply Ducts:
 - 1. Ducts Connected to Fan Coil Units, Split-DX System Air Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive 1-inch wg.
 - b. Minimum SMACNA Seal Class: C.
 - c. SMACNA Leakage Class for Rectangular: 24.
 - d. SMACNA Leakage Class for Round: 12.

2. Ducts Connected to Constant-Volume Air-Handling and Rooftop Units:
 - a. Pressure Class: Positive 2-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round: 6.
 3. Ducts Connected to Variable-Air-Volume Air-Handling and Rooftop Units:
 - a. Pressure Class: Positive 4-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round: 3.
- C. Return and Outside Air Ducts:
1. Ducts Connected to Fan Coil Units, Split-DX System Air Units Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive or negative 1-inch wg.
 - b. Minimum SMACNA Seal Class: C.
 - c. SMACNA Leakage Class for Rectangular: 24.
 - d. SMACNA Leakage Class for Round: 12.
 2. Ducts Connected to Air-Handling and Rooftop Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round: 6.
- D. Exhaust Ducts:
1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 1-inch wg.
 - b. Minimum SMACNA Seal Class: C if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round: 6.
 2. Ducts Connected to Air-Handling and Rooftop Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round: 6.
 3. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
 - a. Exposed to View: 18-gauge Type 304, stainless-steel sheet, No. 4 finish.
 - b. Concealed: 16-gauge Carbon-steel sheet.
 - c. Continuously welded seams and joints
 - d. Pressure Class: Positive or negative 2-inch wg.
 - e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - f. SMACNA Leakage Class: 3.

4. Ducts Connected to Dishwasher Hoods:
 - a. 18-gauge Type 304, stainless-steel sheet.
 - b. Exposed to View: No. 4 finish.
 - c. Concealed: No. 2D finish.
 - d. Continuously welded seams and joints
 - e. Pressure Class: Positive or negative 2-inch wg.
 - f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - g. SMACNA Leakage Class: 3.

5. Ducts Connected to Shower Return air grilles:
 - a. 18-gauge Type 304, stainless-steel sheet.
 - b. Exposed to View: No. 4 finish.
 - c. Concealed: No. 2D finish.
 - d. Continuously welded seams and joints
 - e. Pressure Class: Positive or negative 2-inch wg.
 - f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - g. SMACNA Leakage Class: 3.

6. Ducts Connected to Fans Exhausting Laboratory and Process (ASHRAE 62.1, Class 3 and 4) Air:
 - a. Type 316, stainless-steel sheet.
 1. Exposed to View: No. 4 finish.
 2. Concealed: No. 2D finish.
 - b. Continuously welded seams and joints
 - c. Pressure Class: Positive or negative 3-inch wg.
 - d. Minimum SMACNA Seal Class: A.
 - e. SMACNA Leakage Class: 3.

7. Ducts Connected to Chlorine and Acid Rooms (ASHRAE 62.1, Class 3 and 4) Air:
 - a. Type 316, stainless-steel sheet.
 1. Exposed to View: No. 4 finish.
 2. Concealed: No. 2D finish.
 - b. Continuously welded seams and joints
 - c. Pressure Class: Positive or negative 3-inch wg.
 - d. Minimum SMACNA Seal Class: A.
 - e. SMACNA Leakage Class: 3.

8. Ducts Connected to Fans Exhausting Welding Fumes (ASHRAE 62.1, Class 3 and 4) Air:
 - a. Type 316, stainless-steel sheet.
 1. Exposed to View: No. 4 finish.
 2. Concealed: No. 2D finish.
 - b. Continuously welded seams and joints
 - c. Pressure Class: Positive or negative 3-inch wg.
 - d. Minimum SMACNA Seal Class: A.

- e. SMACNA Leakage Class: 3.
- E. Intermediate Reinforcement:
- 1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
 - 2. Stainless-Steel Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.
 - 3. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.
- F. Elbow Configuration:
- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - 2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1. Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or welded.
- G. Branch Configuration:
- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
 - 2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1,000 fpm or Lower: 90-degree tap.

- b. Velocity 1,000 to 1,500 fpm: Conical tap.
- c. Velocity 1,500 fpm or Higher: 45-degree lateral.

END OF SECTION 23 31 13

SECTION 23 31 18- FABRIC DUCT

PART 1-GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

- A. Extent of non-metal ductwork is indicated on drawings and by requirements of this section.
- B. Types of non-metal ductwork required for this project include the following:
 - 1. Fabric Air Dispersion Products suitable for Natatoriums and Gymnasiums.

1.3 QUALITY ASSURANCE

- A. Building Codes and Standards:
 - 1. Product must be Classified by Underwriters Laboratories in accordance with the 25/50 flame spread / smoke developed requirements of NFPA 90-A and are also classified in accordance with ICC Evaluation Service AC167.
 - 2. All product sections must be labeled with the logo and classification marking of Underwriters Laboratories.
- B. Design & Quality Control
 - 1. Manufacturer must have documented design support information including duct sizing, vent and orifice location, vent and orifice sizing, length, and suspension. Parameters for design, including maximum air temperature, velocity, pressure and fabric permeability, shall be considered and documented.

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: Submit manufacturer's specifications on materials and manufactured products used for work of this section.
- C. Building Code Data: Submit UL file number under which product is Classified by Underwriters Laboratories.
- D. Provide detailed drawings confirming configuration of Fabric Tensioning System (components, support locations, segment lengths) and Textile Dispersion System (diameter, lengths, airflow, pressure, velocity, and textile permeability).
- E. Provide detailed installation instructions for components to be installed.

1.5 WARRANTY

- A. Manufacturer must provide a complete product (20) twenty-year pro-rated warranty for products supplied for the fabric and suspension of this system as well as a Design and

Performance Warranty. Laundering frequency nor any other conditions shall pertain to warranty terms.

1. Years (1) one through (10) ten: 100% coverage.
2. Years (11) eleven through (15) fifteen: 50% coverage.
3. Years (16) sixteen through (20) twenty: 25% coverage.

1.6. DELIVERY, STORAGE AND HANDLING

- A. Protect fabric air dispersion systems from damage during shipping, storage, and handling.
- B. Contractor shall adequately protect ductwork from damage after delivery to the project. Ductwork shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- C. Do not deliver ductwork to the project site until progress of construction has reached the stage where ductwork is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with requirements, provide products manufactured in the United States by the following:
 1. DuctSox – Sedona Xm
 2. FabricAir, Inc. - Combi 80

2.2 FABRIC AIR DISPERSION SYSTEM

- A. Air diffusers constructed with internal tensioning frame.
 1. System shall cylindrically tension fabric along the entire length of fabric duct, including all fittings (crosses, elbows, reducers, and tees).
 2. Tensioning system shall include full 360-degree tensioning and intermediate rings with quick connection spacer tubes concealed inside the fabric system.
 3. Interior structure to include multiple mechanically adjustable tension devices. To provide proper fabric tensioning, structural and fabric system shall be configured in segments of no more than 45 feet.
 4. Fabric components supported solely by metal cylindrical rings.

5. Each cylindrical ring shall require vertical metal to metal vertical cable safety attachment.
 6. If within a natatorium, all metal structural components shall be able to withstand chlorinated environment and shall not be susceptible to corrosion. Provide necessary coatings and materials.
- B. Air diffusers constructed with external structural frame.
1. The system shall be made with sewn in but removable aluminum hoops. The hoops shall:
 - a. Maintain the ducts' cylindrical shape at all times.
 - b. Be made to a circular arc angle of 180° (8" - 48"), 120° (49" - 60"), 90° (61" - 68") or 60° (69" - 80") depending on duct diameter.
 - c. Shall be centered at the 12:00 o'clock position of the duct.
 - d. Shall be installed at the factory, on-site installation shall not be allowed.
 2. Diameter and spacing of hoops shall be determined by the manufacturer based on duct diameter.
 3. Elbows of 70° or more shall have at least two hoops.
 4. Air dispersion shall be accomplished with linear or polar arrays of laser cut orifices. Size of laser cut orifices shall be from 1" to 5" diameter. Due to exact throw requirements and NC requirements alternative flow models are not acceptable.
 5. Number of orifices shall be determined by manufacturer.
 6. Fabric system shall include connectors to attach to suspension system.
 7. If within a natatorium, all metal structural components shall be able to withstand chlorinated environment and shall not be susceptible to corrosion. Provide necessary coatings and materials.
- C. FABRIC
1. Fabric Color: Provide sample swatch of actual material and color with submittal and coordinate with the architect.
 2. Fabric air dispersion system shall be constructed of a woven, 100% anti-microbial treated, fire retardant and permeable fabric complying with the following characteristics:
 - a. Filament/filament twill polyester that includes 55% recycled content, treated with a machine washable anti-microbial agent by the fabric manufacturer, fire retardant in accordance with UL 2518. Non-linting filament yarn to meet the requirements of ISO Class 3 environment.
 - b. Duct Shape: ROUND (coordinate with plans).

- c. Fabric: 100% Flame Retardant Polyester, factory treated with an EPA approved antimicrobial agent
- d. Base Permeability @ 0.5" WG: 2 CFM / ft² per ASTM D737; shall be verified by the Frazier Permeability Test.
- e. Weight: 8.5 oz. / yd² per ASTM D3776.
- f. Shrinkage: Max. 0.5% per DIN EN 26 630.
- g. Temperature Range: -40°F and +284°F.
- h. Fire Retardancy: Shall meet the requirements in NFPA 90-A, ICC AC167 and UL 2518.

D. TEXTILE SYSTEMS FABRICATION REQUIREMENTS

- 1. Provide system in modular lengths optimized for maintenance, connected by zippers with proper radial securing clips (inlets, endcaps and mid-sections) and top access zippers (if required) for vertical cable safety attachment. Zippers shall provide closure completely around the circumference to prevent leakage. Required number of zippers shall be specified by the manufacturer.
- 2. Integrated air dispersion outlets (orifices, nozzles, linear vents or other) shall be specified and approved by manufacturer.
- 3. The system shall be made of permeable fabric. Base permeability of fabric shall be reached based on a combination of weave construction and a thermo fixation process in order to prevent permeability degradation after wash. Fabric permeability based on a calendaring process is not acceptable.
- 4. Inlet connection to metal duct via fabric draw band with anchor patches as supplied by manufacturer. Anchor patches to be secured to metal duct via zip screw fastener – supplied by contractor.
- 5. Inlet connection includes zipper for easy removal / maintenance.
- 6. Lengths to include required intermediate zippers as specified by manufacturer.
- 7. End cap includes zipper for easy maintenance.
- 8. Each section of the fabric shall include identification labels documenting order number, section diameter, section length, piece number, code certifications and other pertinent information

E. DESIGN PARAMETERS

- 1. Fabric air diffusers shall be designed from 0.25" water gage minimum to 3" maximum, with 0.5" as the standard.
- 2. Fabric air diffusers shall be limited to design temperatures between -40°F and +284°F.
- 3. Design CFM, diameter, dispersion, static pressure, and diffuser length shall be designed or approved by the manufacturer.

4. Do not use fabric diffusers in concealed locations.
5. Use fabric diffusers only for positive pressure air distribution components of the mechanical ventilation system.

PART 3 – INSTALLATION

3.1 INSTALLATION OF FABRIC AIR DISPERSION SYSTEM

- A. Install chosen suspension system with minor noise and fabric motion at start-up in accordance with the requirements of the manufacturer. Instructions for installation shall be provided by the manufacturer with product. Suspension Track and cable within a natatorium shall be able to withstand chlorinated environment and shall not be susceptible to corrosion. Provide necessary coatings and materials.

3.2 CLEANING AND PROTECTION

- A. Clean air handling unit and ductwork prior to the fabric air dispersion system unit-by-unit as it is installed. Clean external surfaces of foreign substance which may cause corrosive deterioration of facing.
- B. Temporary Closure: At ends of ducts which are not connected to equipment or distribution devices at time of ductwork installation, cover with polyethylene film or other covering which will keep the system clean until installation is completed.
- C. If fabric dispersion system becomes soiled during installation, they should be removed and cleaned following the manufacturers standard terms of laundry.

END OF SECTION 23 31 18

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Back-draft dampers.
 - 2. Combination fire-and-smoke dampers.
 - 3. Duct access doors.
 - 4. Fire dampers.
 - 5. Smoke dampers.
 - 6. Volume control dampers.
 - 7. Flexible duct connections
 - 8. Duct Taps
 - 9. Duct test holes
 - 10. Flexible duct elbow supports
- B. Related Sections:
 - 1. Section 23 31 00 - HVAC Duct and Casings: Requirements for duct construction and pressure classifications.

1.3 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate shop fabricated assemblies including volume control dampers, duct access doors, and duct test holes.
- C. Product Data: Submit data for shop fabricated assemblies including fire dampers including locations and ratings, smoke dampers including locations and ratings, backdraft dampers, flexible duct connections, volume control dampers, duct access doors, duct test holes and hardware used. Include electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Submit for Fire, Smoke and Combination Fire/Smoke Dampers.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

1.6 COORDINATION

- A. Coordinate Work where appropriate with building control Work.
- B. Coordinate fire alarm wiring requirements with Division 26.

1.7 WARRANTY

- A. Furnish five (5) year manufacturer warranty for duct accessories.

1.8 EXTRA MATERIALS

- A. Furnish two (2) of each size and type of fusible link for fire rated dampers.

PART 2 - PRODUCTS

2.1 BACK-DRAFT DAMPERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Arrow United Industries
 - 2. American Warming and Ventilating
 - 3. Ruskin
 - 4. Air Balance
 - 5. NCA
 - 6. Pottorff
 - 7. Greenheck
- B. Product Description: Multi-Blade, back-draft dampers: Parallel-action, gravity-balanced, Galvanized 16 gage thick steel, or extruded aluminum. Blades, maximum 6-inch width, center pivoted, with felt or flexible vinyl sealed edges. Blades linked together in rattle-free manner with 90-degree stop, steel ball bearings, and plated steel pivot pin. Furnish dampers with adjustment device to permit setting for varying differential static pressure.

2.2 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Cesco
 - 2. NCA
 - 3. Ruskin
 - 4. Nailor
 - 5. Pottorff
 - 6. Greenheck
- B. Fabricate in accordance with NFPA 90A, UL 555, and UL 555S. Dampers shall be Leakage Class 1. Damper shall include a factory installed sleeve.
- C. Construction: Fabricate with 16 gage roll formed, galvanized steel hat-shaped channel frame. Furnish stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, concealed linkage, and 1/2-inch actuator shaft. Blades shall be airfoil type, 14-gauge equivalent. Blade edge seals shall be mechanically fastened to blade.

- D. Operators: UL listed and labeled two-position, fail close, electric type suitable for 120 volts, single phase, 60 Hz. Furnish end switches to indicate damper position. Locate damper operator on exterior of sleeve and link to damper operating shaft.
- E. Temperature rating: 250°F.
- F. Normally Closed Smoke Responsive Fire Dampers: Curtain type, opening by gravity upon actuation of Electro thermal link, flexible stainless-steel blade edge seals to produce constant sealing pressure.
- G. Coordinate fire alarm control wiring with Division 26.
- H. Rating: 1-1/2 hours in wall rated at less than three (3) hours.
- I. Normally Open Smoke Responsive Fire Dampers: Curtain type, closing upon actuation of Electro thermal link, flexible stainless-steel blade edge seals to produce constant sealing pressure, stainless steel springs with locking devices to maintain positive closure for units mounted horizontally.
- J. Electric Fuse Link: Heat actuated, quick detecting to release at 165 degrees Fahrenheit, UL listed and labeled. Controlled closing and locking of damper in 7-15 seconds to allow duct pressure to equalize. Instantaneous closure is not acceptable. Manual reset at damper.

2.3 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. Fabrication: Rigid and close fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, furnish minimum 1-inch-thick insulation with sheet metal cover.
 - 1. Less Than 12 inches square, secure with sash locks.
 - 2. Up to 18 inches Square: Furnish two hinges and two (2) sash locks.
 - 3. Up to 24 x 48 inches: Three hinges and two compression latches with outside handles.
 - 4. Larger Sizes: Furnish additional hinge.
 - 5. Access panels with sheet metal screw fasteners are not acceptable.

2.4 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Cesco
 - 2. NCA
 - 3. Ruskin
 - 4. Nailor
 - 5. Pottorff
 - 6. Greenheck

- B. Fabricate in accordance with NFPA 90A and UL 555, and manufacturer's condition of listing. Permanently mark dampers for use in dynamic systems.
- C. Ceiling Fire Dampers: Galvanized steel, 24 gage frame and 24 gage blades with UL classified insulation if required. Provide with radiation blanket.
- D. Curtain Type Dampers: 20 gage Galvanized steel frame with interlocking 24 gage galvanized steel blades. Furnish stainless steel closure springs and latches for horizontal installations and closure under airflow conditions. Configure with blades out of air stream.
- E. Multiple Blade Dampers: 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless-steel sleeve bearings and plated steel axles, 1/8 x 1/2-inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.
- F. Fusible Links: UL 33, separate at 165 degrees Fahrenheit.
- G. Rating: 1-1/2 hours in wall rated at less than three (3) hours.

2.5 SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Cesco
 - 2. NCA
 - 3. Ruskin
 - 4. Nailor
 - 5. Pottorff
 - 6. Greenheck
- B. Fabricate in accordance with UL 555S, Leakage Class I.
- C. Construction: Fabricate with 16 gage roll formed, galvanized steel hat-shaped channel frame. Furnish self-lubricating stainless-steel sleeve bearings and plated steel axles, stainless steel jamb seals, concealed linkage and 1/2-inch actuator shaft. Blades shall be airfoil type, 14-gauge equivalent. Blade edge seals shall be mechanically fastened to blade.
- D. Operators: UL listed and labeled two-position, fail close, electric type suitable for 120 volts, single phase, 60 Hz. Furnish end switches to indicate damper position. Actuator to be mounted internally or externally as required.
- E. Temperature rating: 250°F.
- F. Coordinate fire alarm control wiring with Division 26.

2.6 VOLUME CONTROL DAMPERS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated on Drawings.
- B. Splitter Dampers:
 - 1. Material: Same gage as duct to 24 inches size in both dimensions, and two gages heavier for sizes over 24 inches.

2. Blade: Fabricate of single thickness sheet metal secured with continuous hinge or rod with end bearings.
 3. Operator: Minimum 1/4-inch diameter rod in self aligning, universal joint action, flanged bushing with set screw.
- C. Single Blade Dampers: Fabricate for duct height up to 12".
- D. Multi-Blade Damper: Opposed blade interlocking type pattern for duct height 12" and greater. Assemble blades in galvanized frame channel with suitable hardware and linkage concealed in frame. Provide multiple section dampers for sizes larger than 48-inch x 72 inch. Provide jack shafting configuration and crossovers.
- E. Damper Blades:
1. Provide 16-gauge galvanized steel center and edge grooved blade type where velocities do not exceed 1500 FPM.
 2. Provide 14 gage galvanized steel. Roll formed airfoil blade type where velocities exceed 1500 FPM.
 3. Maximum leakage shall be 8 CFM per square foot of damper area at four (4) inches wg pressure.
- F. End Bearings: Except in round ductwork 12 inches and smaller, furnish end bearings. On multiple blade dampers, furnish oil-impregnated nylon or bronze bearings. Furnish closed end bearings on ducts having pressure classification over two (2) inches wg.
- G. Quadrants:
1. Furnish locking, indicating quadrant regulators on single and multi-blade dampers that do not have actuators.
 2. On insulated ducts mount quadrant regulators on 2" standoff mounting brackets, bases, or adapters.
 3. Where rod lengths exceed 30 inches furnish regulator at both ends.
 4. Provide remote damper operators for concealed dampers. Operator shall utilize miter gears, worm gears and couplings or be cable operated. Coordinate operator trim and location with Architect / Engineer.
- H. Actuators:
1. Maximum damper area per actuator shall be 24 square feet face area.
 2. Actuators shall be two position or modulating spring return type.
 3. Duct mounted dampers shall have actuators mounted outside of air stream.
 4. Coordinate with Section 23 09 23 – Direct-Digital Control System for HVAC.

2.7 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

- B. Connector: Fabric crimped into metal edging strip.
 - 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric conforming to NFPA 90A, minimum density 30 oz per sq yd.
 - 2. Net Fabric Width: Approximately six (6) inches wide.
 - 3. Metal: Three (3) inch wide, galvanized steel. Same gage as connecting duct.
 - 4. Install flexible connections with a minimum of one (1) inch between metal edges.
 - 5. Provide flexible duct connections at every duct connection to equipment.
- C. Application:
 - 1. Flexible duct connectors are not permitted on duct connections to internally isolated equipment. Internal isolation shall be in accordance with Section 230548.

2.8 DUCT TAPS

- A. Provide 24-gauge galvanized steel conical fittings with integral balancing damper for duct taps serving single ceiling diffuser. Balancing damper shall consist of 24 gauge, 3/8" steel axel and nylon end bearings with 2" standoff quadrant mount.
- B. Provide 24-gauge galvanized steel 45 degree, rectangular to round, side takeoff fitting with integral balancing damper when airflow is less than or equal to 20 percent of main duct airflow. Balancing damper shall consist of 24 gauge, 3/8" steel axel and nylon end bearings with 2" standoff quadrant mount.
- C. Provide tee split with radius elbow when takeoff or branch duct airflow is greater than 20 percent of main duct. Square throat elbows are acceptable in areas of limited clearances. Provide splitter damper. Refer to Section 23 31 00 - HVAC Duct and Casings.
- D. Provide volume damper at all takeoffs in constant volume systems and at all takeoffs downstream of terminal units in variable volume systems.

2.9 DUCT TEST HOLES

- A. Permanent Test Holes: Factory fabricated, airtight flanged fittings with screw cap. Furnish extended neck fittings to clear insulation.
- B. Coordinate test hole locations and requirements with TAB contractor. If additional test holes are required for TAB, contractor will provide at no additional cost.

2.10 FLEXIBLE DUCT ELBOW SUPPORTS

- A. Elbow supports shall be constructed of durable composite material and be fully adjustable to support flexible duct diameters 6" – 16". Elbow supports shall be UL listed for use in return air plenum spaces.
- B. Provide elbow supports at each diffuser connection.
- C. Manufactured by Thermaflex – FlexFlow Elbow

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify rated walls are ready for fire damper installation.
- B. Verify ducts and equipment is ready for accessories.
- C. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.2 REPORTS

- A. Per NFPA 90A, all fire dampers, smoke dampers and fire/smoke dampers must be tested prior to occupancy and contractor shall provide written confirmation if the dampers are operating as required. Provide pass / fail report in excel spreadsheet. Include type of damper, damper manufacturer / model, actuator manufacturer / model, fusible link in the excel spreadsheet.
- B. Contractor to provide as-built drawings of location of all fire, smoke and fire/smoke dampers with appropriate label that matches the installation.
- C. Per NFPA 80, contractor shall test and inspect all dampers prior to one (1) year warranty period. All inspections, testing and maintenance of dampers must be documented, indicating the location of the damper, date(s) of inspection, name of inspector and deficiencies discovered. The document must have a space to indicate when and how the deficiencies were corrected. All documentation is expected to be maintained and made available for review by the AHJ.
- D. After first year, test and inspection frequency must be every 4 years.

3.3 INSTALLATION.

- A. Install in accordance with NFPA 90A and follow SMACNA HVAC Duct Construction Standards Metal and Flexible. Refer to Section 23 31 00 - HVAC Duct and Casings for duct construction and pressure class.
- B. Install back-draft dampers on exhaust fans or exhaust ducts nearest to outside if motorized dampers are not shown on plans.
- C. Install duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and as indicated on Drawings. Install at locations for cleaning kitchen exhaust ductwork in accordance with NFPA 96. Install minimum 8 x 8-inch size for hand access, 18 x 18-inch size for shoulder access, and as indicated on Drawings. Review locations prior to fabrication.
- D. Install temporary duct test holes required for testing and balancing purposes. Cut or drill in ducts. Cap with neoprene plugs, threaded plugs, threaded or twist-on metal caps.
- E. Provide fire dampers, combination fire and smoke dampers and smoke dampers at locations as indicated on Drawings. Install with required perimeter mounting angles, sleeves, and breakaway duct connections.

- F. Install smoke dampers and combination fire and smoke dampers in accordance with NFPA 92A.
- G. Install volume dampers at points on supply, return, outside air and exhaust systems where branches extend from larger ducts. For air systems with common return air plenum provide volume dampers in both outside air and return air ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
 - 3. Install stainless steel volume dampers in stainless steel ducts.
 - 4. Install aluminum volume dampers in natatoriums.

3.4 DEMONSTRATION

- A. Demonstrate re-setting of fire dampers, fire and smoke dampers and smoke dampers to Owner's representative.

END OF SECTION 23 33 00

SECTION 23 33 19 - DUCT SILENCERS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Duct silencers.
 - 2. Crosstalk silencers.
 - 3. Ductwork lagging.

1.3 PERFORMANCE REQUIREMENTS

- A. Sound control components are selected to maintain the sound level of space at levels not to exceed those listed below. The midpoint of Noise Criteria (NC) curves shall apply.
- B. Sound control components are designed to maintain rooms at the following maximum sound levels, in Noise Criteria (NC) as defined by HVAC Applications and ANSI S1.8.
 - 1. **Offices**
 - a. Executive: 30
 - b. Conference rooms: 30
 - c. Private: 35
 - d. Open-plan areas: 35
 - e. Computer/business machine areas: 40
 - f. Public circulation: 40
 - 2. **Schools**
 - a. Lecture and classrooms: 30
 - b. Open-plan classrooms: 35
 - 3. **Libraries:** 25
 - 4. **Theaters**
 - a. Theater: 25
 - b. Stage house: 25
 - c. Trap room: 25
 - d. Orchestra pit: 25
 - e. Rehearsal rooms: 25
 - f. Teaching studios: 30
 - g. Practice rooms: 30
 - h. Ensemble rooms: 30
 - i. Shop: 45

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.

- B. Shop Drawings: Indicate assembly, materials, thickness, dimensional data, pressure losses, acoustical performance, layout, and connection details for sound attenuation products fabricated for this project.
- C. Product Data: Submit catalog information indicating, materials, dimensional data, pressure losses, and acoustical performance for standard sound attenuation products.
- D. Design Data: Submit selection of each individual trap. Selection shall indicate airflow and pressure drop. Sound attenuators shall be selected based on full return airflow.
- E. Test Reports: Indicate acoustic housings meet or exceed specified sound transmission loss values.
- F. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.
- G. Manufacturer's Certificate: Certify silencers meet or exceed specified requirements.
- H. Manufacturer's Field Reports: Indicate sound isolation installation is complete and in accordance with instructions.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of crosstalk silencers, acoustic housings, duct silencers and ductwork lagging. Record actual locations of hangers including attachment points.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with AMCA 300, ANSI S1.13, ARI 575, ANSI S12.36, standards and recommendations of ASHRAE 68.
- B. Combustion ratings for the silencer acoustic fill material shall not be greater than the following when tested to ASTM E84, NFPA Standard 255 or UL No. 723:
 - 1. Flame Spread Classification: 20
 - 2. Smoke Development Rating: 20
 - 3. Fuel Contribution: 20

1.7 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) year's experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

- B. Do not deliver Equipment to the project site until progress of construction has reached the stage where sound attenuators are actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 DUCT SILENCERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
1. Aerosonics
 2. United McGill
 3. IAC
 4. Vibro-Acoustics
 5. Dynasonics
 6. Commercial Acoustics
 7. Ruskin
 8. Price
- B. Description: Sheet metal outer casing, sound absorbing fill material with coating, and inner casing of perforated sheet metal with integral interior baffles of similar construction. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- C. Configuration:
1. Tubular with inner casing and liner, aerodynamically shaped center body with nose cone and truncated tail cone, diameter and length as indicated on Drawings.
 2. Rectangular with lined splitters with radius nose and contoured tails. Size as indicated on Plans.
- D. Materials:
1. Outer Casing: Minimum 22 gage thick galvanized steel stiffened with mastic filled lock formed seams, two (2) inch long, 11 gage button punched slip joints on both ends.
 2. Inner Casing and Splitters: Minimum 24 gage thick perforated galvanized steel.
 3. Fill: Glass fiber or mineral wool of minimum 3 lb/cu ft density with antimicrobial and erosion coatings.
- E. Rating:
1. ASTM E477 Insertion Loss and Maximum Generated Noise based on 1000 fpm Face Velocity. Performance criteria listed below based on IAC model LFM:

Insertion Loss (dB)

Length - Octave Band Center Frequency (Hz)

		63	125	250	500	1000	2000	4000
Forward Flow	3 FT	4	7	13	16	15	10	9
	5 FT	6	10	17	25	25	14	11
Reverse Flow	3 FT	5	7	13	17	16	11	10
	5FT	7	12	19	27	27	14	13

Generated Noise (dB)

		<u>Octave Band Center Frequency (Hz)</u>						
		63	125	250	500	1000	2000	4000
Forward Flow (all lengths)		32	24	32	25	34	39	24
Reverse Flow (all lengths)		31	30	34	35	40	45	28

2. Maximum static pressure shall not exceed 0.17 inches wg.
3. Return air silencers installed at mechanical room walls shall be sized for full design return flow to mechanical room. Outside air and exhaust air shall not be subtracted from return in order to ensure silencers operate within design parameters for all modes of operation.

2.2 CROSS-TALK SILENCERS / TRANSFER DUCT

- A. Description: Double wall sheet metal duct elbow with 1" insulation and perforated liner covering entire inside surface. Size as indicated on plans. Refer to Section 23 31 13 and detail on Plans.
- B. Casing: Construct elbow using duct gauges specified for size shown.
- C. Rating:
 1. Size transfer duct at a maximum of 500 fpm Face Velocity.
 2. Full design return air flow form space shall be used for sizing transfer ducts.
 3. Maximum static pressure loss through transfer duct shall not exceed 0.05 inches wg.

2.3 DUCTWORK LAGGING

- A. Acoustic Insulation: Two (2) inch thick, 3 to 5 lb/cu ft density glass fiber or mineral wool insulation.
- B. Covering: Gypsum board with surface weight minimum 4 lb/sq ft. All joints of covering shall be sealed as specified.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Support duct silencers independent of ductwork.
- B. Install crosstalk silencers in wall. Pack and resiliently seal wall penetration.

- C. Lag ductwork at wall by wrapping with insulation and covering. Lagging of duct will be identified on the plans. Apply covering to be airtight. Do not attach covering rigidly to ductwork. Fire damper sleeve shall be lagged at wall penetration, no exception.
- D. Silencers shall be installed in accordance with manufacturer recommendations.
- E. Silencers installed in duct systems that generate excessive system effect and pressure drop shall be removed and installed correctly by contractor at no additional cost.
- F. Duct transition upstream of silencers shall be 30 degrees maximum. Duct transition downstream of silencer shall be 15 degrees maximum.
- G. Silencers shall be installed a distance of (3x duct diameter) from elbows.
- H. Silencers shall be installed a minimum of (1x duct diameter) from fan or unit outlets / inlets.
- I. Where multiple silencers are ganged together provide continuous galvanized steel nosing, crimped or button punched, on internal partitions.
- J. Silencers at mechanical room walls shall be installed with wall at midway point of casing. Pack and resiliently seal wall penetration. Silencers may be placed with overhang on either side of wall to allow coordination with trades.
- K. Silencers located at fire rated walls shall be connected to wall sleeve of damper. Provide duct lagging on damper sleeve.

END OF SECTION 23 33 19

SECTION 23 34 00 - HVAC FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide complete, fully operational fans where indicated on Drawings.
- B. Section Includes:
 - 1. Hooded propeller roof fans
 - 2. Upblast centrifugal roof fans
 - 3. Upblast centrifugal roof fans – Grease exhaust
 - 4. Centrifugal filtered supply fans
 - 5. Inline Fans
 - 6. Side Wall Propeller Fans
- C. Related Sections:
 - 1. Section 23 31 00 - HVAC Duct and Casings - Ducts: Product requirements for hangers for placement by this section.
 - 2. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.
 - 3. Coordinate work in this Section with Division 7.

1.3 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, and ductwork and accessory connections.
- C. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics, and connection requirements.
- D. Manufacturer's Installation Instructions: Submit fan manufacturer's instructions.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.5 QUALITY ASSURANCE

- A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.

- B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
- C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705 and UL 762 for kitchen exhaust.
- D. Balance Quality: Conform to AMCA 204.

1.6 WARRANTY

- A. Furnish one (1) year manufacturer's warranty for fans. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up will not be acceptable.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor.

1. Fan Belts: Two (2) sets for each belt-driven fan.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Fans shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver Equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.9 UNIT IDENTIFICATION REQUIREMENTS

- A. Furnish each fan with a durable, deep etched, .025" thick, factory installed aluminum identification plate, permanently mounted with the following information:

- Unit identification as indicated within Contract Documents.
- Serial Number.
- Model Number.
- Capacity (CFM) and static pressure (w.g.).
- Motor Horsepower.
- Fan RPM.
- Unit Power Supply: Volts / PH / Amps.
- Supply Fan Drive Type.
- Sales Order #.
- Date of unit manufactured.

PART 2 - PRODUCTS

2.1 HOODED PROPELLER ROOF FANS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
1. Greenheck
 2. Cook
 3. Twin City
- B. Unit shall be a low profile, hooded, roof mounted, belt driven or direct drive, propeller supply ventilator. Coordinate drive with fan schedule on drawings.
- C. Fan shall be constructed in accordance with UL 705. Fan shall bear the AMCA certified ratings seal for air performance.
- D. Construction: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The motor, bearings and drives shall be mounted on a welded tubular steel power assembly. The power assembly shall be rigidly secured to the fan housing. The powder coated steel fan housing shall include a minimum 14-gauge base with integral spun venturi and continuously welded or application of butyl tape to inside of the curb cap for maximum leak protection. The fan shall be enclosed with a minimum 18-gauge galvanized steel hood bolted to the fan housing. The hood shall have a removable top cap to allow unobstructed access to the motor and power assembly without removing entire hood. The fan outlet shall be protected from entry of foreign material by ½" x ½" galvanized steel screen. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- E. Coating: All ungalvanized steel fan components shall be treated with an electrostatically applied, baked polyester powder coating. Each component shall be subject to a five stage environmentally friendly wash system, followed by a minimum 2 mil thick baked powder finish. Paint must exceed 1,000-hour salt spray under ASTM B117 test method.
- F. Propeller: Propeller shall be a high-efficiency fabricated steel design with blades securely fastened to a minimum 7-gauge steel hub. The hub shall be keyed and locked to the fan shaft utilizing two setscrews. Propeller shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.
- G. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase, and enclosure.
- H. Bearings: Bearings shall be designed and tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a cast iron housing

selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

- I. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.
- J. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- K. Accessories:
 1. Motorized damper in damper tray of roof curb. Actuator shall be same voltage as motor in fan. Damper shall energize fan through integral end switch.
 2. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Factory provided disconnect switches shall be rated for outdoor use. Three phase combination disconnect/starter shall be provided by Division 26.
 3. Direct drive units shall be provided with motor speed control option.

2.2 UPBLAST CENTRIFUGAL ROOF FANS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 1. Greenheck
 2. Cook
 3. Twin City
- B. Fan shall be a spun aluminum, roof mounted, belt driven or direct drive, upblast centrifugal ventilator. Coordinate drive with fan schedule on drawings.
- C. Fan shall be constructed in accordance with UL 705. Fan shall bear the AMCA certified ratings seal for air performance.
- D. Construction: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16-gauge marine alloy aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have sealed curb cap corners by continuous weld or application of butyl tape to inside of the curb cap for maximum leak protection. The windband shall have a rolled bead for added strength. A two-piece top cap shall have stainless steel quick release latches to provide access into the motor compartment without the use of tools. An integral conduit chase shall be provided into the motor compartment to facilitate wiring connections. The motor, bearings and drives shall be mounted on a minimum 14-gauge steel power assembly, isolated from the unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. Lifting lugs shall be provided to help prevent damage from improper lifting. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.

- E. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.
- F. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure.
- G. Bearings: Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
- H. Belts & Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150 percent of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.
- I. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- J. Accessories:
 - 1. Motorized damper in damper tray of roof curb. Actuator shall be same voltage as motor in fan. Damper shall energize fan through integral end switch.
 - 2. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Factory provided disconnect switches shall be rated for outdoor use. Three phase combination disconnect/starter shall be provided by Division 26.
 - 3. Direct drive units shall be provided with motor speed control option.

2.3 UPBLAST CENTRIFUGAL ROOF FANS - GREASE EXHAUST

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Greenheck
 - 2. Cook
 - 3. Twin City
- B. Unit shall be a low profile, hooded, roof mounted, belt driven or direct drive, propeller ventilator. Coordinate drive with fan schedule on drawings.
- C. Unit shall be constructed in accordance with UL 762. Fan shall bear the AMCA certified ratings seal for sound and air performance.
- D. Construction: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The aluminum base shall have sealed curb cap corners by continuous weld or application of butyl tape to inside of the curb cap for maximum leak protection. The windband shall have a rolled bead for added strength. A two-piece top cap shall have stainless steel quick release latches to provide access into the motor compartment without

the use of tools. An external wiring compartment to facilitate wiring connections. The motor, bearings and drives shall be mounted on a 14-gauge steel power assembly. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. A one (1) inch thick, three-pound density foil back heat shield shall be utilized to protect the motor and drive components from excessive heat. Lifting lugs shall be provided to help prevent damage from improper lifting. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.

- E. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency.
- F. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase, and enclosure.
- G. Bearings: Heavy duty regreasable ball type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours.
- H. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150 percent of the installed motor horsepower. The variable pitch drive must be factory set to the specified fan RPM.
- I. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- J. Accessories:
 - 1. Disconnect Switch: Coordinate with Division 26.
 - 2. Direct drive units shall be provided with motor speed control option.
 - 3. Gravity actuated back-draft damper with adjustable counterweight.
 - 4. Provide minimum 10" tall, vented curb extension.
 - 5. Provide grease trap with drain connection.
 - 6. Provide heat baffle.
 - 7. Provide Clean-Out Port.

2.4 CENTRIFUGAL FILTERED SUPPLY FAN - KITCHEN HOOD

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Greenheck
 - 2. Cook
 - 3. Twin City
- B. Unit shall be a low profile, hooded, roof mounted, belt driven or direct drive, propeller supply ventilator. Coordinate drive with fan schedule on drawings.
- C. Description: Fan shall be a side intake, roof mounted, belt driven, centrifugal filtered supply fan.
- D. Fan shall be constructed in accordance with UL 705. Fan shall bear the AMCA certified ratings seal for air performance.

- E. Construction: The fan shall be of bolted construction utilizing corrosion resistant fasteners. Housing shall be minimum 18-gauge galvanized steel, bolted to a minimum 16-gauge steel fan base with pre-punched mounting holes. Unit shall be provided with an insulated top cover and 1" washable permanent aluminum filter. Internal blower and motor assembly shall be mounted on rubber vibration isolators. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- F. Wheel: Wheel shall be DWDI centrifugal forward curved type, constructed of painted steel. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.
- G. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase, and enclosure.
- H. Bearings: Bearings shall be permanently lubricated, sealed ball type selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
- I. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.
- J. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- K. Accessories:
 - 1. Motorized damper in damper tray of roof curb. Actuator shall be same voltage as motor in fan. Damper shall energize fan through integral end switch.
 - 2. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Factory provided disconnect switches shall be rated for outdoor use. Three phase combination disconnect/starter shall be provided by Division 26.
 - 3. Direct drive units shall be provided with motor speed control option.

2.5 INLINE FANS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Greenheck
 - 2. Cook
 - 3. Twin City
- B. Fan shall be a duct mounted, centrifugal, belt driven or direct drive, inline type supply or exhaust ventilator.
- C. All fans shall bear the AMCA Certified Ratings Seal for both sound and air performance.
- D. Construction: The fan housing shall be of the square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars. Fan construction shall

include two removable access panels located perpendicular to the motor mounting panel. The access panels must be of sufficient size to permit easy access to all interior components. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.

- E. Coating: For fans serving Natatoriums or corrosive environments provide epoxy coating on all inside and outside surfaces including fan wheel and pulley.
- F. Wheel: The fan wheels shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced.
- G. Motor: Motors shall be heavy duty ball bearing type, carefully matched to the fan load, and furnished at the specified voltage, phase, and enclosure. Motor Pulleys shall be adjustable for system balancing.
- H. Bearings: Precision ground and polished shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L10) life in excess of 100,000 hours at maximum catalogued operating speed.
- I. Belts & Drives: Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
- J. Accessories:
 - 1. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Three phase combination disconnect/starter shall be provided by Division 26.
 - 2. Gravity actuated back-draft damper with adjustable counterweight.
 - 3. Direct drive units shall be provided with motor speed control option.
 - 4. Companion Flanges: For inlet and outlet duct connections.
 - 5. Fan Guards: 1/2 by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
 - 6. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

2.6 HIGH VOLUME, LOW SPEED FANS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Big Ass Fans – Essence Model
- B. Construction: Fan shall TUV certified and built pursuant to the construction guidelines set forth by the UL standard 507 and CSA standard 22.2. No. 113. The fan shall be designed to move an effective amount of air for cooling and destratification in commercial applications. The fan shall incorporate a direct drive system designed specifically for high volume, low speed fans to ensure silent operation. The sound levels from the fan operating at maximum speed shall not exceed 40 dBA (measured 20' or below the blades and 20' or horizontally from the center of the fan).

- C. Air Foils: The fan shall be equipped with eight (8) high volume, low speed airfoils of precision extruded, anodized aluminum alloy. Each airfoil shall be of the high performance mini-elipto design. The airfoils shall be connected to the hub and interlocked with eight (8) stainless steel retainers and two (2) sets of stainless-steel bolts and washers per airfoil.
- D. Winglets: The fan shall be equipped with eight (8) unswept winglets designed to redirect outward airflow downward, thereby enhancing the efficiency and effectiveness of the fan. The winglets shall be molded of high strength polymer and shall be attached at the tip of each airfoil with a stainless-steel screw. The standard color of the winglets shall be silver or black.
- E. Trim: The fan shall be equipped with trim inserts that nest between the hub and the inner edge of the foil. The trim inserts (8 each) shall provide a cleaner fit between the airfoils and the hub to help reduce the drag, turbulence, and the noise. Trim inserts shall be black.
- F. Motor: The fan motor shall be a permanent magnet brushless motor rated for continuous operation at maximum speed with the capability of modulating the fan speed from 0-100% without the use of a gearbox or other mechanical means of control. The motor shall operate from any voltage ranging from 100-120 VAC, 1 PH, 60 HZ, without requiring adapters or customer selection. The motor shall be non-ventilated, heat sink design with the capability of continuous operation in -13° to 131°F ambient conditions. The standard color of the motor shall be white with silver trim or silver with black trim.
- G. Hub: The fan hub shall be constructed of zinc plated steel for high strength and durability. The hub shall be precision machined to achieve a well-balanced and solid rotating assembly.
- H. Mounting System: The fan mounting system shall be designed for quick and secure installation from a variety of structural supports. All components in the mounting system shall be of formed metal design using low-carbon steel no less than 3/16" thick and containing no critical welds. The mounting system shall be powder coated for appearance and resistance to corrosion. All mounting bolts shall be metric stainless steel or equivalent. No mounting hardware substitutions, including cast aluminum are acceptable. The fan extension tube shall be a round, extruded aluminum tube. The extension tube shall include a chrome plate with forward and reverse controls and a fan status indicator light that is visible from the floor.
- I. Safety Cables: The fan shall be equipped with upper and lower safety cables. The upper safety cable shall provide an additional means of securing the fan assembly to the building structure. The lower safety cable shall provide an additional means of securing the motor unit to the mounting system. All safety cables shall be 3/16" diameter and fabricated out of 7x19 stranded galvanized steel. The loops must be secured with swaged Nicopress fittings, pre-loaded and tested to 3,000 lbs. Field construction of safety cables in not permitted.
- J. Controller: The controller shall be incorporated into the fan assembly. The controller shall be factory programmed to minimize starting and breaking torques. The controller shall be housed in an enclosure to prevent accidental contact with the enclosed equipment and to prevent entry of unwanted substances.
- K. Fire Control Panel Integration: The fan shall be equipped with a 10-30VDC pilot relay for seamless fire control panel integration. Fans shall be interlocked to shut down immediately upon receiving a water flow signal from the alarm system in accordance with requirement of NFPA 72 – National Fire Alarm and Signaling Code.

- L. Wall Control: The fan shall be equipped with a low voltage wired remote wall control providing control of all fan functions. The wall control shall be capable of mounting to a standard electrical box or directly to a wall surface. The wall control shall include a rotary style dial for controlling the fans power and speed and an LED light to identify and relay faults in the system. Communication with the fan drive and controller shall be a standard, commercially available CAT 5 (or higher) Ethernet cable that is field installed and provided by the installer.
- M. Warranty:

Furnish five (5) year manufacturer's warranty for high volume low speed fans. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or startup will not be acceptable.

The manufacturer shall replace any products or components defective in material or workmanship, free of charge to the customer (including all transportation charges).
- N. Accessories:
 - 1. Provide clear lockable enclosure for wall controller with two sets of keys.

2.7 CEILING MOUNTED EXHAUST FANS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Greenheck
 - 2. Cook
 - 3. Twin City
- B. Fan shall be centrifugal direct drive type. Coordinate drive with fan schedule on drawings.
- C. Fan shall be constructed in accordance with UL 705. Fan shall bear the AMCA certified ratings seal for air performance.
- D. Construction: The fan housing shall be constructed of heavy gauge galvanized steel. Housing interior shall be lined with 0.5" acoustical insulation. Outlet shall include backdraft damper and shall be acceptable for horizontal and vertical discharge.
- E. Grille: Aluminum construction with white enamel finish.
- F. Wheel: Wheel shall be forward-curved centrifugal type and dynamically balanced.
- G. Motor: Motor shall be electronic commutation (EC) motor specifically designed for fan applications. Motors shall be permanently lubricated with heavy-duty ball bearings to match the fan load and prewired to the specific voltage and phase. Speed shall be controlled by either a potentiometer dial mounted on the motor or by a 0-10 VDC signal. Motor disconnect shall be internal and of the plug-in type. The motor shall be mounted on vibration isolators.
- H. Accessories:
 - 4. Discharge Accessories: Provide with 6" hooded wall cap or 10" (throat size) roof hood for exhaust discharge. Refer to drawings for discharge location. Wall hood cap shall be of aluminum construction, built-in bird screen and damper and powder

coating color options. Coordinate with architect for color prior to ordering. Roof hood shall be of aluminum construction, galvanized steel internal supports, integral birdscreen and built-in flashing flange.

5. Direct drive units shall be provided with motor speed control option.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify roof curbs are installed and dimensions are as shown on shop drawings.

3.2 INSTALLATION

- A. Secure roof fans with cadmium plated steel lag screws to roof curb structure.
- B. Install power ventilators level and plumb.
- C. Install dampers in roof curb damper tray.
- D. Provide hinged curb adapter to permit access to dampers and duct connection.
- E. Install safety screen where inlet or outlet is exposed.
- F. Provide sheaves required for final air balance.
- G. Install units with clearances for service and maintenance.
- H. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.3 CLEANING

- A. Vacuum clean inside of fan cabinet.

3.4 DEMONSTRATION

- A. Demonstrate fan operation and maintenance procedures.

3.5 PROTECTION OF FINISHED WORK

- A. Do not operate fans until ductwork is clean, bearings are lubricated, and fan has been test run under observation.

END OF SECTION 23 34 00

SECTION 23 34 23 - HIGH-PLUME BLOWER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide complete, fully operational fans where indicated on Drawings.
- B. Section Includes:
 - 1. High Plume Laboratory Exhaust Fans
- C. Related Sections:
 - 1. Section 23 31 00 - HVAC Duct and Casings - Ducts: Product requirements for hangers for placement by this section.
 - 2. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.
 - 3. Coordinate work in this Section with Division 7.

1.3 REFERENCE STANDARDS

- A. AMCA -99 Standards Handbook
- B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
- C. AMCA 211 - Certified Ratings Procedure.
- D. AMCA 300 - Test Code for Sound Rating Air Moving Devices.
- E. AMCA 311 - Certified Sound Ratings Program for Air Moving Devices.
- F. AFMBA - Method of Evaluating Load Ratings of Bearings (ASA - B3.11).
- G. AMCA 204 - Balance Quality and Vibration Levels for Fans.
- H. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
- I. SMACNA - Medium Pressure Plenum Construction Standard.
- J. ANSI Z9.5 - Laboratory Design
- K. ASHRAE - Laboratory Design Guide.

1.4 QUALITY ASSURANCE

- A. Performance ratings: Conform to ANSI/AMCA Standards 210 and 300. Fans must be tested in accordance with AMCA Publications 211 and 311 in an AMCA accredited

laboratory and certified for air and sound performance. Fan shall be licensed to bear the AMCA ratings seal for air performance (AMCA 210) and sound performance (AMCA 300). Manufacturers that are not licensed to bear the AMCA 210 ratings seal must provide performance witness testing (at the manufacturer's expense), per paragraph 1.4.D.

- B. Classification for Spark Resistant Construction shall conform to ANSI/AMCA Standard 99.
- C. Each fan shall be vibration tested before shipping, as an assembly, in accordance with ANSI/AMCA Standard 204. Each assembled fan shall be test run at the factory at the specified fan RPM and vibration signatures shall be taken on each bearing in three planes - horizontal, vertical, and axial. The maximum allowable fan vibration shall be less than 0.15 in. /sec peak velocity; filter-in reading as measured at the fan RPM. This report shall be provided at no charge to the customer upon request.
- D. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance.
- E. Balance Quality: Conform to AMCA 204.
- F. Each fan shall be tested before shipping. Motors to be tested for amperage draw.

1.5 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, and ductwork and accessory connections.
- C. Product Data: Provide fan curves for each fan at the specified operation point, with the flow, static pressure and horsepower clearly plotted. Provide nozzle velocity of exhaust fan, total exhaust flow and discharge plume height at specified wind velocity.
- D. Manufacturer's Installation Instructions: Submit fan manufacturer's instructions and O&M Manual.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Fans shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If

protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver Equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.
- E. Handle and lift fans in accordance with the manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage. Follow all safety warnings posted by the manufacturer.

1.8 WARRANTY

- A. Furnish one (1) year manufacturer's warranty for entire assembly. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date of from shipment or start up will not be acceptable.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor.
 - 1. Fan Belts: One (1) for each belt-driven fan.
 - 2. Filters: One (1) set for each unit.

1.10 UNIT IDENTIFICATION REQUIREMENTS

- A. Furnish each fan with a durable, deep etched, .025" thick, factory installed aluminum identification plate, permanently mounted with the following information:
 - Unit identification as indicated within Contract Documents.
 - Serial Number.
 - Model Number.
 - Capacity (CFM) and static pressure (w.g.).
 - Motor Horsepower.
 - Fan RPM.
 - Unit Power Supply: Volts / PH / Amps.
 - Supply Fan Drive Type.
 - Sales Order #.
 - Date of unit manufactured.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Greenheck: Vektor H series
 - 2. Cook
- B. Base fan performance at standard conditions (density 0.075 Lb/ft³).
- C. Each fan to be equipped with 316 stainless steel lifting lugs for corrosion resistance.
- D. Fasteners exposed to corrosive exhaust shall be stainless steel.
- E. Curb cap shall be hot rolled coated with corrosion resistant coating.
- F. Fan assemblies that use flexible connectors that can fail, and cause loss of laboratory containment shall not be acceptable.
- G. Fan assembly shall be designed for a minimum of 125-mph wind loading, without the use of guy wires.
- H. Fans selected shall be capable of accommodating static pressure and flow variations of +/-15% of scheduled values.

2.2 SPECIAL PROJECT REQUIREMENTS: CONSTRUCTION

- A. Due to sight line and structural concerns submitted fans shall not exceed scheduled maximum allowable height and weight.

2.3 CORROSION RESISTANT COATING

- A. All steel fan and system components (fan, nozzle, windband and plenum) shall be corrosion resistant, factory coated with LabCoat™, a two part electrostatically applied and baked, sustainable, corrosion resistant coating system. Standard finish color to be gray.
- B. All parts shall be cleaned and chemically prepared for coating using a multistage wash system which includes acid pickling to remove oxide, increase surface area and improves coating bond to the substrate.
- C. The first powder coat applied over the prepared surface shall be a zinc rich epoxy primer (no less than 70% zinc) and heated to a gelatinous consistency (partial cure) at which the second powder coat of polyester resin shall be electrostatically applied and simultaneously be cured at a uniform temperature of 400°F.
- D. The coating system, a total thickness of up to 6 mils, is not affected by the UV component of sunlight (does not chalk), and has superior corrosion resistance to acid, alkali, and solvents. Coating system shall exceed 4,000-hour ASTM B117 Salt Spray Resistance.
- E. Entire coating process shall be performed in fan factory and not in field. Third party coating is not acceptable.

2.2 FAN HOUSING AND OUTLET

- A. Fan housing to be aerodynamically designed with high-efficiency inlet, engineered to reduce incoming air turbulence.
- B. Fan housing shall be welded steel with a minimum of 4 mils of HiPro Polyester Resin. No uncoated metal fan parts will be allowed.
- C. A high velocity conical discharge nozzle shall be supplied by the fan manufacturer and be designed to efficiently handle an outlet velocity of up to 6,000 FPM. Discharge nozzles shall be steel with corrosion resistant coating or chemical resistant medium density polyethylene with UV inhibitors to prevent chalking and have smooth interior surfaces. Discharge stack caps or hinged covers, impeding exhaust flow shall not be permitted.
- D. Provide housing drain for removal of rain and condensation.
- E. A bolted and gasketed access door shall be supplied in the fan housing allowing for servicing and cleaning. Access door can also be used for impeller inspection or removal of impeller, shaft and bearings without removal of the fan housing.
- F. Standard finish color to be grey.

2.3 FAN IMPELLER

- A. Fan impeller shall be centrifugal, backward inclined, with non-stall characteristics. The impeller shall be electronically balanced both statically and dynamically per AMCA Standard 204.
- B. Fan impeller shall be manufactured of aluminum (AMCA type B spark resistant), fully welded and meet specification section 2.15 for corrosion resistant coating.

2.4 FAN BYPASS AIR PLENUM

- A. A bypass air plenum shall be provided for variable air volume systems. The plenum shall be provided with bypass air damper(s) for introducing outside air at roof level upstream of the fan, complete with bypass air weather hood and bird screen.
- B. The plenum shall be double-wall construction; LabCoat™ coated exterior and interior steel walls. Coating must meet section 2.2 for corrosion resistant coating. Plenums fabricated of plastics or resins which are combustible and have mechanical properties less than steel shall not be acceptable.
- C. The bypass air plenum shall be mounted on factory fabricated roof curb provided by the fan manufacturer.
- D. Fan designs that use inlet flexible connectors that can leak causing loss of lab exhaust shall not be permitted.
- E. Bypass air damper(s) shall be opposed-blade design for airflow control, airfoil design, fabricated of aluminum. Bypass damper(s) shall have plated steel damper rods, stainless steel sleeved bearings, 301 stainless steel jamb seals and the blades shall have polymer edge seals. Damper model shall be equal to or exceed a heavy-duty control damper, Greenheck HCD-130. Damper blade drive linkage shall be set by manufacturer and welded to eliminate linkage slippage. All damper access and service (drive actuators) shall be performed outside of the contaminated airstream.

- F. Fan isolation damper(s) shall be parallel-blade design, airfoil design, fabricated of aluminum. Damper(s) shall be coated up to 4 mils of chemically resistant Hi-Pro Polyester resin, electrostatically applied and baked. Isolation damper(s) shall have plated steel damper rods, stainless steel sleeved bearings, 301 stainless steel jamb seals and the blades shall have polymer edge seals. Damper model shall be equal to or exceed a heavy-duty control damper, Greenheck HCD-130. Damper blade drive linkage shall be set by manufacturer and welded to eliminate linkage slippage. All damper access and service (drive actuators) shall be performed outside of the contaminated airstream.
- G. Isolation damper actuator(s), if scheduled, shall be factory mounted and shall be wired to a step-down transformer. Actuator and transformer are located in a weatherproof enclosure.
- H. Blower / Plenum vibration isolation shall be limited to neoprene / cork vibration pads.

2.5 FAN MOTORS AND DRIVE.

- A. Motors shall be premium efficiency, standard NEMA frame, 1,800 RPM, Totally Enclosed Fan Cooled (TEFC) with a 1.15 service factor. A factory-mounted NEMA 3R disconnect switch shall be provided for each fan. Motor maintenance shall be accomplished without fan impeller removal or requiring maintenance personnel to access the contaminated exhaust components
- B. Fans submitted that use 900 RPM, 1,200 RPM, or are C-Face motors, shall include one spare motor per fan system, in accordance with ANSI Z9.5, section 4.14.7.4, CRITICAL SERVICE SPARES.
- C. Drive belts and sheaves shall be sized for 200% of the motor horsepower, and shall be readily and easily accessible for service, if required. Drive shall consist of a minimum of two belts under all circumstances.
- D. Fan shaft to be turned and polished of 1040 steel material as standard, coated with corrosion resistant coating.
- E. Fan shaft bearings shall be Air Handling Quality, ball or roller pillow block type and be sized for an L-10 life of no less than 100,000 hours. Bearings shall be fixed to the fan shaft using concentric mounting locking collars, which reduce vibration, increase service life, and improve serviceability. Bearings that use set screws shall not be allowed.
- F. All shaft bearings shall have extended lube lines with Zerk fittings.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install fans as indicated, with flexible electrical leads.
- B. Pipe housing drain to nearest drain.
- C. Install fans in accordance with manufacturer's Installation, Operation and Maintenance manual.

END OF SECTION 23 34 23

SECTION 23 36 00 - AIR TERMINAL UNITS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Single duct air terminal units
 - 2. Series Fan-Powered Air Terminal Units
- B. Related Sections:
 - 1. Section 23 09 23 – Direct Digital Controls: Controls remote from unit.
 - 2. Section 23 09 93 – Sequences of Operation for HVAC System.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

1.4 ACTION SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.
 - 1. Air terminal units.
 - 2. Liners and adhesives.
 - 3. Sealants and gaskets.
- C. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work within shop coordination drawings.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
 - 3. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- D. Delegated-Design Submittal:
 - 1. Materials, fabrication, assembly, and spacing of hangers and supports.

- E. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Size and location of initial access modules for acoustic tile.
 - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- F. Field quality-control reports.
- G. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in "Operation and Maintenance Data," include the following:
 - 1. Instructions for resetting minimum and maximum air volumes.
 - 2. Instructions for adjusting software set points.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Test and rate air terminal unit performance for air pressure drop, flow performance, and acoustical performance in accordance with ARI 880 and ARI 885. Attach ARI seal to each terminal unit.
- C. All electrical components shall be UL Listed and installed in accordance with the National Electric Code. Electrical connections to terminal units shall be single point. The energy terminal shall be UL Listed as a complete assembly.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

1.6 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Filters shall be provided by air terminal unit manufacturer and not by the mechanical contractor.
 - 1. Fan-Powered-Unit Filters: Furnish [one] 1 spare filter(s) for each filter installed.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant volume regulators.

1.8 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.9 COORDINATION

- A. Coordinate Work with Section 23 09 23 - Direct-Digital Control System for HVAC.

1.10 WARRANTY

- A. Furnish one (1) year manufacturer warranty for air terminal units. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up will not be acceptable.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Air Terminal Units shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 SINGLE DUCT AIR TERMINAL UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Titus
 - 2. Krueger
 - 3. Nailor
 - 4. Price
 - 5. Metalaire

- B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- C. Identification: Furnish each air terminal unit with identification label and airflow indicator. Include unit nominal airflow, maximum factory-set airflow and minimum factory-set airflow and coil type.
- D. Casing: Minimum 22-gauge galvanized steel.
 - 1. Casing Lining: Fiber free, 1/2-inch thick, engineered polyurethane foam, 1.5 lb. / cu. ft. insulation complying with NFPA 90A, UL 181 erosion requirements, UL 181 Mold Growth and Humidity, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84. Exposed fiberglass is not acceptable. The casing shall be designed for hanging by 10-gauge sheet metal hanger brackets for suspending unit with threaded rod.
 - 2. Air Inlets: Round stub connections or oval connections for duct attachment.
 - 3. Air Outlet: S-slip and drive connections.
 - 4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
 - 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- E. Volume Damper: Heavy gauge galvanized steel with peripheral gasket and self-lubricating bearings.
 - 1. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
 - 2. Damper Position: Normally open.
- F. Velocity Sensors: Multi-point array, center-averaging differential pressure, with velocity sensors in air inlets and air outlets. Sensors that deliver the differential pressure signal from one end of the sensor is not acceptable. Balancing taps and airflow calibration charts shall be provided for field airflow measurements.
- G. Actuators shall be capable of supplying at least 35 inches per pound of torque to the damper shaft and shall be mounted externally for service access.
- H. Factory installed hydronic heating coils (where scheduled): Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.
- I. Factory installed Electric-Resistance Heating Coils (where scheduled): Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.
 - 1. Provide 480v / 3ph / 60Hz 4W wye single point power connection.

2. Stage(s): Refer to schedule.
 3. Access door interlocked non-fused disconnect switch.
 4. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable.)
 5. Nickel chrome 80/20 heating elements.
 6. Airflow switches for proof of airflow.
 7. Fan interlock contacts.
 8. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
 9. Magnetic contactor for each step of control (for three-phase coils).
- J. Factory-Mounted and Wired Controls: Electrical components mounted in control box with removable cover. Incorporate single-point electrical connection to power source for terminal units with electric heat.
1. Control Transformer (Required only for terminal units with electric heat): Factory mounted for control voltage. Coordinate equipment voltage requirement with electrical plans.
 2. Wiring Terminations: Coordinate required wiring diagrams with Building Automation System controls subcontractor.
 3. The following equipment items are to be furnished by Specification Section 23 09 23 - Direct-Digital Controls and installed by air terminal unit manufacturer.
 - a. Auto temperature control card (DDC).
 - b. 24-volt damper actuator.
 4. The following equipment items are to be furnished and installed by the air terminal unit manufacturer:
 - a. Volume Control Damper.
 - b. Multi-point flow sensor.
 - c. Controller enclosure.
 - d. Power transformer; required only for terminal units with electric heat. (Coordinate voltage with electrical plans).
- K. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.
- L. Sound Ratings: Not to exceed 35 NC at one (1) inch static pressure. Sound performance shall be ARI certified.
1. Maximum discharge sound power level of 62 DB.
 2. Maximum radiated sound power level of 70 DB.
 3. DB level based on third octave band.
- M. Temperature sensor provided, wired, and installed by Building Automation System Control Contractor: Refer to Section 23 09 23 – Direct Digital Controls.

- N. For Sequence of Operation: Refer to Section 23 09 93.

2.2 SERIES FAN-POWERED AIR TERMINAL UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Titus
 2. Krueger
 3. Nailor
 4. Price
 5. Metalaire
- B. Configuration: Volume-damper assembly and fan in series arrangement inside unit casing with control components inside a protective metal shroud for installation above a ceiling.
- C. Identification: Furnish each air terminal unit with identification label and airflow indicator. Include unit nominal airflow, maximum factory-set airflow and minimum factory-set airflow and coil type.
- D. Casing: Minimum 20-gauge galvanized steel.
1. Casing Lining: Fiber free, 1/2-inch thick, engineered polyurethane foam, 1.5 lb. / cu. ft. insulation complying with NFPA 90A, UL 181 erosion requirements, UL 181 Mold Growth and Humidity, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84. Exposed fiberglass is not acceptable. The casing shall be designed for hanging by 10-gauge sheet metal hanger brackets for suspending unit with threaded rod.
 2. Air Inlets: Round stub connections or oval connections for duct attachment.
 3. Air Outlet: S-slip and drive connections.
 4. Access: Removable top and bottom access panels, which allows removal of fan assembly and servicing of terminal without disturbing duct connections; with airtight gasket and quarter-turn latches.
 5. Fan: Forward-curved centrifugal; direct-drive.
 6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- E. Volume Damper: Heavy gauge galvanized steel with flow-sensing ring and peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
 2. Damper Position: Normally open.
- F. Velocity Sensors: Multi-point array, center-averaging differential pressure, with velocity sensors in cold- and hot-deck air inlets and air outlets. Sensors that deliver the differential pressure signal from one end of the sensor is not acceptable. Balancing taps and airflow calibration charts shall be provided for field airflow measurements.

- G. Motor:
1. Type: General Electric electronically commutated motor (ECM), variable speed dc brushless. Motor shall be complete and operated by a single-phase integrated controller/inverter that operates the wound stator and senses rotor position to electronically commute the stator. All motors shall be designed for synchronous rotation. Rotor shall be permanent magnet type with near zero rotor losses. Motor shall have built-in soft start and soft speed change ramps. Motor shall be able to be mounted with shaft in horizontal or vertical orientation. Motor shall be permanently lubricated with ball bearings. Motor shall be directly coupled to the blower. Motor shall maintain a minimum of 70 percent efficiency over its entire operating range. Provide a motor that is designed to overcome reverse rotation and not affect life expectancy.
 2. Fan-Motor Assembly Isolation: Rubber isolators.
 3. Enclosure: Totally enclosed, air over.
 4. Enclosure Materials: Rolled Steel.
 5. Motor Bearings: Permanently lubricated ball bearings.
 6. Unusual Service Conditions:
 7. Efficiency: Premium efficient.
 8. NEMA Design: NEMA MG-1.
 9. Service Factor: 1.15.
 10. Motor Speed: Infinitely adjustable, factory provided and mounted PWM controller for adjustable fan speed control. PWM controller shall be field adjustable with standard screwdriver. Fan CFM shall be pre-set at factory as shown on plans.
 11. Electrical Characteristics:
 - a. Horsepower: Refer to detail
 - b. Volts: 277
 - c. Phase: Single.
 - d. Hz: 60.
- H. Construction Filters for induced air inlet: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
1. Material: Pleated cotton-polyester media having 90 percent arrestance and minimum MERV 8.
 2. Thickness: 1 inch.
- I. Factory manufactured and mounted Induced air inlet and discharge air attenuator section: steel sheet outer casing, sound absorbing fill material with coating, and inner casing of perforated sheet metal (Provide where scheduled).
1. Lining: Adhesive attached, 3/4-inch thick, polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-

- spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- J. Factory installed hydronic heating coils (where scheduled): Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.
- K. Factory installed Electric-Resistance Heating Coils (where scheduled): Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.
1. Provide 277v/ 480v / 3ph / 60Hz 4W wye single point power connection, factory pre-wired for 277v/1ph/60Hz connection to fan.
 2. Stage(s): Refer to schedule.
 3. Access door interlocked disconnect switch.
 4. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable.)
 5. Nickel chrome 80/20 heating elements.
 6. Airflow switches for proof of airflow.
 7. Fan interlock contacts.
 8. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
 9. Magnetic contactor for each step of control (for three-phase coils).
- L. Factory-Mounted and Wired Controls: Electrical components mounted in control box with removable cover. Incorporate single-point electrical connection to power source.
1. Control Transformer: Factory mounted for control voltage. Coordinate equipment voltage requirement with electrical plans.
 2. Wiring Terminations: Coordinate required wiring diagrams with Building Automation System controls subcontractor.
 3. Disconnect Switch: Factory-mounted, non-fuse type in control panel.
 4. The following equipment items are to be furnished by Specification Section 23 09 23 - Direct-Digital Controls and installed by air terminal unit manufacturer.
 - a. Auto temperature control card (DDC).
 - b. 24-volt damper actuator.
 5. The following equipment items are to be furnished and installed by the air terminal unit manufacturer:

- a. Volume Control Damper.
 - b. Multi-point flow sensor.
 - c. Controller enclosure.
 - d. Power transformer (Coordinate voltage with electrical plans).
- M. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.
- N. Sound Ratings: Not to exceed 35 NC at one (1) inch static pressure. Sound performance shall be ARI certified.
- 1. Maximum discharge sound power level of 62 DB.
 - 2. Maximum radiated sound power level of 70 DB.
 - 3. DB level based on third octave band.
- O. Temperature sensor provided, wired, and installed by Building Automation System Control Contractor: Refer to Section 23 09 23 – Direct Digital Controls.
- P. For Sequence of Operation: Refer to Section 23 09 93.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install ceiling access doors or locate units above easily removable ceiling components.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 CONNECTIONS

- A. Install piping adjacent to air terminal unit to allow service and maintenance.
- B. Hot-Water Piping: In addition to requirements in Section 232113 "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.

- C. Connect ducts to air terminal units according to Section 233113 "Metal Ducts."
- D. Coordinate duct installations and specialty arrangements with Drawings.
- E. Make connections to air terminal units with flexible connectors complying with requirements in Section 233300 "Air Duct Accessories."

3.4 IDENTIFICATION

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
 - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Air terminal unit will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
 - 3. Verify that controls and control enclosure are accessible.
 - 4. Verify that control connections are complete.
 - 5. Verify that nameplate and identification tag are visible.
 - 6. Verify that controls respond to inputs as specified.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

3.8 ADJUSTING

- A. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design flow to 0 percent full flow. Set units with heating coils for minimum 50 percent full flow.

END OF SECTION 23 36 00

SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Air devices.

1.3 REFERENCES

- A. Air Movement and Control Association International, Inc.:
 - 1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 70 - Method of Testing for Rating the Performance of Air Outlets and Inlets.
- C. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.
- C. Test Reports: Rating of air outlet and inlet performance.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of air outlets and inlets.

1.6 QUALITY ASSURANCE

- A. Test and rate diffuser, register, and grille performance in accordance with ASHRAE 70.
- B. Test and rate louver performance in accordance with AMCA 500.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Air Devices shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 AIR DEVICES

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Titus
 - 2. Krueger
 - 3. Nailor
 - 4. Price
 - 5. Metalaire
- B. Mounting:
 - 1. Plaster Surfaces: Provide with plaster frames or plaster rings to make airtight seal against mounting surface.
 - 2. "T" Bar Ceilings: Lay-in type.
 - 3. Gyp Board and Wall surfaces: 1-1/2" overlap flange.
- C. Fire rated diffusers for fire rated roof/ceiling assembly: Refer to diffuser schedule for fire rated assembly requirement.
 - 1. UL classified fire rated ceiling diffuser assembly listed in The Underwriters Laboratories "Fire Resistance Directory".

2. Shall have a fire resistance rating of 3 hours.
 3. Heavy Gauge Steel Diffusers shall be tested in accordance with UL 263 and must meet NFPA 90A requirements. Diffusers must be able to operate in (3) three-hour fire rated ceiling and must be installed in accordance with the installation instructions.
 4. UL 555C Fire resistance rating: 3-hour ceiling radiation damper with fusible link assembly. Fire closure temperature of 165°F.
 5. UL listed thermal blanket insulation, mineral fiber around entire diffuser.
 6. Complete fire rated damper assembly with blanket shall be provided and submitted by/with Diffusers, Registers, and Grilles.
- D. Source Quality Control
1. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."
- E. Accessories:
1. Square to round neck adapter.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify inlet and outlet locations.
- B. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Verify ceiling and wall systems are ready for installation.
- E. Refer to Architectural Code Information and Fire Rated Assemblies Drawing to verify if ceiling is fire rated. If ceiling is fire rated provide U.L. tested radiation damper with thermal blanket for all ceiling mounted supply and return air grilles.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers
- B. Install balancing dampers on duct take-off to diffusers, grilles, and registers, whether or not dampers are furnished as part of diffuser, grille, and register assembly. Refer to Section 23 33 00 – Air Duct Accessories.
- C. Install diffusers, registers, and grilles level and plumb.

- D. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- E. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.
- F. Paint visible portion of ductwork behind air outlets and inlets matte black. Refer to Section 09 91 00.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.5 SCHEDULES:

- A. Refer to Drawings.

END OF SECTION 23 37 13

SECTION 23 37 23 - HVAC GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide complete, fully operational fans where indicated on Drawings.
- B. Section Includes:
 - 1. Dryer vent roof cap
 - 2. Roof mounted intake hood
 - 3. Roof mounted relief hood
- C. Related Sections:
 - 1. Section 23 31 00 - HVAC Duct and Casings: Product requirements for hangers for placement by this section.
 - 2. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.
 - 3. Coordinate work in this Section with Division 7.

1.3 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, ductwork, and accessory connections.
- C. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics, and connection requirements.
- D. Manufacturer's Installation Instructions: Submit fan manufacturer's instructions.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.5 QUALITY ASSURANCE

- A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.

- C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705 and UL 762 for kitchen exhaust.
- D. Balance Quality: Conform to AMCA 204.
- E. Energy Recovery Unit Wheel Energy Transfer Rating: Meet ARI 1060.

1.6 WARRANTY

- A. Furnish one (1) year manufacturer's warranty. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up will not be acceptable.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Ventilators shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS.

2.1 DRYER VENT ROOF CAP

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Greenheck
 - 2. Cook
 - 3. PennBarry
- B. Unit shall be a spun aluminum, roof mounted gravity ventilator.
- C. Construction: The unit shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of

minimum 16-gauge marine alloy aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. The spun aluminum baffle shall have a rolled bead for added strength. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.

- D. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- E. Accessories: Gravity actuated back-draft damper with adjustable counterweight.

2.2 ROOF MOUNTED INTAKE HOOD

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Greenheck
 - 2. Cook
 - 3. PennBarry
 - 4. Twin City
- B. Unit shall be an aluminum roof mounted intake hood.
- C. Construction: The unit shall be of bolted and welded construction utilizing corrosion resistant fasteners. The aluminum hood shall be constructed of minimum 14-gauge marine alloy aluminum, bolted to a minimum 8-gauge aluminum support structure. The aluminum base shall have sealed curb cap corners by continuous weld or application of butyl tape to inside of the curb cap for maximum leak protection. Birdscreen constructed of 1/2" mesh shall be mounted across the intake opening. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- D. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- E. Accessories:
 - 1. Motorized damper in damper tray of roof curb. Actuator shall be low voltage for control wiring from DDC controller. Damper shall include integral end switch.

2.3 ROOF MOUNTED RELIEF HOOD

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Greenheck
 - 2. Cook
 - 3. PennBarry
 - 4. Twin City
- B. Unit shall be an aluminum roof mounted relief hood.

- C. Construction: The unit shall be of bolted and welded construction utilizing corrosion resistant fasteners. The aluminum hood shall be constructed of minimum 14-gauge marine alloy aluminum, bolted to a minimum 8-gauge aluminum support structure. The aluminum base shall have sealed curb cap corners by continuous weld or application of butyl tape to inside of the curb cap for maximum leak protection. Bird screen constructed of 1/2" mesh shall be mounted across the intake opening. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- D. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- E. Accessories:
 - 1. Gravity actuated back-draft damper with adjustable counterweight.
 - 2. Motorized damper: actuator shall be low voltage for control wiring from DDC controllers. Damper shall include integral end switch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify roof curbs are installed and dimensions are as shown on shop drawings.

3.2 INSTALLATION

- A. Secure intake/relief hoods with cadmium plated steel lag screws to roof curb structure.
- B. Install dampers in roof curb damper tray.
- C. Provide hinged curb adapter to permit access to dampers and duct connection.
- D. Install safety screen where inlet or outlet is exposed.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Furnish services of factory trained representative for minimum of one (1) day to start-up, calibrate controls, and instruct Owner on operation and maintenance.

3.4 CLEANING

- A. Vacuum clean inside of fan cabinet.

3.5 DEMONSTRATION

- A. Demonstrate fan operation and maintenance procedures.

3.6 PROTECTION OF FINISHED WORK

- A. Do not operate until ductwork is clean, bearings are lubricated, and fan has been test run under observation.

END OF SECTION 23 37 23

SECTION 23 43 00 - ELECTRONIC BI-POLAR IONIZATION AIR CLEANERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Electronic Bi-polar ionization air cleaning device.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include dimensions; electrical characteristics, operating characteristics; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.
- B. Provide line-by-line specification review annotated to certify compliance or deviation.
- C. Shop Drawings: For each electronic air cleaner. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show assembly, dimensions, materials, and methods of assembly of components.
 - 2. Include setting drawings, templates, and requirements for installing anchor bolts and anchorages.
 - 3. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For bi-polar ionization technology include emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
 - 1. Comply with applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality"; Section 5 - "Systems and Equipment"; and Section 7 - "Construction and Startup."

- C. Comply with NFPA 90A and NFPA 90B.
- D. Comply with UL 867.
 - 1. The Air Purification Technology shall have been tested by UL or Intertek/ETL to prove conformance to UL 867-2007 including the ozone chamber testing and peak ozone test for electronic devices. Manufacturers that achieved UL 867 prior to December 21, 2007, and have not been tested in accordance with the newest UL 867 standard with the ozone amendment shall not be acceptable. All manufacturers requesting prior approval shall submit their independent UL 867 test data with ozone results to the engineer for preliminary review and during the submittal process. All manufacturers shall submit a copy with their quotation. Contractors shall not accept any proposal without the proper ozone testing documentation.
 - 2. The maximum allowable ozone concentration per the UL 867-2007 chamber test shall be 0.007 PPM. The maximum peak ozone concentration per the UL 867-2007 peak test as measured 2 inches away from the electronic air cleaner's output shall be no more than 0.0042 PPM. Manufacturers with ozone output exceeding these ozone values shall not be acceptable.
 - 3. Regardless of installation location (in unit or in ductwork) ozone results shall be submitted with a copy of quotation from the ozone chamber test performed by a nationally recognized testing laboratory. Compliance with UL 867 but no ozone results is not acceptable.

1.7 WARRANTY

- A. Equipment shall be warranted by the manufacturer against defects in material and workmanship for a period of one (1) year from substantial completion. Labor to replace equipment under warranty shall also be included at no additional cost to the owner or installing contractor.
- B. Warranty certificated shall be issued to the owner at time of substantial completion.

PART 2 - PRODUCTS

2.1 ELECTRONIC BI-POLAR IONIZATION AIR CLEANERS

- A. Description: Custom, self-cleaning, factory-fabricated bi-polar ionization generator air cleaner.
 - 1. Manufacturers: Subject to compliance with requirements, provide the following:
 - 1. Global Plasma Solutions
- B. Power Requirements:
 - 1. Volts: 115 volts or 24VAC
 - 2. Phase: Single.
 - 3. Hertz: 60.
 - 4. Shall be powered from the rooftop unit main electrical connection.
- C. Mounting Requirements:
 - 1. Mounting location of the ionization device shall be downstream of supply fan. Consult with manufacturer for installation requirements.

- D. Product Description: Bi-polar ionization device shall produce ions by needlepoint ionization technology to break down gases. The gases effected are gases with electron-volt potential numbers below 12. They are broken down to harmless compounds prevalent in the atmosphere such as oxygen, nitrogen, water vapor and carbon dioxide. When the ions combine on the surface of a pathogen, they rob the pathogen of the hydrogen necessary for them to survive. During the final step of deactivation, the ions eliminate hydrogen from the pathogen and then the plasma cleansing process is complete, making the airborne virus, bacteria, or mold spore inactive and in essence killing the contaminant.
- a. Ion generator casings shall be constructed out of powder coated, nickel steel, or stainless steel, recessed stainless steel needles. T Each generator shall have an LED display to confirm operation.
 - b. Provide with BAS sensors for Volatile Organic Compounds (VOC) level measuring upstream and downstream of ionization device or dry alarm contacts for ion generation system status. BAS integration of sensors shall show VOC depression across ionization device and provide numerical values for VOC levels to show proper operation or alarms for device.
 - c. Provide internal short circuit protection, overload protection and automatic fault reset.
- E. The Ionization system shall be capable of:
1. Effectively killing microorganisms downstream of the bi-polar ionization equipment (mold, bacteria, virus, etc.).
 2. Controlling gas phase contaminants generated from human occupants, building structure, furnishings, and outside air contaminants.
 3. Capable of reducing static space charges.
 4. Effectively reducing space particle counts.
 5. All manufacturers shall provide documentation by an independent NELEC accredited laboratory that proves the product has minimum kill rates for the following pathogens given the allotted time and in a space condition:
 - a. MRSA: 99.5% in 60 minutes or less
 - b. Coli: 93.5% in 30 minutes or less
 - c. H1N1: 86.6% in 60 minutes or less
 - d. Aspergillus: 74.8% in 60 minutes or less
 - e. Manufacturers not providing the equivalent space kill rates shall not be acceptable. All manufactures requesting prior approval shall provide to the engineer independent test data from a NELEC accredited independent lab confirming kill rates and time meeting the minimum requirements stated in section 2.2 B, points 6A thru 6F. Products tested only on Petri dishes to prove kill rates shall not be acceptable. Products being sold under different trade names than those tested shall not be acceptable.

- F. The bipolar ionization system shall operate in such a manner that equal amounts of positive and negative ions are produced. Single pole ion devices shall not be acceptable.
 - 1. Airflow rates may vary through the full operating range of a VAV system. The quantity of air exchange shall not be increased due to the air purification system requirements.
 - 2. Velocity Profile: The air purification device shall not have a maximum velocity profile.
- G. Humidity: Plasma Generators shall not require preheat protection when the relative humidity of the entering air exceeds 85%. Relative humidity from 0 - 100%, non-condensing, shall not cause damage, deterioration, or dangerous conditions to the air purification system.
- H. Power Pack: For each system, include auto-reset overload protection, on-off switch, & pilot light showing operating status. For systems that do not utilize a feedback functionality indicating ion production, and only indicate power available to the ionizer, provide a duct mounted ion sensor powered from 12V DC or 24V AC. Ion sensor to be from 500 to 20,000 ions per cm³ and contain a dry contact BMS interface.
- I. Controls:
 - 1. Ionization device shall be provided within control and power enclosure. Contacts for enable-disable control and remote monitoring by building automation system shall be provided.
- J. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

2.2 SPECIAL PROJECT REQUIREMENTS: CONSTRUCTION

- A. Bi-Polar Ionization Devices shall be installed and wired within HVAC equipment by BAS contractor.

2.3 CAPACITIES AND CHARACTERISTICS

- A. Unit Length Dimensions:
 - 1. Ionization device shall be provided for mounting in fan coil unit supply path downstream of fan. Coordinate with final approved unit submittal.
- B. The unit cabinet footprint shall not be increased in order to fit the bi-polar ionization device. It is the responsibility of the bi-polar ionization manufacturer to coordinate with fan coil unit manufacturer to ensure devices will fit prior to bid date. Failure to do so will result in all costs being covered by bi-polar ionization manufacturer. Clearance for maintenance and airflow must be maintained for electronic bi-polar ionization air cleaner, all air handling unit components, and other components in the mechanical room or plenum space.
- C. Number of Devices:
 - 1. Multiple ionization devices shall be provided per manufacturer's airflow limitation per device. If coil surface area is taller than 54", provide an electronic bi-polar ionization air cleaner at the top of the coil and another device halfway up the coil surface. Coordinate quantity and sizing with final approved Air Handling Unit submittal.
- D. System Airflow: Refer to equipment schedule for CFM values.
- E. Maximum or Rated Face Velocity: 500 fpm

ELECTRONIC BI-POLAR IONIZATION AIR CLEANERS

F. Ozone Requirements

1. Comply with UL 867.
2. The Air Purification Technology shall have been tested by UL or Intertek/ETL to prove conformance to UL 867-2007 including the ozone chamber testing and peak ozone test for electronic devices. Manufacturers that achieved UL 867 prior to December 21, 2007, and have not been tested in accordance with the newest UL 867 standard with the ozone amendment shall not be acceptable. All manufacturers requesting prior approval shall submit their independent UL 867 test data with ozone results to the engineer for preliminary review and during the submittal process. All manufacturers shall submit a copy with their quotation. Contractors shall not accept any proposal without the proper ozone testing documentation.
3. The maximum allowable ozone concentration per the UL 867-2007 chamber test shall be 0.007 PPM. The maximum peak ozone concentration per the UL 867-2007 peak test as measured 2 inches away from the electronic air cleaner's output shall be no more than 0.0042 PPM. Manufacturers with ozone output exceeding these ozone values shall not be acceptable.
4. Regardless of installation location (in unit or in ductwork) ozone results shall be submitted for review and approval showing performance of the unit and the ozone generation during the ozone chamber test. Test shall be performed by a nationally recognized testing laboratory. Compliance with UL 867 but no ozone results is not acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All electronic bi-polar ionization devices shall be mounted by BAS contractor according to the bi-polar ionization manufacturer provided installation manual. All electrical connections shall be coordinated with the electrical subcontractor and BAS contractor.
1. Position each electronic bi-polar ionization device with clearance for normal service and maintenance.
 2. Mount using clips or hardware provided by Bioclimatic (if applicable).
 3. Install electronic bi-polar ionization devices as indicated above and per manufacturer recommendations.
 4. Installing BAS contractor shall provide wire, perform wiring, and confirm power supply primary power is properly grounded and brackets are grounded.
 5. System shall not be operated without a ground.
 6. Mount air flow switch or use a fan interlock relay to energize only when there is airflow per bi-polar ionization manufacturer's installation manual and/or recommendations. Air flow switch or fan interlock shall be provided by electrical contractor.
 7. Coordinate installations with AHU installing contractor.
 8. All BAS wire and wiring shall be provided by and performed by BAS installing contractor along with all necessary BAS integration. See DDC plans, notes, and specification for more details.

3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installation, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections: Test for proper operation of ionization device and controls interlocks.
- D. Air filter will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.3 COMMISSIONING & TRAINING

- A. A manufacturer's authorized representative shall provide start-up supervision and training of owner's personnel in the proper operation and maintenance of all equipment.

END OF SECTION

SECTION 23 43 13 - UVC EMITTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes UVC Emitters.
- B. Related Sections:
 - 1. Section 23 05 00 - Common Work Results for HVAC.
 - 2. Section 23 07 16 - HVAC Equipment Insulation: Product requirements for insulation for placement by this section.
 - 3. Section 23 33 00 - Air Duct Accessories: Product requirements for flexible duct connections for placement by this section.

1.3 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- C. Product Data, Submit the following:
 - 1. Published Literature: Indicate capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements.
 - 2. Sound Power Level Data: Fan outlet and casing radiation at rated capacity per ARI 260.
 - 3. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring. Indicate factory installed and field installed wiring.
- D. Manufacturer's Installation Instructions: Submit.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- C. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- E. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- F. Comply with NFPA 70.

1.6 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Emitters shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

- E. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- F. Protect units from physical damage. Leave factory covers in place until startup of machine.

1.8 WARRANTY

- A. Furnish one (1) year manufacturer parts and labor warranty for air handling units. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up is not acceptable.

1.9 COORDINATION

- A. Coordinate sizes and locations of emitters with existing air handling units scheduled to receive an emitter retrofit.
- B. Coordinate electrical requirements with electrical plans.

PART 2 - PRODUCTS

2.1 GERMICIDAL UVC EMITTERS

- A. UVC Emitters shall be provided for each Air Handling Unit and manufactured by Steril-Aire, Inc. or UV Resources only. UVC lights including but not limited to safety switches and non-fused service disconnects shall be field installed by local Steril-Aire or UV Resources factory authorized representative and not by mechanical contractor. A separate 120v/1ph electrical connection shall be provided and wired by electrical contractor.
- B. Provide UVC Emitter in a same section as cooling coil immediately downstream of cooling coils and over drain pans; lights shall provide full coverage of cooling coils and drain pan. The UVC emitter shall be mounted inside the air handler casing a minimum of 12" downstream of cooling coil.
- C. UVC Emitter and fixture shall be factory assembled and tested. Unit shall consist of housing, power source, reflector, emitter sockets, emitter, door safety switches and unit mounted disconnect for separate 120v / 1ph / 60 Hz power supply. Unit shall be constructed to withstand HVAC environments and shall be UL and CSA listed for damp locations.

UVC light housing shall be constructed of hospital grade stainless steel or designed to allow full 360° coverage of the cooling coil section and shall be equipped with ½" conduit openings on each end to facilitate conduit nipple coupling fixture to fixture and wiring to power. Incorporate all components into one integral assembly that maximizes serviceability. Unit shall be designed to be mounted inside the air stream and downstream of the cooling coil.

Power source shall be a Class P2, rapid start type with a power factor of 0.99 and an efficiency of not less than 89%. Unit voltage shall be 120 and designed to maximize photon production, radiance and reliability in cold or moving air streams of 35°-170°F. 100% RD and at any velocity and shall include RF and EMI suppression and Smart System – "End of Lamp Life" protection.

Reflector shall be constructed of heavy gauge aluminum alloy with a minimum 86% reflectance at 254 nm.

Sockets shall be medium bi-pin, double click safety, and twist lock type. They are constructed of a UVC resistant polycarbonate.

Emitter tube shall be high output, hot cathode, T5 diameter, medium bi-pin type that produces broadband UVC of 250 – 260 nm. Each tube shall produce the specified output at any airflow velocity and air temperature of 35°-170°F and produce no ozone or other secondary contamination. Lamp life shall be 9000 hours with no more than 20% output loss at the end of life and shall be constructed with UV-C proof material bases and shall not produce ozone.

The minimal UV-C energy striking a surface shall be sufficient to continuously destroy a mono-layer of mold and/or bacteria in less than one hour while operating in air temperatures of 1-70 °C.

Independent testing: When tested in accordance with the general provisions of IES Lighting Handbook, 1981 Application volume, output per 1" arc length is not less than 10μW/cm² at 1 meter in a 400 fpm airstream of 45° F.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install based on manufacturer's requirements.

3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3.3 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.

3. Install new, clean filters.

3.4 ADJUSTING

- A. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

3.5 CLEANING

- A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units externally and internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, comb coils, drain pans, and filter housings, and install new, clean filters.

3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain UVC Emitters.

3.7 PROTECTION OF FINISHED WORK

- A. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION 23 43 00

SECTION 23 73 13 - MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes modular factory fabricated air-handling units and accessories.
- B. Related Sections:
 - 1. Section 23 05 00 - Common Work Results for HVAC.
 - 2. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for vibration isolators for placement by this section.
 - 3. Section 23 07 16 - HVAC Equipment Insulation: Product requirements for insulation for placement by this section.
 - 4. Section 23 33 00 - Air Duct Accessories: Product requirements for flexible duct connections for placement by this section.
 - 5. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for electric motors for placement by this section.
 - 6. Section 23 05 14 - Variable Frequency Controllers.

1.3 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Provide line-by-line schedule notes review annotated to certify compliance or deviation.
- C. Provide Footprint Square Footage Discrepancy Chart in spreadsheet form. Clearly show the differences in height, length, and width between the submitted units and designed units per plans for each AHU with corresponding tag.
- D. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- E. Product Data, Submit the following:
 - 1. Published Literature: Indicate capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements.
 - 2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.

3. Fans: Performance and fan curves with specified operating point plotted, power, RPM.
 4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity per ARI 260.
 5. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring. Indicate factory installed and field installed wiring.
- F. Manufacturer's Installation Instructions: Submit.
- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- C. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- E. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- F. Comply with NFPA 70.

1.6 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Equipment shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- A. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If

protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

- B. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- C. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.
- D. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- E. Protect units from physical damage. Leave factory covers in place until startup of machine.

1.8 WARRANTY

- A. Furnish one (1) year manufacturer parts and labor warranty for air handling units. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up is not acceptable.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor or "by others".
 - 1. Filters: Furnish three (3) sets for each unit. One set during construction, a new set of filters for Test and Balancing services, and final new set at substantial completion. Filters shall be protected with polyester fabric at all times during construction.

1.10 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate sizes and locations of structural-steel support members, if any, with actual equipment provided.

PART 2 - PRODUCTS

2.1 MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

- A. Manufacturers: Subject to compliance with scheduled efficiencies, capacities, and specification, provide products by the following manufacturers.

1. Carrier
 2. Trane
 3. JCI
- B. Configuration: Coordinate with project plans and schedules.
- C. Performance Base: Sea level pressure or altitude.
- D. Fabrication: Conform to AMCA 99 and ARI 430. Units shall be factory assembled and ship in one piece where possible. Shipping splits are acceptable provided manufacturer includes gaskets and bolts.

2.2 SPECIAL PROJECT REQUIREMENTS: CONSTRUCTION

- A. In order to demonstrate energy compliance with 2015 IECC, performance method; the project as specified and scheduled was energy modeled and complies. Alternate manufacturers are allowed but must not exceed maximum scheduled brake horsepower, efficiency, etc.
- B. Air handling units shall be constructed to fit scheduled maximum dimensions including factory built mixing boxes and must maintain minimum specified access sections as scheduled and shown on plans. Rotating units to different orientations other than what is drawn on plans will be unacceptable. If potentially submitted equipment shall exceed any scheduled dimension, manufacturer shall provide performance data and dimensional data for consulting engineer to review and determine if proposed unit will fit within allotted space and maintain all required maintenance clearance. Equipment with deviations to dimensions shall be submitted 10 days prior to bid date for review.
- C. Outside air / return air mixing boxes shall be factory fabricated with the same construction as the unit casing. Field supplied or installed mixing boxes are not acceptable. Dampers shall be factory installed on mixing box openings. Actuators shall be provided by the control's contractor. This applies to all the air handling units with energy recovery wheel and any unit with outside and return air ducted to the plenum.
- D. Where total energy recovery wheels are scheduled to be provided, the energy recovery wheels shall be factory fabricated and within its own modular section with the same construction as the unit casing. The energy recovery wheel modular section shall have the same height and width as the associated fan and coil section. Any mismatched height or width dimension or any stand-alone energy recovery wheel section will not be accepted.

2.3 UNIT IDENTIFICATION REQUIREMENTS

- A. Furnish each unit with a durable, deep etched, .025" thick, factory installed aluminum identification plate, permanently mounted with the following information:
- Project name and address.
 - Unit identification as indicated within Contract Documents.
 - Serial Number.
 - Model Number.
 - CFM.
 - Entering and leaving air temperature (DB/WB) (cooling and heating coil).
 - Entering and leaving water temperature (cooling and heating coil).
 - Cooling and heating coil flow rate (GPM).
 - Fan Motor Horsepower.

- Blower est. ext. sp. (in. wg.).
- Unit Power Supply: Volts / PH / Amps; MCA / MOCP
- Sales Order #.
- Date of unit manufactured.

B. Custom label shall be provided by and installed at the factory. Label shall not be by a third party or contractor.

2.4 CASING

A. Full perimeter welded double-bottom steel base assembly constructed with a minimum of 14-gauge galvanized steel and shall be a minimum of six (6) inches in height. Base assembly shall be thermally broken and insulated with a minimum of 2" thick, R-13 closed-cell sprayed foam. Assemble multiple sections that are shipped loose with gaskets, caulk, and bolts per the manufacturer's installation instructions.

B. Outside Casing:

1. Galvanized Steel: 18-gauge G90 with fiberglass insulation or 20-gauge G90 if expanded foam injected insulation is utilized.

C. Inside Casing:

1. Galvanized Steel: Solid 20-gauge G90. Provide 20-gauge perforated panels in fan section and discharge plenum.

D. Casing shall be supported by free-standing 16-gauge G90 structural frame with removable panels. Framing members shall have thermal break and injected with expanded foam insulation. Structural integrity of frame shall not be affected by removing panels. Top, bottom, and side panels shall be of one-piece double-wall construction, formed and reinforced to provide a rigid assembly. All panels shall be completely gasketed at factory with a minimum 1/4-inch-thick x 3/4 inch wide closed-cell neoprene. Top and side panels shall be easily removable for service.

E. Insulation: Glass fiber or Expanded Foam.

1. 'K' (Ksi) factor at 75 degrees Fahrenheit: Maximum 0.154 Btuh inch / sq. ft. / degrees Fahrenheit.
2. Density: Two (2) inch thick, minimum 1-1/2 lbs. /cu ft. throughout the entire unit. One (1) inch thick casing panels in any section is unacceptable.
3. Insulation in perforated sections shall be coated on air side to prevent erosion into air stream. Uncoated insulation is unacceptable.
4. If air unit structural frame comes into contact with conditioned air, it shall be insulated with the same material throughout the rest of the unit.

F. Access Section: Minimum 24" access section with minimum 19" door clearance of double wall galvanized steel construction for flush mounting, with gasket, latch, and handle assembly, same thickness as casing. Access door frame shall be extruded aluminum, foam filled with a thermal break barrier, and include a full perimeter gasket. All access doors shall match unit casing construction, include a thermal break, and a factory installed sealable test port equal to Ventfabrics model 699. Provide access section between parallel coil sections, upstream of coil sections, upstream and downstream of the energy recovery wheels, in fan sections, filter sections, and mixing boxes.

- G. Cooling Coil Drain Pan: Welded double wall, type 304 stainless steel IAQ pan with two (2) inch insulation and welded corners. Drain pans without welded corners are not acceptable. Cross break and pitch to drain connection. Cooling coils with a finned height greater than 48 inches shall have an intermediate stainless steel IAQ drain pan extending entire length of coil. Intermediate pan shall have a minimum of two drop tubes to main pan. Drain pans shall allow no standing water and comply with ASHRAE Standard 62. Drain pans must be accessible for cleaning.
- H. Strength: Furnish structure to brace casings for suction pressure of five (5) inch wg, with maximum deflection of 1 in 200.

2.5 FANS

- A. Type: Refer to Air Handling Unit Schedule for fan type and drive type.
 - 1. Direct drive plenum fans shall be single width single inlet type with backward inclined airfoil blades. Plenum fan wheel, airfoil blades and hub shall be constructed from aluminum.
- B. Fan shall be statically and dynamically balanced at the factory as a complete fan assembly.
- C. The Fan wheels shall be keyed to shaft to prevent slipping.
- D. Construction: AMCA Class II minimum.
- E. Performance Ratings: Conform to AMCA 210 and label with AMCA Certified Rating Seal.
- F. Sound Ratings: Tested to ARI 260 and label with Certified Sound Rating Seal.
- G. Bearings: Provide permanently lubricated bearings.
- H. Mounting: Locate fan and motor internally on welded or bolted steel base coated with corrosion resistant paint or rust-resistant G90 steel and factory-mounted motor on slide rails. Furnish access to motor, drive, and bearings through hinged access doors. Mount base on vibration isolators with deflections in accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment or 2" deflection, whichever requirement is stricter.
- I. Fan Modulation: Variable frequency drive.
- J. Fan Motors: All motors shall be premium efficiency, NEMA MG-1 Section 3, Inverter Duty. Refer to Specification 23 05 13 - Common Motor Requirements for HVAC Equipment for acceptable motor manufacturers.
- K. Flexible Connection: Provide internal flexible connection between fan and air unit casing. Flexible connection between air unit casing and connecting duct shall not be provided when fan is internally isolated with flexible connection to casing.
- L. **All fans shall be provided with zero net effect vertical backdraft dampers. These non-controlled dampers shall provide for isolation in event a fan fails or is turned off and to prevent filters from being pulled into the fan section.**

2.6 BEARINGS AND DRIVES

- A. Bearings: Pillow block type, self-aligning, grease-lubricated ball bearings, with ABMA 9 L-10 life at 200,000 hours.
- B. Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated to prevent corrosion.
- C. Motor Shaft Grounding Kit: For all AHU motors, a motor shaft grounding kit shall be provided. This shall be factory installed prior to shipment. If not available from the factory, manufacturer is responsible for providing kits and field installation with no additional cost to owner or contractor.
- D. Motor: Motor shall be non-overloading. Motor horsepower shall be sized at a point on fan curve resulting from 105 percent of design RPM at scheduled CFM with a reduction in static pressure of 0.5-inch wg. All fan motors shall be in accordance with Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
 - 1. Motor Enclosure: Totally Enclosed Fan-Cooled (TEFC); **ECM motors shall not be acceptable.**
 - 2. Provide (2) two forged motor lifting eyes and oversized conduit boxes with ground lugs.
 - 3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 4. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified

2.7 COILS

- A. Provide access doors upstream and downstream of coils. Enclose coils with headers and return bends fully contained within casing. Slide coils into casing through removable end panel with blank-offs and casing sealing grommets at connection penetrations. Coils shall be supported by stainless steel coil support members maintaining a minimum of 1" separation between bottom of coil casing and drain pan.
- B. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with ARI 410.
- C. Water Heating Coils:
 - 1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
 - 2. Configuration: Drainable, with threaded plugs for drain and vent; serpentine type with return bends on smaller sizes and return headers on larger sizes.
 - 3. 18-inch access section between parallel coil faces.
 - 4. Casing: Die formed channel frame of galvanized steel.
 - 5. Tubes: 5/8-inch OD seamless copper expanded into fins, brazed joints. Minimum tube thickness shall be 0.020" copper.

6. Fins: Aluminum, maximum of 10 fins per inch. Minimum fin thickness shall be 0.008" aluminum.
- D. Water Cooling Coils:
1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
 2. Configuration: Drainable, with threaded plugs for drain and vent; threaded plugs in return bends and in headers opposite each tube.
 3. Coils shall be a maximum of eight (8) rows deep.
 4. 18-inch access section between parallel coil faces.
 5. Casing: Die formed channel frame of 16-gauge type 304 stainless steel.
 6. Drain Pans: Extend 12 inches downstream of coil and for coil banks more than 48 inches high provide intermediate pan with down spouts.
 7. Tubes: 5/8-inch OD seamless copper expanded into fins, brazed joints. Minimum tube thickness shall be 0.020" copper.
 8. Fins: Aluminum, maximum of 10 fins per inch. Minimum fin thickness shall be 0.008" aluminum.
 9. Coil supports shall be 16-gauge type 304 stainless steel.
- E. Tube Velocities: Coil tube design velocity shall be between 2 feet and 5 feet per second and also maintain design water side temperature difference down to 30 percent flow through coil. Provide tubes that are enhanced internally if minimum initial design tube velocity cannot be obtained.
- F. Refrigerant Cooling Coils:
1. Coils shall be designed for use with R-410a, as indicated on schedule.
 2. Coils shall be intertwined; split-faced coils not acceptable.
 3. Configuration: Sweat type copper suction connections located at the bottom of the suction headers for gravity oil drainage.
 4. Coils shall be a maximum of eight (8) rows deep.
 5. 18-inch access section between parallel coil faces.
 6. Casing: Die formed channel frame of stainless steel.
 7. Drain Pans: Extend 12 inches downstream of coil and for coil banks more than 48 inches high provide intermediate pan with down spouts.
 8. Tubes: 5/8-inch OD seamless copper, 0.020" thick, expanded into fins, brazed joints.
 9. Fins: Aluminum, 0.008" thick, maximum of 10 fins per inch.

10. Coil supports shall be 16-gauge type 304 stainless steel.

2.8 TOTAL ENERGY RECOVERY WHEEL UNIT

- A. Manufacturers: Subject to compliance with scheduled efficiencies, capacities, and specification, provide products by the following manufacturers.
 1. SEMCO
 2. Innergytech
- B. Provide energy recovery wheel where scheduled.
- C. Casing construction shall be the same as the rest of the unit.
- D. Total energy recovery wheel shall be installed by air unit manufacturer at the factory prior to shipment and shall be an integral component of the fully assembled unit. Loose or separate wheel sections shall not be acceptable.
- E. Energy recovery wheel shall be constructed of corrugated media, with a desiccant intimately bound and uniformly and permanently dispersed throughout the matrix structure of the media. Rotors with desiccants coated bonded or synthesized onto the media are not acceptable due to delaminating or erosion of the desiccant material.
- F. Media shall be resistant to corrosion resistance and resistance against attack from laboratory chemicals present in pharmaceutical, hospital, etc. environments as well as attack from external outdoor air conditions. Face flatness of the wheel shall be maximized in order to minimize wear on inner seal surfaces and to minimize cross leakage.
- G. Rotor shall be constructed of alternating layers of flat and corrugated media.
- H. Wheel layers should be uniform in construction forming uniform aperture sizes for airflow. Wheel construction shall be fluted or formed honeycomb geometry so as to eliminate internal wheel bypass. Wheel layers that can be separated or spread apart by airflow are unacceptable due to the possibility of channeling and performance degradation.
- I. The minimum acceptable performance shall be as specified in the unit schedule.
- J. Desiccant Material: The desiccant material shall be a molecular sieve, and specifically 3A molecular sieve to minimize cross contamination.
- K. Wheel Media Support System: The wheel frames shall consist of evenly spaced steel spokes, galvanized steel outer band and rigid center hub. The wheel construction should allow for post fabrication wheel alignment.
- L. Wheel Seals: The wheel seals shall be full contact nylon brush seals or equivalent. Seals should be easily adjustable.
- M. Wheel cassette: Cassettes shall be fabricated of heavy duty reinforced galvanized steel or welded structural box tubing. Cassettes shall have a built-in adjustable purge section minimizing cross contamination of supply air as shown on unit schedule.
- N. Bearings shall be inboard, zero maintenance, permanently sealed roller bearings, or alternatively, external flanged or pillow block bearings.
- O. Drive systems shall consist of fractional horsepower AC drive motors with multi-link drive belts.

- P. Face and bypass dampers shall be furnished as shown on unit schedule and drawings.
- Q. The wheel shall be listed or recognized by UL or equivalent.
- R. Provide a factory installed and wired variable frequency drive (VFD) controller that shall support full economizer and frost protection modes. Control system shall include factory mounted and wired temperature sensors in all four airstreams. The VFD shall be mounted in a NEMA 1 enclosure, include an LCD display screen, allow for an 80:1 turndown ratio, and communicate to the BAS via BACnet MS/TP.

2.9 AIR FILTRATION

- A. Filter Box: Section with filter guides, access doors as shown on plans, for side loading with gaskets and blank-off plates.
- B. Filter Frames: Pad holding frames shall be permanent metal frames designed to contain replaceable filter media pads. Frames shall be constructed of 22-gauge, galvanized steel U channel cell sides, expanded metal support grid, 9-gauge hinged retainer gate, sized to fit in standard universal holding frames, and accept maximum 2" thick media. Acceptable manufacturers: AAF or pre-approved equal.
- C. Replaceable Filter Media: MERV 13 or greater rating in accordance with ASHREA Test Standard 52.2-2007.
- D. High-Capacity Angle Filter: Two (2) inch extended area filters. Air quantities as scheduled; clean pressure drop of 0.10 inches wg; dirty pressure drop of 0.75 inches wg.
- E. Filter Area: Max velocity of 350 FPM.
- F. Filter Gauges: Provide Dwyer 2000 (photohelic) magnehelic gauges, 4" diameter and shall be accurate to $\pm 2\%$ of full range. One gauge shall be provided for each filter bank. Gauges shall be recessed into cabinet casing.

2.10 MULTIZONE DAMPERS

- A. Damper Leakage: Maximum 4.5 cfm/sq. at four (4) inch w.g. differential pressure.
- B. Damper housing shall be constructed of minimum 16-gauge mill-galvanized steel with minimum 1" thick fiberglass insulation between decks and around housing.
- C. Damper blades shall be of single wall 16-gauge galvanized steel plug welded to damper shafts or double wall airfoil design with compressible metal jamb seals, extruded-vinyl blade edge seals and stainless steel or bronze sleeve bearings.
- D. Damper blades shall be grouped and connected to a common linkage for each zone at the factory.
- E. Each damper shaft shall be of single piece design, constructed of minimum $\frac{1}{2}$ " solid steel, and shall extend a minimum of 6" beyond housing. Damper shafts shall not require the use of a linkage or extension for actuator mounting.
- F. Damper Actuators: Provided by Section 23 09 23 - Direct-Digital Control System for HVAC.

- G. Provide Zone Volume Control Dampers: Refer to section 23 33 00 Air Duct Accessories.

2.11 CONTROLS

- A. Controls: Refer to Section 23 09 23 - Direct-Digital Control System for HVAC.

2.12 CAPACITY

- A. Performance: Provide equipment as scheduled on Drawings.

2.13 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Provide equipment with electrical characteristics as shown on Electrical Drawings.
- B. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Requirements for motors.
- C. Section 23 05 14 - Variable Frequency Controllers: Requirements for drives.
- D. Combination Starter-Disconnect Switch: Provided by Division 26.
- E. Junction Box: Factory provided, mounted, and wired junction boxes on each fan section. J-box shall allow electrical contractor to connect power to device without penetrating through cabinet. Field installed J-boxes will not be acceptable; it shall be the complete responsibility of the manufacturer to install. Units shall be shipped with J-boxes pre-wired and mounted. Within equipment submittal the manufacturer shall show J-box location on plan view dimensional drawing.
- F. Motor Overload Panel: For units with more than one fan, and to allow for a connection to a single variable frequency drive, provide a factory mounted and wired motor overload panel. Panel shall be UL listed, NEMA 1 enclosure with IECC manual starters with rotary type operators and auxiliary contacts.
- G. All starters shall be equipped with integral phase-failure relay (automatic resetting type) to shut down motor upon loss of an electrical phase.

2.14 SOURCE QUALITY CONTROL

- A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.
- B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."
- C. Water Coils: Factory tested to 300 psig according to ARI 410 and ASHRAE 33.
- D. Refrigerant Coils: Factory tested to 450 psig according to ARI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with ARI 430.
- B. Install assembled units with internal vibration isolators. Internally isolated fans shall be provided with resilient mountings and flexible electrical leads. Install restraining snubbers as required. Adjust snubbers to prevent tension in flexible connectors when fan is operating. Refer to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- C. Equipment Mounting: Install air-handling units on concrete bases using elastomeric pads. Secure units to anchor bolts installed in concrete bases. Comply with requirements for concrete bases; Comply with requirements for vibration isolation devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- D. Contractor to provide fixed sheaves required for final air balance as dictated by Test and Balance Contractor.
- E. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.
- F. Insulate coil headers located outside airflow as specified for piping. Refer to Section 23 07 19 - HVAC Piping Insulation.
- G. Provide trapped condensation drain line routed to the nearest floor drain. Refer to detail on Drawings and Section 23 21 13 - Hydronic Piping.
- H. Installation of Hot Water Heating and/or Chilled Water Coil:
 - 1. Make connections to coils with unions. Position unions to permit coil removal.
 - 2. Connect water supply to leaving airside of coil (counter flow arrangement).
 - 3. Locate water supply at bottom of supply header and return water connection at top.
 - 4. Install water coils to allow draining and install drain connection at low points.
 - 5. Install the following piping accessories on piping connections. Refer to Section 23 21 13 - Hydronic Piping.
 - a. On supply: (refer to coil connection details)
 - 1. Thermometer well and thermometer.
 - 2. Well for control system temperature sensor.
 - 3. Shutoff valve.
 - 4. Pressure gage.
 - 5. Strainer
 - b. On return: (refer to coil connection details)
 - 1. Air vent.
 - 2. Thermometer well and thermometer.
 - 3. Well for control system temperature sensor.
 - 4. Pressure gage.

5. Modulating control valve (by BAS).
 6. TA 78K (combination balancing / shut-off globe valve with memory stop and pressure / temperature ports).
 7. Shutoff valve (provided by mechanical contractor in addition to balancing valve).
6. Install valves and piping specialties in accordance with details as indicated on Drawings.
 7. Install manual air vents at high points complete with shutoff valve. Refer to Section 23 21 13 - Hydronic Piping.
 8. Install floor support stands at piping drops to air unit coil connections. Air unit coil shall not carry any suspended piping load.
- I. Air unit manufacturer representative shall remove vibration isolation shipping blocks prior to start-up and ensure that fan base is free floating, and isolators are not short-circuited during operation.

3.2 CONNECTIONS

- A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.
- B. Comply with requirements for piping specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Install piping adjacent to air-handling unit to allow service and maintenance.
- D. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.
- E. Refrigerant Piping: Comply with applicable requirements in Section 23 23 00 "Refrigerant Piping." Install shutoff valve and union or flange at each supply and return connection.
- F. Coordinate duct installations and specialty arrangements with schematics on Drawings and with requirements specified in Section 23 31 13 "Metal Ducts" and Section 23 33 00 "Air Duct Accessories."
- G. Connect duct to air-handling units with flexible connections. Comply with requirements in Section 23 33 00 "Air Duct Accessories."

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

- C. Tests and Inspections:
1. Leak Test: After installation, fill water coils with water, and test coils and connections for leaks.
 2. Charge refrigerant coils with refrigerant and test for leaks.
 3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3.4 STARTUP SERVICE

- A. Perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.
 2. Verify that shipping, blocking, and bracing are removed.
 3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
 4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
 5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
 6. Verify that zone dampers fully open and close for each zone.
 7. Verify that outdoor- and return-air mixing dampers open and close and maintain minimum outdoor-air setting.
 8. Comb coil fins for parallel orientation.
 9. Verify that proper thermal-overload protection is installed for electric coils.
 10. Install new, clean filters.
 11. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.
- B. Starting procedures for air-handling units include the following:
1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
 2. Measure and record motor electrical values for voltage and amperage.
 3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.5 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

3.6 CLEANING

- A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units externally and internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, comb coils, drain pans, and filter housings, and install new, clean filters.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

3.8 PROTECTION OF FINISHED WORK

- A. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.
- B. All air units shall remain in manufacturer's protective shipping wrap during construction. Air unit casing openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

END OF SECTION 23 73 13

SECTION 23 74 13 - PACKAGED, OUTDOOR, CENTRAL-STATION AIR HANDLING UNITS

PART 1 -GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes packaged, outdoor, central-station air-handling units with the following components and accessories such as but not limited to:
 - 1. Direct-expansion cooling.
 - 2. Hot-gas re-heat.
 - 3. Gas furnace.
 - 4. Integral, space temperature controls.
 - 5. Roof curbs.
- B. Electrical characteristics: Coordinate with electrical plans prior to submitting equipment; provide single point power connections.

1.3 ACTION SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
- B. Provide line-by-line specification review annotated to certify compliance or deviation.
- C. Shop Drawings:
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, and required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Prepare the following:
 - a. Mounting Details: For securing and flashing roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
 - b. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof-curb mounting details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Structural members to which RTUs will be attached.
 - 2. Roof openings
 - 3. Roof curbs and flashing.
- B. Required roof penetrations for ducts, pipes, and electrical raceways, including size and location of each penetration.
- C. Startup service reports.

- D. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For units to include in emergency, operation, and maintenance manuals.

1.6 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor.

1. Filters: One (1) set for each unit.

1.7 QUALITY ASSURANCE

- A. ARI Compliance:

1. Comply with ARI 210/240 and ARI 340/360 for testing and rating energy efficiencies for RTUs.
2. Comply with ARI 270 for testing and rating sound performance for RTUs.

- B. ASHRAE Compliance:

1. Comply with ASHRAE 15 for refrigeration system safety.
2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

- D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

- E. UL Compliance: Comply with UL 1995.

- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.8 WARRANTY

- A. The manufacturer shall provide a full machine parts, labor, and refrigerant warranty for a period of one (1) year. **Warranty shall begin from date of Certificate of Substantial Completion.** Provide a sample of manufacturer's warranty certificates as described below within equipment submittal. **Warranty start dates from shipment or startup will not be accepted.**
- B. Provide an extended four (4) year FULL machine parts, labor, and refrigerant warranty for rooftop units. All components to be included such as but not limited to refrigerant, compressors, evaporator coils, condenser coils, electric heaters, gas-fired heaters, roof curbs, motors, starters, variable frequency drives, controls, etc. In the event of failure, the manufacturer shall provide a new motor,

compressor, fan, evaporator coil, condenser coil, and controllers, drive assembly, etc. Local or field rebuilt motors, compressors, drive assemblies etc. are not acceptable.

- C. In addition to full machine parts, labor and refrigerant, the Standard warranty shall include miscellaneous materials, travel time, incidental expenses, normal freight/shipping, refrigerant, oils, lubricants, belts, filters, insulation, and any expenses related to service calls required to diagnose and correct warranty issues.
- D. The manufacturer shall provide factory certificates for each Rooftop Unit listing at a minimum the model, serial number, and warranty information as specified above. Payment to contractor may be held if warranty certificates are not provided in a timely manner.
- E. All warranty work shall be performed by factory direct service technician. Warranty work shall not be performed by installing mechanical contractor.

1.9 FACTORY TESTING

- A. All units shall be factory assembled, internally wired, fully charged with refrigerant, and 100% tested prior to leaving the factory. Certified factory testing report shall be sent to owner and engineer upon request. The factory test shall include a refrigerant circuit test, a unit control system operations checkout, a unit refrigerant leak test and a final unit inspection. If unit fails any portion of the certified test, failures shall be corrected before unit leaves the factory.
- B. If for any reason unit does not meet the manufacturer's standards, those items shall be corrected and re-tested prior to leaving the factory with no additional cost to the owner.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Units shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.
- E. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- F. Protect units from physical damage. Leave factory covers in place until startup of machine.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Trane – Horizon
 - 2. JCI
 - 3. Carrier
- B. All units shall be of the same manufacturer and same model. Mismatched manufacturers will not be acceptable.
- C. Configuration: Coordinate with project plans and schedules.
- D. Performance Base: Sea level pressure or altitude.
- E. Fabrication: Conform to AMCA 99 and ARI 430. Units shall be factory assembled and ship in one piece where possible. Shipping splits are acceptable provided manufacturer includes gaskets and bolts and performs final unit inspection.

2.2 CASING

- A. General Fabrication Requirements for Casings: Formed and reinforced insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
- B. Construction:
 - 1. Thermal break double wall.
- C. Exterior Casing Material: 18-gauge galvanized steel with factory painted finish capable of withstanding at least 1,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure. Roof panels shall be pitched with overhangs above access doors, and knockouts with grommet seals for electrical and piping connections and lifting lugs.
- D. Interior Casing Corrosion Protection: All exposed metal surfaces in the air tunnel except the coils, coil casings, condensate drain pans, damper gears, and actuators, are spray coated with a two-part polyurethane, heat baked coating. Selection covers coating of the supply fans, filter rack, dampers, economizer, service door interiors, control cabinet, and condenser section interior. Option is intended for use in coastal saltwater conditions under the stress of heat, salt, sand, and wind and is applicable to all corrosive environments where a polyurethane coating is acceptable. The coating shall withstand at least 1,500 hours when tested under ASTM B 117-95 requirements.
- E. Casing Fabrication Requirements:
 - 1. Inside casing: 18 Gauge galvanized steel.
- F. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Refrigerant piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

- G. Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.
- H. Unit shall be provided with base discharge and return air openings. All openings through the base pan of the unit shall have upturned flanges of at least 1/2 inch in height around the opening.
- I. Unit base pan shall be provided with minimum 1-inch-thick foam insulation.
- J. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
1. Materials: ASTM D1929-11 with a minimum flash ignition temperature of 610°F.
 2. Double wall thickness and density: 2 inches, 3 lbs. density engineered polymer foam injected.
- K. Condensate Drain Pans: Formed sections of welded Type 304 stainless-steel sheet, a minimum insulation of two (2) inches deep and complying with ASHRAE 62.1.
1. Double-Wall Construction: Fill space between walls with expanded foam insulation with a thermal break and seal moisture tight.
 2. Cross break and pitch to drain connection.
 3. Drain Connections: Threaded nipple.
 4. Cooling coils with a finned height greater than 48 inches shall have an intermediate stainless steel IAQ drain pan extending entire length of the coil intermediate drain pan shall have a minimum of two drop tubes to main pan.
 5. Drain pans shall allow no standing water and must be accessible for cleaning.
- L. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- M. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.
- N. Base Rails: Full perimeter insulated galvanized rails for mounting on roof curb or pad as indicated.
- O. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
- P. Service Doors: Hinged access doors with gaskets. Material and construction of doors shall match material and construction of cabinet in which doors are installed.
- Q. Floor: Reinforced, metal surface; reinforced to limit deflection when walked on by service personnel. Insulation shall be below metal walking surface.

2.3 UNIT IDENTIFICATION REQUIREMENTS

- A. Furnish each unit with a durable, deep etched, .025" thick, factory installed aluminum identification plate, permanently mounted with the following information:
- Project name and address.
 - Unit identification as indicated within Contract Documents.
 - Serial Number.

- Model Number.
 - CFM.
 - Entering and leaving air temperature (DB/WB) (cooling and heating coil).
 - Fan Motor Horsepower.
 - Blower est. ext. sp. (in. wg.).
 - Unit Power Supply: Volts / PH / Amps; MCA /MOCP
 - Sales Order #.
 - Date of unit manufactured.
- B. Custom label shall be provided by and installed at the factory. Label shall not be by a third party or contractor.

2.4 FANS

- A. Direct-Driven Supply-Air Fans: Single width, single inlet, direct drive plenum; with permanently lubricated, VFD driven motor resiliently mounted in the fan inlet. Painted-steel or aluminum wheels with solid steel motor shaft.
- B. Direct-Driven Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.
1. Low sound operating, PVC coated fan guard, to discharge vertically. FRP construction on condenser fans under 15-tons. Fully dipped and baked epoxy on condenser fan assembly is also acceptable.
 2. Condenser Fan Motor: Totally enclosed air over (TEAO), permanently lubricated ball bearings; resiliently mounted; overload protected. Motors shall be ECM, Electronically Commutated Motors, or VFD driven on all units.
 3. Provide factory installed head pressure control module. Condenser airflow shall continuously modulate based on head pressure and cooling operation shall be allowed down to 35°F with adjustable compressor lockout.
 4. Fan Safety Guards: Steel with corrosion-resistant coating.
- C. Seismic Fabrication Requirements: Fabricate fan section, internal mounting frame and attachment to fans, fan housings, motors, casings, accessories, and other fan section components with reinforcement strong enough to withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment" when fan-mounted frame and RTU-mounted frame are anchored to building structure.
- D. Supply Fan Motor:
1. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
 2. Enclosure: Totally enclosed fan-cooled (TEFC). ECM motors shall not be acceptable.
 3. Supply fans shall be provided with a (VFD) variable frequency drive for balancing and soft start purposes. VFD shall be factory provided and installed and wired in a ventilated controls compartment by manufacturer prior to shipment. Externally mounted VFD's shall be provided in NEMA 3R enclosure.
 4. Mounting: Locate fan and motor internally on welded or bolted steel base coated with corrosion resistant paint or rust-resistant G90 steel and factory-mounted motor on fan isolation sled with rubber in shear isolators. Fan wheel and motor shall be dynamically

balanced after assembly. Furnish access to motor, drive, and bearings through hinged access doors.

2.5 COILS

- A. Capacity Ratings: Comply with ASHRAE 33 and ARI 410 and coil bearing the ARI label.
- B. Leak Test: Coils shall be leak tested with air underwater.
- C. Supply-Air Refrigerant Coil:
 - 1. Aluminum plate fin and seamless copper tube with brazed joints in galvanized steel casing with equalizing-type vertical distributor.
 - 2. Tube Header Material: Seamless Copper.
 - 3. Fin and Tube Joints: Mechanical bond.
 - 4. Refrigerant Coil Capacity Reduction: Circuit coils for intertwined control.
 - 5. Coating: Coils shall have a factory applied, flexible, epoxy polymer e-coat uniformly applied to all coil surface areas without material bridging between fins. Humidity and water immersion resistance shall be up to a minimum 1,000 and 250 hours respectively (ASTM D2247-92 and ASTM D870-92). Corrosion durability shall be confirmed through testing to no less than 6,000 hours salt spray per ASTM B117-90. Coated coils shall receive a spray-applied, UV-resistant polyurethane topcoat to prevent UV degradation of the e-coat. Coating shall carry a 5-year warranty, from the date of substantial completion. Field applied coatings will not be acceptable.
 - 6. Condensate Drain Pan: Stainless steel formed with pitch and drain connections complying with ASHRAE 62.1.
- D. Outdoor-Air Refrigerant Coil:
 - 1. Aluminum plate fin and seamless copper tube with brazed joints in galvanized steel casing with equalizing-type vertical distributor.
 - 2. Tube Header Material: Seamless Copper.
 - 3. Fin and Tube Joints: Mechanical bond.
 - 4. All condenser coils require louvered panels for added protection of the condenser coils from hail and other physical damage.
 - 5. Coating: Coils shall have a factory applied, flexible, epoxy polymer e-coat uniformly applied to all coil surface areas without material bridging between fins. Humidity and water immersion resistance shall be up to a minimum 1,000 and 250 hours respectively (ASTM D2247-92 and ASTM D870-92). Corrosion durability shall be confirmed through testing to no less than 6,000 hours salt spray per ASTM B117-90. Coated coils shall receive a spray-applied, UV-resistant polyurethane topcoat to prevent UV degradation of the e-coat. Coating shall carry a 5-year warranty, from the date of substantial completion. Field applied coatings will not be acceptable.
- E. Hot-Gas Reheat Refrigerant Coil (Required):
 - 1. Aluminum plate fin and seamless copper tube with brazed joints in galvanized steel casing with equalizing-type vertical distributor.

2. Tube Header Material: Seamless Copper.
3. Fin and Tube Joints: Mechanical bond.
4. Refrigerant Coil Capacity Reduction: Circuit coils for intertwined control.
5. Coating: Coils shall have a factory applied, flexible, epoxy polymer e-coat uniformly applied to all coil surface areas without material bridging between fins. Humidity and water immersion resistance shall be up to a minimum 1,000 and 250 hours respectively (ASTM D2247-92 and ASTM D870-92). Corrosion durability shall be confirmed through testing to no less than 6,000 hours salt spray per ASTM B117-90. Coated coils shall receive a spray-applied, UV-resistant polyurethane topcoat to prevent UV degradation of the e-coat. Coating shall carry a 5-year warranty, from the date of substantial completion. Field applied coatings will not be acceptable.
6. Shall be available and provided as a factory installed option. Hot-gas reheat coil shall be modulating control. On/off control not acceptable.
7. Lead refrigeration circuit shall be provided with hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a dehumidification control signal terminal which allow the unit to have a dehumidification mode of operation, which includes supply air temperature control to prevent supply air temperature swings and overcooling of the space.
8. Evaporator temperature to be precisely controlled by monitoring the compressor saturated suction temperature.
9. Shall be capable of simultaneously operating both the non-hot-gas reheat compressor circuits and hot-gas reheat compressor circuits of multiple compressor units when both the humidity level and the first stage cooling temperature level exceed their set points.
10. Shall be capable of prioritizing a cooling demand over a dehumidification demand and shut off the hot-gas reheat coil circuit(s) to meet the temperature requirements. Shall be able of turning the hot-gas reheat coil back on if the dehumidification demand still exists after the cooling demand has been met.
11. Shall consist of a reheat coil, three-way solenoid valve, a check valve and associated copper piping.
12. Reheat coil shall be constructed with enhanced aluminum fins mechanically bonded to copper tubes. Fin count shall not exceed 14 fins per inch.
13. Reheat coil shall be located on the leaving air side of the evaporator coil.
14. Three-way solenoid valves shall be non-modulating type and normally closed for the reheat coil.
15. Check valve shall be provided to prevent reverse flow of refrigerant during cooling operation.

2.6 REFRIGERANT CIRCUIT COMPONENTS

- A. Comply with requirements in ASHRAE 15, "Safety Standard for Refrigeration Systems."
- B. Refrigerant Charge: Factory charged with refrigerant and filled with oil.

- C. Compressors: Scroll compressors mounted on integral vibration isolators, internal overcurrent and high temperature protection, internal pressure relief and crankcase heater.
- D. Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged compressor access doors shall be fabricated of double wall, rigid polyurethane foam insulated panels to prevent the transmission of noise outside the cabinet.
- E. Refrigerant: R-410A.
 - 1. Classified as Safety Group A1 according to ASHRAE 34.
 - 2. Provide unit with operating charge of refrigerant.
- F. Refrigeration System Specialties:
 - 1. Expansion valve with replaceable thermostatic element.
 - 2. Refrigerant filter/dryer.
 - 3. Manual-reset high-pressure safety switch.
 - 4. Automatic-reset low-pressure safety switch.
 - 5. Minimum off-time relay.
 - 6. Automatic-reset compressor motor thermal overload.
 - 7. Brass service valves installed in compressor suction and liquid lines.
 - 8. Low-ambient kit high-pressure sensor.
 - 9. Hot-gas reheat solenoid valve with a replaceable magnetic coil.
 - 10. Thermostat for coil freeze-up protection during low ambient temperature operation or loss of air.
- G. Capacity Control:
 - 1. For unit's ≤ 2 nominal tons: Single circuit, single compressor with on/off or two-stage (100% / 67%) compressor.
 - 2. For units 3 to 10 nominal tons: Single circuit, single digital scroll, or inverter VFD compressor.
 - 3. For units > 10 and ≤ 30 nominal tons: Provide dual independent refrigerant circuits with a minimum of two compressors; a digital scroll or inverter VFD compressor shall be used on the lead refrigerant circuit and a staged compressor shall be used for the lag circuit.
 - 4. For unit's ≥ 30 nominal tons: Provide dual independent refrigerant circuits with a minimum of four compressors. A digital scroll or inverter VFD compressor shall be used on both refrigerant circuits. On each circuit, provide a lead digital or inverter VFD compressor and an on/off lag compressor.
 - 5. Evaporator temperature is to be measured and controlled by suction pressure transducers on each refrigeration circuit. The use of coil discharge temperature sensors is not acceptable.
- H. Safety Controls:

1. Compressor motor and condenser coil fan motor low ambient lockout.
2. Overcurrent protection for compressor motor.

2.7 AIR FILTRATION

- A. The filter rack shall be designed to handle a maximum 2" thick high efficiency filter. Filters replaceable through side access, hinged access door.
- B. Provide the following filter racks and media:
 1. SA Upstream of Coil: MERV 13.
- C. Replaceable Filter Media: As indicated above or greater rating in accordance with ASHRAE Test Standard 52.2.
- D. High-Capacity Filter: Two (2) inch extended area filters. Air quantities as scheduled; clean pressure drop of 0.10 inches w.g; dirty pressure drop of 0.75 inches w.g.
- E. Filter Area: Max velocity of 350 FPM.
- F. Acceptable manufacturer: American Air Filter or prior approved equal.

2.8 GAS FURNACE HEATING

- A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47 and NFPA 54.
 1. CSA Approval: Designed and certified by and bearing label of CSA.
- B. Burners:
 1. Heat-Exchanger Material: Stainless steel with a minimum thermal efficiency of 80 percent.
 2. Fuel: Natural gas.
 3. Ignition: Electronically controlled electric spark with flame sensor.
- C. Heat-Exchanger Drain Pan Material: Stainless steel.
- D. Venting: Gravity vented.
- E. Safety Controls:
 1. Gas Control Valve: Electronic modulating.
 2. Gas Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

2.9 GERMICIDAL UVC EMITTERS – REQUIRED FOR ALL AIR HANDLING UNITS INCLUDING OUTSIDE AIR UNITS.

Provide adequate space in the cooling coil section to allow for UVC Emitter installation and wiring and allow for a minimum 18" access door. Maintain full service.

- A. UVC Emitters shall be provided for each Air Handling Unit and manufactured by **Steril-Aire, Inc. only**. UVC lights including but not limited to safety switches and non-fused service

disconnects shall be field installed by local Steril-Aire factory authorized representative and not by mechanical contractor. A separate 120v/1ph electrical connection shall be provided by electrical contractor.

- B. Provide UVC Emitter in a same section as cooling coil immediately downstream of cooling coils and over drain pans; lights shall provide full coverage of cooling coils and drain pan. The UVC emitter shall be mounted inside the air handler casing a minimum of 12" downstream of cooling coil.
- C. UVC Emitter and fixture shall be factory assembled and tested. Unit shall consist of housing, power source, reflector, emitter sockets, emitter, door safety switches and unit mounted disconnect for separate 120v / 1ph / 60 Hz power supply. Unit shall be constructed to withstand HVAC environments and shall be UL and CSA listed for damp locations.

Housing shall be constructed of hospital grade stainless steel and equipped with ½" conduit openings on each end to facilitate conduit nipple coupling fixture to fixture and wiring to power. Incorporate all components into one integral assembly that maximizes serviceability. Unit shall be designed to be mounted inside the air stream and downstream of the cooling coil.

Power source shall be a Class P2, rapid start type with a power factor of 0.99 and an efficiency of not less than 89%. Unit voltage shall be 120 and designed to maximize photon production, radiance, and reliability in cold or moving air streams of 35°-170°F. 100% RD and at any velocity and shall include RF and EMI suppression and Smart System – "End of Lamp Life" protection.

Reflector shall be constructed of heavy gauge aluminum alloy with a minimum 86% reflectance at 254 nm.

Sockets shall be medium bi-pin, double click safety, and twist lock type. They are constructed of a UVC resistant polycarbonate.

Emitter tube shall be high output, hot cathode, T5 diameter, medium bi-pin type that produces broadband UVC of 250 – 260 nm. Each tube shall produce the specified output at any airflow velocity and air temperature of 35°-170°F and produce no ozone or other secondary contamination.

Independent testing: When tested in accordance with the general provisions of IES Lighting Handbook, 1981 Application volume, output per 1" arc length is not less than 10µW/cm² at 1 meter in a 400-fpm airstream of 45° F.

2.10 DAMPERS

- A. Outside Air and Economizer Damper Assembly: Unit shall include 0-100% economizer consisting of a motor operated outside air damper and return air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge and end seals. Damper blades shall be gear driven and designed to have no more than 20 cfm of leakage per sq. ft. at 4 in. w.g. air pressure differential across the damper. Low leakage dampers shall be Class 2 AMCA certified, in accordance with AMCA Standard 511. Damper assembly shall be controlled by spring return, enthalpy activated fully modulating actuator. Unit shall include outside air opening bird screen, outside air hood and adjustable barometric relief dampers.
- B. Damper blades shall be gear driven and designed to meet smoke damper Class-1 leakage specifications in accordance with U.L. 555S at 4 inches w.g. air pressure differential across the damper.
- C. Damper assembly shall be controlled by spring return, modulating actuator.
- D. Once set, outdoor air dampers shall open to the minimum set position when indoor fan starts. The damper shall close to the full closed position when indoor fan shuts down.
- E. Demand Control Ventilation: Provide a factory installed and wired return air CO₂ sensor to override the damper actuator to provide more outside air.
- F. Bird Screen: Provide 1-inch aluminum mesh pre filter upstream of the outside air opening.
- G. Configuration: Designed to inhibit wind-driven rain and snow from entering unit.

2.11 ELECTRICAL POWER CONNECTION

- A. Provide single connection of power to unit with unit factory mounted disconnect switch accessible from outside unit.
- B. General Electrical Power Connection Requirements: Factory-installed and wired switches, motor controllers, transformers, and other necessary electrical devices shall provide a single-point field power connection to unit.
- C. Convenience Outlet: A GFCI, 120v/15amp, 2 plug, unpowered convenience outlet connection shall be a separate electrical feed and not from the main.

- D. Enclosure: NEMA 250, Type 4X, mounted in unit with hinged access door in unit cabinet having a lock and key.
- E. Wiring: Numbered and color-coded to match wiring diagram.
- F. Wiring Location: Install factory wiring outside an enclosure in a raceway.
- G. Power Interface: Field power interface shall be to [wire lugs] [NEMA KS 1, heavy-duty, non-fused disconnect switch].
- H. Factory Wiring: Branch power circuit to each motor and to controls with one of the following disconnecting means:
 - 1. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
 - 2. NEMA KS 1, heavy-duty, non-fusible switch.
 - 3. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- I. Factory-Mounted, Overcurrent-Protection Service: For each motor.
- J. Transformer: Factory mounted with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity. Convenience outlet shall be a separate electrical connection and not powered from the main electrical feed.
- K. Controls: Factory wire unit-mounted controls components to a terminal strip for connection to third party BAS controller.
- L. Control Relays: Auxiliary and adjustable time-delay relays.
- M. Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.

2.12 CONTROLS

- A. Refer to Sequences of Operation within Controls specification.
- B. BAS Interface: Completely integrated microprocessor based Direct Digital Control (DDC) system to control all functions including space temperature, leaving air temperature, space humidity, scheduling, monitoring, unit safety protection, including compressor minimum run and minimum off times and diagnostics. The system shall be provided with all required temperature sensors, pressure sensors, controller, and keypad/display operator interface. All microprocessor boards, hardware and software shall be factory provided and installed to enable the BAS to monitor, control, and display unit status and alarms.
- C. Unit shall be completely factory wired with necessary controls and contactor pressure lugs or terminal block for power wiring. Units shall provide an external location for mounting a fused disconnect device. 24-volt electromechanical control circuit shall include control transformer and contactor pressure lugs for power wiring. Unit shall have single point power entry as standard.
 - 1. Unit controller shall be capable of controlling all features and options of the unit.

2. Controller shall be capable of standalone operation with unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling available without dependence on a building management system.
3. Controller shall have an onboard clock and calendar functions that allow for occupancy scheduling.
4. Controller shall include non-volatile memory to retain all programmed values, without the use of an external battery, in the event of a power failure.

2.13 ROOF CURBS (PROVIDED BY RTU MANUFACTURER AND NOT “BY OTHERS”):

- A. Roof Curb shall be constructed of G90 galvanized steel and designed to mate with the down flow (confirm arrangement with plans) supply openings and provide support and a watertight seal. The roof curb design shall allow field-fabricated rectangular supply ductwork to be connected directly to the curb. Curb design shall comply with NRCA requirements. Curbs shall be shipped fully welded and insulated and include wood nailer strips.
- B. **Curbs shall be rated for a minimum of 140 mph and certified by structural engineer upon submittal. Certification shall be provided within submittal for approval.**
- C. Provide sound attenuation manufactured by **BRD HUSHCORE BUB-755 Noise Control System** and shall be in full compliance with the following specifications:
 1. The overall installed thickness shall be 10” for BUB-755 products.
 2. Shall have a thermal value of R-27.
 3. Shall meet Class “A” per ASTM E84 for flammability.
 4. The composite panels shall get HUSH SEALANT™ model HSAC-100 acoustical grade caulk at seams and all perimeter edges inside the curb.
 5. Shall have 65% post-consumer recycled content.
 6. The combination of all layers shall be tested for Sound Transmission Loss in accordance with procedure ASTM E-90-10. The assembly shall be rated at not less than STC-52 with 1/3 octave performance values as listed below for sound radiation through the deck inside the curb.

Freq. (Hz)	<u>80</u>	<u>125</u>	<u>250</u>	<u>500</u>	<u>1K</u>	<u>2K</u>	<u>4K</u>	<u>8K</u>	<u>ST C</u>
TL (dB)	26	33	42	50	60	64	71	80	52
 7. Copy of test report by an accredited lab shall be included in the submittals to document the above performance.
- D. Comply with requirements in "The NRCA Roofing Manual."
- E. Match roof curb to roof slope to provide level surface for RTU mounting.
- F. Provide curb having vertical members insulated with a minimum thermal resistance (R-value) of 6.0 BTU/hr-ft²-°F or greater.

- G. Provide curb with continuous insulation between unit base and roof curb. All walls are to be insulated with 2" fiberglass insulation; floor to be insulated with 1" fiberglass insulation.
- H. Curb height shall be a minimum of 14".
- I. All curbs shall be provided with minimum 12-gauge wind clips.
- J. Roof Curb for Horizontal Airflow (where scheduled) - Horizontal openings in curb shall be custom designed for return and/or discharge for horizontal air handling. Opening size and location shall be indicated on drawings and/or schedule.
- K. Provide wood nailing strip to which roofer may nail roof flashing.
- L. Ship roof curb loose for field installation prior to unit placement.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.
- C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's rigging and installation instructions for unloading units and moving to final locations.
- B. Curb Support: Install roof curb on roof structure according to "The NRCA Roofing Manual."
 - 1. Install and secure units on curbs and coordinate roof penetrations and flashing with roof construction.
 - 2. Coordinate size, installation, and structural capacity of roof curbs, equipment supports, and roof penetrations.
 - 3. Coordinate size, location, and installation of unit manufacturer's roof curbs and equipment supports with roof Installer.
- C. Comply with requirements for gas-fired furnace installation in NFPA 54, "National Fuel Gas Code."
- D. Install separate devices furnished by manufacturer and not factory installed.
- E. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.
- F. Unless shown to come through roof curb to internal drain install drainpipes from unit drain pans to approved roof drain.

3.3 CONNECTIONS

- A. Coordinate installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems.
- B. Where installing piping adjacent to units, allow space for service and maintenance.
- C. Gas Piping Connections:
 - 1. Comply with requirements in Section 23 11 23 "Natural-Gas Piping."
 - 2. Connect gas piping to furnace, full size of gas train inlet, and connect with union, pressure regulator, and shutoff valve with sufficient clearance for burner removal and service.
 - 3. Install AGA-approved flexible connectors.
- D. Coordinate duct installation requirements with schematics on Drawings and with requirements specified for duct systems.
- E. Duct Connections:
 - 1. Comply with requirements in Section 23 31 13 "Metal Ducts."
 - 2. Drawings indicate the general arrangement of ducts.
 - 3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 23 33 00 "Air Duct Accessories."
- F. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in electrical Sections.
 - 1. Install electrical devices furnished by unit manufacturer but not factory mounted.

3.4 STARTUP SERVICE

- A. A factory-authorized service representative shall perform startup service.
 - 1. Complete installation and startup check according to manufacturer's written instructions.
 - 2. Inspect units for visible damage to furnace combustion chamber.
 - 3. Perform the following operations for both minimum and maximum firing and adjust burner for peak efficiency:
 - a. Measure gas pressure at manifold.
 - b. Measure combustion-air temperature at inlet to combustion chamber.
 - c. Measure flue-gas temperature at furnace discharge.
 - d. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
 - e. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.

4. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
 - a. High-limit heat exchanger.
 - b. Alarms.
5. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans.
6. Start refrigeration system when outdoor-air temperature is within normal operating limits and measure and record the following:
 - a. Cooling coil leaving-air, dry- and wet-bulb temperatures.
 - b. Cooling coil entering-air, dry- and wet-bulb temperatures.
 - c. Condenser coil entering-air dry-bulb temperature.
 - d. Condenser coil leaving-air dry-bulb temperature.
7. Simulate maximum cooling demand and inspect the following:
 - a. Compressor refrigerant suction and hot-gas pressures.
 - b. Short-circuiting of air through outside coil or from outside coil to outdoor-air intake.
 1. Inspect casing insulation for integrity, moisture content, and adhesion.
 2. Verify that clearances have been provided for servicing.
 3. Verify that controls are connected and operable.
 4. Verify that filters are installed.
 5. Clean coils and inspect for construction debris.
 6. Inspect operation of power vents.
 7. Purge gas line.
 8. Inspect and adjust vibration isolators and seismic restraints.
 9. Verify bearing lubrication.
 10. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
 11. Adjust fan belts to proper alignment and tension.
 12. Start unit.
 13. Inspect and record performance of interlocks and protective devices including response to smoke detectors by fan controls and fire alarm.
 14. Operate unit for run-in period.
 15. Calibrate controls.

16. Adjust and inspect high-temperature limits.
 17. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
 18. Verify operational sequence of controls.
 19. Measure and record the following airflows. Plot fan volumes on fan curve.
 - a. Supply-air volume.
 - b. Return-air flow.
 - c. Outdoor-air flow.
- B. After startup, change filters, verify bearing lubrication, and adjust belt tension.
- C. Remove and replace components that do not properly operate and repeat startup procedures as specified above.
- D. Prepare written report of the results of startup services.

3.5 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.6 DEMONSTRATION

- A. A factory-authorized service representative shall train Owner's maintenance personnel to adjust, operate, and maintain units.

3.7 COMPLETION AND CLEANUP

- A. Contractor shall comb and vacuum clean coils, inside and outside of unit cabinet prior to start-up.
- B. Install temporary filters during construction and start-up period. Replace with specified filters at Substantial Completion.

3.8 PROTECTION OF FINISHED WORK

- A. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation

END OF SECTION

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

SECTION 23 74 13.1 – HIGH CAPACITY PACKAGED, OUTDOOR, CENTRAL-STATION AIR HANDLING UNITS

PART 1 -GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes packaged, outdoor, central-station air-handling units with the following components and accessories such as but not limited to:
 - 1. Direct-expansion cooling.
 - 2. Gas furnace.
 - 3. Integral, space temperature controls.
 - 4. Roof curbs.
- B. Electrical characteristics: Coordinate with electrical plans prior to submitting equipment; provide single point power connections.

1.3 ACTION SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
- B. Provide line-by-line specification review annotated to certify compliance or deviation.
- C. Shop Drawings:
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, and required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Prepare the following:
 - a. Mounting Details: For securing and flashing roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
 - b. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof-curb mounting details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Structural members to which RTUs will be attached.
 - 2. Roof openings
 - 3. Roof curbs and flashing.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

- B. Required roof penetrations for ducts, pipes, and electrical raceways, including size and location of each penetration.
- C. Startup service reports.
- D. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For units to include in emergency, operation, and maintenance manuals.

1.6 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor.
 - 1. Filters: One (1) set for each unit.

1.7 QUALITY ASSURANCE

- A. ARI Compliance:
 - 1. Comply with ARI 210/240 and ARI 340/360 for testing and rating energy efficiencies for RTUs.
 - 2. Comply with ARI 270 for testing and rating sound performance for RTUs.
- B. ASHRAE Compliance:
 - 1. Comply with ASHRAE 15 for refrigeration system safety.
 - 2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
 - 3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.
- E. UL Compliance: Comply with UL 1995.
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.8 WARRANTY

- A. The manufacturer shall provide a full machine parts, labor, and refrigerant warranty for a period of one (1) year. **Warranty shall begin from date of Certificate of Substantial Completion.** Provide

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a sample of manufacturer's warranty certificates as described below within equipment submittal.
Warranty start dates from shipment or startup will not be accepted.

- B. Provide an extended four (4) year FULL machine parts, labor, and refrigerant warranty for rooftop units. All components to be included such as but not limited to refrigerant, compressors, evaporator coils, condenser coils, electric heaters, gas-fired heaters, roof curbs, motors, starters, variable frequency drives, controls, etc. In the event of failure, the manufacturer shall provide a new motor, compressor, fan, evaporator coil, condenser coil, and controllers, drive assembly, etc. Local or field rebuilt motors, compressors, drive assemblies etc. are not acceptable.
- C. In addition to full machine parts, labor and refrigerant, the Standard warranty shall include miscellaneous materials, travel time, incidental expenses, normal freight/shipping, refrigerant, oils, lubricants, belts, filters, insulation, and any expenses related to service calls required to diagnose and correct warranty issues.
- D. The manufacturer shall provide factory certificates for each Rooftop Unit listing at a minimum the model, serial number, and warranty information as specified above. Payment to contractor may be held if warranty certificates are not provided in a timely manner.
- E. All warranty work shall be performed by factory direct service technician. Warranty work shall not be performed by installing mechanical contractor.

1.9 FACTORY TESTING

- A. All units shall be factory assembled, internally wired, fully charged with refrigerant, and 100% tested prior to leaving the factory. Certified factory testing report shall be sent to owner and engineer upon request. The factory test shall include a refrigerant circuit test, a unit control system operations checkout, a unit refrigerant leak test and a final unit inspection. If unit fails any portion of the certified test, failures shall be corrected before unit leaves the factory.
- B. If for any reason unit does not meet the manufacturer's standards, those items shall be corrected and re-tested prior to leaving the factory with no additional cost to the owner.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Units shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment

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from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

- E. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- F. Protect units from physical damage. Leave factory covers in place until startup of machine.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Refer to specification section 01 23 00, Alternate Number 3A.

- B. All units shall be of the same manufacturer and same model. Mismatched manufacturers will not be acceptable.
- C. Configuration: Coordinate with project plans and schedules.
- D. Performance Base: Sea level pressure or altitude.
- E. Fabrication: Conform to AMCA 99 and ARI 430. Units shall be factory assembled and ship in one piece where possible. Shipping splits are acceptable provided manufacturer includes gaskets and bolts and performs final unit inspection.

2.2 CASING

- A. General Fabrication Requirements for Casings: Formed and reinforced insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
- B. Construction:
 - 1. Thermal break double wall.
- C. Exterior Casing Material: 18-gauge galvanized steel with factory painted finish capable of withstanding at least 1,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure. Roof panels shall be pitched with overhangs above access doors, and knockouts with grommet seals for electrical and piping connections and lifting lugs.
- D. Interior Casing Corrosion Protection: All exposed metal surfaces in the air tunnel except the coils, coil casings, condensate drain pans, damper gears, and actuators, are spray coated with a two-part polyurethane, heat baked coating. Selection covers coating of the supply fans, filter rack, dampers, economizer, service door interiors, control cabinet, and condenser section interior. Option is intended for use in coastal saltwater conditions under the stress of heat, salt, sand, and wind and is applicable to all corrosive environments where a polyurethane coating is acceptable. The coating shall withstand at least 1,500 hours when tested under ASTM B 117-95 requirements.
- E. Casing Fabrication Requirements:

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1. Inside casing: 18 Gauge galvanized steel.
- F. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Refrigerant piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.
- G. Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.
- H. Unit shall be provided with base discharge and return air openings. All openings through the base pan of the unit shall have upturned flanges of at least 1/2 inch in height around the opening.
- I. Unit base pan shall be provided with minimum 1-inch-thick foam insulation.
- J. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
1. Materials: ASTM D1929-11 with a minimum flash ignition temperature of 610°F.
 2. Double wall thickness and density: 2 inches, 3 lbs. density engineered polymer foam injected.
- K. Condensate Drain Pans: Formed sections of welded Type 304 stainless-steel sheet, a minimum insulation of two (2) inches deep and complying with ASHRAE 62.1.
1. Double-Wall Construction: Fill space between walls with expanded foam insulation with a thermal break and seal moisture tight.
 2. Cross break and pitch to drain connection.
 3. Drain Connections: Threaded nipple.
 4. Cooling coils with a finned height greater than 48 inches shall have an intermediate stainless steel IAQ drain pan extending entire length of the coil intermediate drain pan shall have a minimum of two drop tubes to main pan.
 5. Drain pans shall allow no standing water and must be accessible for cleaning.
- L. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- M. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.
- N. Base Rails: Full perimeter insulated galvanized rails for mounting on roof curb or pad as indicated.
- O. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.

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- P. Service Doors: Hinged access doors with gaskets. Material and construction of doors shall match material and construction of cabinet in which doors are installed.
- Q. Floor: Reinforced, metal surface; reinforced to limit deflection when walked on by service personnel. Insulation shall be below metal walking surface.

2.3 UNIT IDENTIFICATION REQUIREMENTS

- A. Furnish each unit with a durable, deep etched, .025" thick, factory installed aluminum identification plate, permanently mounted with the following information:
 - Project name and address.
 - Unit identification as indicated within Contract Documents.
 - Serial Number.
 - Model Number.
 - CFM.
 - Entering and leaving air temperature (DB/WB)
 - Fan Motor Horsepower.
 - Blower est. ext. sp. (in. wg.).
 - Unit Power Supply: Volts / PH / Amps; MCA /MOCP
 - Sales Order #.
 - Date of unit manufactured.
- B. Custom label shall be provided by and installed at the factory. Label shall not be by a third party or contractor.

2.4 FANS

- A. Direct-Driven Supply-Air Fans: Single width, single inlet, direct drive plenum; with permanently lubricated, VFD driven motor resiliently mounted in the fan inlet. Painted-steel or aluminum wheels with solid steel motor shaft.
- B. Direct-Driven Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.
 - 1. Low sound operating, PVC coated fan guard, to discharge vertically. FRP construction on condenser fans under 15-tons. Fully dipped and baked epoxy on condenser fan assembly is also acceptable.
 - 2. Condenser Fan Motor: Totally enclosed air over (TEAO), permanently lubricated ball bearings; resiliently mounted; overload protected. Motors shall be ECM, Electronically Commutated Motors, or VFD driven on all units.
 - 3. Provide factory installed head pressure control module. Condenser airflow shall continuously modulate based on head pressure and cooling operation shall be allowed down to 35°F with adjustable compressor lockout.
 - 4. Fan Safety Guards: Steel with corrosion-resistant coating.
- C. Seismic Fabrication Requirements: Fabricate fan section, internal mounting frame and attachment to fans, fan housings, motors, casings, accessories, and other fan section components with reinforcement strong enough to withstand seismic forces defined in Section 230548 "Vibration and

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Seismic Controls for HVAC Piping and Equipment" when fan-mounted frame and RTU-mounted frame are anchored to building structure.

D. Supply Fan Motor:

1. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
2. Enclosure: Totally enclosed fan-cooled (TEFC). ECM motors shall not be acceptable.
3. Supply fans shall be provided with a (VFD) variable frequency drive for balancing and soft start purposes. VFD shall be factory provided and installed and wired in a ventilated controls compartment by manufacturer prior to shipment. Externally mounted VFD's shall be provided in NEMA 3R enclosure.
4. Mounting: Locate fan and motor internally on welded or bolted steel base coated with corrosion resistant paint or rust-resistant G90 steel and factory-mounted motor on fan isolation sled with rubber in shear isolators. Fan wheel and motor shall be dynamically balanced after assembly. Furnish access to motor, drive, and bearings through hinged access doors.

2.5 COILS

A. Capacity Ratings: Comply with ASHRAE 33 and ARI 410 and coil bearing the ARI label.

B. Leak Test: Coils shall be leak tested with air underwater.

C. Supply-Air Refrigerant Coil:

1. Aluminum plate fin and seamless copper tube with brazed joints in galvanized steel casing with equalizing-type vertical distributor.
2. Tube Header Material: Seamless Copper.
3. Fin and Tube Joints: Mechanical bond.
4. Refrigerant Coil Capacity Reduction: Circuit coils for intertwined control.
5. Coating: Coils shall have a factory applied, flexible, epoxy polymer e-coat uniformly applied to all coil surface areas without material bridging between fins. Humidity and water immersion resistance shall be up to a minimum 1,000 and 250 hours respectively (ASTM D2247-92 and ASTM D870-92). Corrosion durability shall be confirmed through testing to no less than 6,000 hours salt spray per ASTM B117-90. Coated coils shall receive a spray-applied, UV-resistant polyurethane topcoat to prevent UV degradation of the e-coat. Coating shall carry a 5-year warranty, from the date of substantial completion. Field applied coatings will not be acceptable.
6. Condensate Drain Pan: Stainless steel formed with pitch and drain connections complying with ASHRAE 62.1.

D. Outdoor-Air Refrigerant Coil:

1. Aluminum plate fin and seamless copper tube with brazed joints in galvanized steel casing with equalizing-type vertical distributor.

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2. Tube Header Material: Seamless Copper.
3. Fin and Tube Joints: Mechanical bond.
4. All condenser coils require louvered panels for added protection of the condenser coils from hail and other physical damage.
5. Coating: Coils shall have a factory applied, flexible, epoxy polymer e-coat uniformly applied to all coil surface areas without material bridging between fins. Humidity and water immersion resistance shall be up to a minimum 1,000 and 250 hours respectively (ASTM D2247-92 and ASTM D870-92). Corrosion durability shall be confirmed through testing to no less than 6,000 hours salt spray per ASTM B117-90. Coated coils shall receive a spray-applied, UV-resistant polyurethane topcoat to prevent UV degradation of the e-coat. Coating shall carry a 5-year warranty, from the date of substantial completion. Field applied coatings will not be acceptable.

2.6 REFRIGERANT CIRCUIT COMPONENTS

- A. Comply with requirements in ASHRAE 15, "Safety Standard for Refrigeration Systems."
- B. Refrigerant Charge: Factory charged with refrigerant and filled with oil.
- C. Compressors: Scroll compressors mounted on integral vibration isolators, internal overcurrent and high temperature protection, internal pressure relief and crankcase heater.
- D. Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged compressor access doors shall be fabricated of double wall, rigid polyurethane foam insulated panels to prevent the transmission of noise outside the cabinet.
- E. Refrigerant: R-410A.
 1. Classified as Safety Group A1 according to ASHRAE 34.
 2. Provide unit with operating charge of refrigerant.
- F. Refrigeration System Specialties:
 1. Expansion valve with replaceable thermostatic element.
 2. Refrigerant filter/dryer.
 3. Manual-reset high-pressure safety switch.
 4. Automatic-reset low-pressure safety switch.
 5. Minimum off-time relay.
 6. Automatic-reset compressor motor thermal overload.
 7. Brass service valves installed in compressor suction and liquid lines.

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8. Low-ambient kit high-pressure sensor.
 9. Hot-gas reheat solenoid valve with a replaceable magnetic coil.
 10. Thermostat for coil freeze-up protection during low ambient temperature operation or loss of air.
- G. Capacity Control:
1. For unit's ≤ 2 nominal tons: Single circuit, single compressor with on/off or two-stage (100% / 67%) compressor.
 2. For units 3 to 10 nominal tons: Single circuit, single digital scroll, or inverter VFD compressor.
 3. For units > 10 and ≤ 30 nominal tons: Provide dual independent refrigerant circuits with a minimum of two compressors; a digital scroll or inverter VFD compressor shall be used on the lead refrigerant circuit and a staged compressor shall be used for the lag circuit.
 4. For unit's ≥ 30 nominal tons: Provide dual independent refrigerant circuits with a minimum of four compressors. A digital scroll or inverter VFD compressor shall be used on both refrigerant circuits. On each circuit, provide a lead digital or inverter VFD compressor and an on/off lag compressor.
 5. Evaporator temperature is to be measured and controlled by suction pressure transducers on each refrigeration circuit. The use of coil discharge temperature sensors is not acceptable.
- H. Safety Controls:
1. Compressor motor and condenser coil fan motor low ambient lockout.
 2. Overcurrent protection for compressor motor.

2.7 AIR FILTRATION

- A. The filter rack shall be designed to handle a maximum 2" thick high efficiency filter. Filters replaceable through side access, hinged access door.
- B. Provide the following filter racks and media:
 1. SA Upstream of Coil: MERV 13.
- C. Replaceable Filter Media: As indicated above or greater rating in accordance with ASHRAE Test Standard 52.2.
- D. High-Capacity Filter: Two (2) inch extended area filters. Air quantities as scheduled; clean pressure drop of 0.10 inches w.g; dirty pressure drop of 0.75 inches w.g.
- E. Filter Area: Max velocity of 350 FPM.
- F. Acceptable manufacturer: American Air Filter or prior approved equal.

2.9 GERMICIDAL UVC EMITTERS – REQUIRED FOR ALL AIR HANDLING UNITS INCLUDING OUTSIDE AIR UNITS.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

Provide adequate space in the cooling coil section to allow for UVC Emitter installation and wiring and allow for a minimum 18" access door. Maintain full service.

- A. UVC Emitters shall be provided for each Air Handling Unit and manufactured by **Steril-Aire, Inc. only**. UVC lights including but not limited to safety switches and non-fused service disconnects shall be field installed by local Steril-Aire factory authorized representative and not by mechanical contractor. A separate 120v/1ph electrical connection shall be provided by electrical contractor.
- B. Provide UVC Emitter in a same section as cooling coil immediately downstream of cooling coils and over drain pans; lights shall provide full coverage of cooling coils and drain pan. The UVC emitter shall be mounted inside the air handler casing a minimum of 12" downstream of cooling coil.
- C. UVC Emitter and fixture shall be factory assembled and tested. Unit shall consist of housing, power source, reflector, emitter sockets, emitter, door safety switches and unit mounted disconnect for separate 120v / 1ph / 60 Hz power supply. Unit shall be constructed to withstand HVAC environments and shall be UL and CSA listed for damp locations.

Housing shall be constructed of hospital grade stainless steel and equipped with ½" conduit openings on each end to facilitate conduit nipple coupling fixture to fixture and wiring to power. Incorporate all components into one integral assembly that maximizes serviceability. Unit shall be designed to be mounted inside the air stream and downstream of the cooling coil.

Power source shall be a Class P2, rapid start type with a power factor of 0.99 and an efficiency of not less than 89%. Unit voltage shall be 120 and designed to maximize photon production, radiance, and reliability in cold or moving air streams of 35°-170°F. 100% RD and at any velocity and shall include RF and EMI suppression and Smart System – "End of Lamp Life" protection.

Reflector shall be constructed of heavy gauge aluminum alloy with a minimum 86% reflectance at 254 nm.

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Sockets shall be medium bi-pin, double click safety, and twist lock type. They are constructed of a UVC resistant polycarbonate.

Emitter tube shall be high output, hot cathode, T5 diameter, medium bi-pin type that produces broadband UVC of 250 – 260 nm. Each tube shall produce the specified output at any airflow velocity and air temperature of 35°-170°F and produce no ozone or other secondary contamination.

Independent testing: When tested in accordance with the general provisions of IES Lighting Handbook, 1981 Application volume, output per 1" arc length is not less than 10 μ W/cm² at 1 meter in a 400-fpm airstream of 45° F.

2.10 DAMPERS

- A. Outside Air and Economizer Damper Assembly: Unit shall include 0-100% economizer consisting of a motor operated outside air damper and return air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge and end seals. Damper blades shall be gear driven and designed to have no more than 20 cfm of leakage per sq. ft. at 4 in. w.g. air pressure differential across the damper. Low leakage dampers shall be Class 2 AMCA certified, in accordance with AMCA Standard 511. Damper assembly shall be controlled by spring return, enthalpy activated fully modulating actuator. Unit shall include outside air opening bird screen, outside air hood and adjustable barometric relief dampers.
- B. Damper blades shall be gear driven and designed to meet smoke damper Class-1 leakage specifications in accordance with U.L. 555S at 4 inches w.g. air pressure differential across the damper.
- C. Damper assembly shall be controlled by spring return, modulating actuator.
- D. Once set, outdoor air dampers shall open to the minimum set position when indoor fan starts. The damper shall close to the full closed position when indoor fan shuts down.
- E. Demand Control Ventilation: Provide a factory installed and wired return air CO₂ sensor to override the damper actuator to provide more outside air.
- F. Bird Screen: Provide 1-inch aluminum mesh pre filter upstream of the outside air opening.
- G. Configuration: Designed to inhibit wind-driven rain and snow from entering unit.

2.11 ELECTRICAL POWER CONNECTION

- A. Provide single connection of power to unit with unit factory mounted disconnect switch accessible from outside unit.
- B. General Electrical Power Connection Requirements: Factory-installed and wired switches, motor controllers, transformers, and other necessary electrical devices shall provide a single-point field power connection to unit.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

- C. Convenience Outlet: A GFCI, 120v/15amp, 2 plug, unpowered convenience outlet connection shall be a separate electrical feed and not from the main.
- D. Enclosure: NEMA 250, Type 4X, mounted in unit with hinged access door in unit cabinet having a lock and key.
- E. Wiring: Numbered and color-coded to match wiring diagram.
- F. Wiring Location: Install factory wiring outside an enclosure in a raceway.
- G. Power Interface: Field power interface shall be to [wire lugs] [NEMA KS 1, heavy-duty, non-fused disconnect switch].
- H. Factory Wiring: Branch power circuit to each motor and to controls with one of the following disconnecting means:
 - 1. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
 - 2. NEMA KS 1, heavy-duty, non-fusible switch.
 - 3. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- I. Factory-Mounted, Overcurrent-Protection Service: For each motor.
- J. Transformer: Factory mounted with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity. Convenience outlet shall be a separate electrical connection and not powered from the main electrical feed.
- K. Controls: Factory wire unit-mounted controls components to a terminal strip for connection to third party BAS controller.
- L. Control Relays: Auxiliary and adjustable time-delay relays.
- M. Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.

2.12 CONTROLS

- A. Refer to Sequences of Operation within Controls specification.
- B. BAS Interface: Completely integrated microprocessor based Direct Digital Control (DDC) system to control all functions including space temperature, leaving air temperature, space humidity, scheduling, monitoring, unit safety protection, including compressor minimum run and minimum off times and diagnostics. The system shall be provided with all required temperature sensors, pressure sensors, controller, and keypad/display operator interface. All microprocessor boards, hardware and software shall be factory provided and installed to enable the BAS to monitor, control, and display unit status and alarms.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

- C. Unit shall be completely factory wired with necessary controls and contactor pressure lugs or terminal block for power wiring. Units shall provide an external location for mounting a fused disconnect device. 24-volt electromechanical control circuit shall include control transformer and contactor pressure lugs for power wiring. Unit shall have single point power entry as standard.
 - 1. Unit controller shall be capable of controlling all features and options of the unit.
 - 2. Controller shall be capable of standalone operation with unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling available without dependence on a building management system.
 - 3. Controller shall have an onboard clock and calendar functions that allow for occupancy scheduling.
 - 4. Controller shall include non-volatile memory to retain all programmed values, without the use of an external battery, in the event of a power failure.

2.13 ROOF CURBS (PROVIDED BY RTU MANUFACTURER AND NOT “BY OTHERS”):

- A. Roof Curb shall be constructed of G90 galvanized steel and designed to mate with the down flow (confirm arrangement with plans) supply openings and provide support and a watertight seal. The roof curb design shall allow field-fabricated rectangular supply ductwork to be connected directly to the curb. Curb design shall comply with NRCA requirements. Curbs shall be shipped fully welded and insulated and include wood nailer strips.
- B. **Curbs shall be rated for a minimum of 140 mph and certified by structural engineer upon submittal. Certification shall be provided within submittal for approval.**
- C. Provide sound attenuation manufactured by **BRD HUSHCORE BUB-755 Noise Control System** and shall be in full compliance with the following specifications:
 - 1. The overall installed thickness shall be 10” for BUB-755 products.
 - 2. Shall have a thermal value of R-27.
 - 3. Shall meet Class “A” per ASTM E84 for flammability.
 - 4. The composite panels shall get HUSH SEALANT™ model HSAC-100 acoustical grade caulk at seams and all perimeter edges inside the curb.
 - 5. Shall have 65% post-consumer recycled content.
 - 6. The combination of all layers shall be tested for Sound Transmission Loss in accordance with procedure ASTM E-90-10. The assembly shall be rated at not less than STC-52 with 1/3 octave performance values as listed below for sound radiation through the deck inside the curb.

Freq. (Hz)	80	125	250	500	1K	2K	4K	8K	ST C
TL (dB)	26	33	42	50	60	64	71	80	52

PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

7. Copy of test report by an accredited lab shall be included in the submittals to document the above performance.
- D. Comply with requirements in "The NRCA Roofing Manual."
- E. Match roof curb to roof slope to provide level surface for RTU mounting.
- F. Provide curb having vertical members insulated with a minimum thermal resistance (R-value) of 6.0 BTU/hr-ft²-°F or greater.
- G. Provide curb with continuous insulation between unit base and roof curb. All walls are to be insulated with 2" fiberglass insulation; floor to be insulated with 1" fiberglass insulation.
- H. Curb height shall be a minimum of 14".
- I. All curbs shall be provided with minimum 12-gauge wind clips.
- J. Roof Curb for Horizontal Airflow (where scheduled) - Horizontal openings in curb shall be custom designed for return and/or discharge for horizontal air handling. Opening size and location shall be indicated on drawings and/or schedule.
- K. Provide wood nailing strip to which roofer may nail roof flashing.
- L. Ship roof curb loose for field installation prior to unit placement.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.
- C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's rigging and installation instructions for unloading units and moving to final locations.
- B. Curb Support: Install roof curb on roof structure according to "The NRCA Roofing Manual."
 1. Install and secure units on curbs and coordinate roof penetrations and flashing with roof construction.
 2. Coordinate size, installation, and structural capacity of roof curbs, equipment supports, and roof penetrations.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

3. Coordinate size, location, and installation of unit manufacturer's roof curbs and equipment supports with roof Installer.
- C. Comply with requirements for gas-fired furnace installation in NFPA 54, "National Fuel Gas Code."
- D. Install separate devices furnished by manufacturer and not factory installed.
- E. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.
- F. Unless shown to come through roof curb to internal drain install drainpipes from unit drain pans to approved roof drain.

3.3 CONNECTIONS

- A. Coordinate installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems.
- B. Where installing piping adjacent to units, allow space for service and maintenance.
- C. Coordinate duct installation requirements with schematics on Drawings and with requirements specified for duct systems.
- D. Duct Connections:
 1. Comply with requirements in Section 23 31 13 "Metal Ducts."
 2. Drawings indicate the general arrangement of ducts.
 3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 23 33 00 "Air Duct Accessories."
- E. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in electrical Sections.
 1. Install electrical devices furnished by unit manufacturer but not factory mounted.

3.4 STARTUP SERVICE

- A. A factory-authorized service representative shall perform startup service.
 1. Complete installation and startup check according to manufacturer's written instructions.
 2. Inspect units for visible damage to furnace combustion chamber.
 3. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

4. Start refrigeration system when outdoor-air temperature is within normal operating limits and measure and record the following:
 - a. Cooling coil leaving-air, dry- and wet-bulb temperatures.
 - b. Cooling coil entering-air, dry- and wet-bulb temperatures.
 - c. Condenser coil entering-air dry-bulb temperature.
 - d. Condenser coil leaving-air dry-bulb temperature.
5. Simulate maximum cooling demand and inspect the following:
 - a. Compressor refrigerant suction and hot-gas pressures.
 - b. Short-circuiting of air through outside coil or from outside coil to outdoor-air intake.
 1. Inspect casing insulation for integrity, moisture content, and adhesion.
 2. Verify that clearances have been provided for servicing.
 3. Verify that controls are connected and operable.
 4. Verify that filters are installed.
 5. Clean coils and inspect for construction debris.
 6. Inspect operation of power vents.
 7. Purge gas line.
 8. Inspect and adjust vibration isolators and seismic restraints.
 9. Verify bearing lubrication.
 10. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
 11. Adjust fan belts to proper alignment and tension.
 12. Start unit.
 13. Inspect and record performance of interlocks and protective devices including response to smoke detectors by fan controls and fire alarm.
 14. Operate unit for run-in period.
 15. Calibrate controls.
 16. Adjust and inspect high-temperature limits.
 17. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

18. Verify operational sequence of controls.
19. Measure and record the following airflows. Plot fan volumes on fan curve.
 - a. Supply-air volume.
 - b. Return-air flow.
 - c. Outdoor-air flow.
- B. After startup, change filters, verify bearing lubrication, and adjust belt tension.
- C. Remove and replace components that do not properly operate and repeat startup procedures as specified above.
- D. Prepare written report of the results of startup services.

3.5 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.6 DEMONSTRATION

- A. A factory-authorized service representative shall train Owner's maintenance personnel to adjust, operate, and maintain units.

3.7 COMPLETION AND CLEANUP

- A. Contractor shall comb and vacuum clean coils, inside and outside of unit cabinet prior to start-up.
- B. Install temporary filters during construction and start-up period. Replace with specified filters at Substantial Completion.

3.8 PROTECTION OF FINISHED WORK

- A. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation

END OF SECTION

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

SECTION 23 81 26 - DUCTLESS MINI-SPLIT-SYSTEM AIR-CONDITIONERS

PART I -GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 GENERAL REQUIREMENTS

- A. Indoor, wall or ceiling mounted, direct-expansion fan coils are matched with cooling only outdoor unit.
- B. Outdoor air-cooled split system compressor sections suitable for on-the-ground, rooftop, wall hung or balcony mounting. Units shall consist of a rotary compressor, an air-cooled coil, propeller-type draw-through outdoor fan, metering device(s), and control box. Units shall discharge air horizontally as shown on the contract drawings. Units shall function as the outdoor component of an air-to-air cooling only or heat pump system (refer to schedule).
- C. Indoor unit shall be rated per ARI Standards 210/240 and listed in the ARI directory as a matched system.
- D. A factory provided and installed BACnet communication interface card with building automation system shall enable building automation system operator to remotely control and monitor the system from an operator workstation. Control features available, and monitoring points displayed, locally at fan coil controller shall be available through building automation system.
- E. Outdoor unit construction shall comply with ANSI/ASHRAE 15, latest revision, and with the NEC. Units shall be evaluated in accordance with UL standard 1995. Units shall be listed in the CEC directory. Unit cabinet shall be capable of withstanding 500-hour salt spray test per Federal Test Standard No. 141 (method 6061). Air-cooled condenser coils shall be leak tested at 573 psig.
- F. Provide equipment with electrical characteristics as shown on the Electrical Drawings.

1.3 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. **Mitsubishi**

1.4 SUBMITTAL:

- A. Submit in form similar to the schedule on the Drawings. Show all data listed in schedule, electrical characteristics and accessories being provided.
- B. Provide line-by-line specification review annotated to certify compliance or deviation.
- C. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures.

DUCTLESS MINI-SPLIT-SYSTEM AIR-CONDITIONERS

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

- D. Product Data: Submit product data, including manufacturer's □product sheet for specified products.

1.5 WARRANTY

- A. One (1) year on unit parts other than compressor/motor assembly. Warranty shall begin from date of Certificate of Substantial Completion.
- B. Five (5) years on compressor/motor assembly. Warranty shall begin from date of Certificate of Substantial Completion.
- C. One (1) year on refrigerant and oil. Warranty shall begin from date of Certificate of Substantial Completion.

PART 2 –PRODUCTS

2.1 UNIT CABINET:

- A. Indoor unit cabinet discharge and inlet grilles shall be attractively styled, high-impact polystyrene. Cabinet shall be fully insulated for improved thermal and acoustic performance.
- B. Outdoor unit cabinet shall be constructed of galvanized steel, bonderized and coated with a baked-enamel finish on inside and outside. Unit access panels shall be removable with minimal screws and shall provide full access to the compressor, fan, and control components. Outdoor compartment shall be isolated and have an acoustic lining to assure quiet operation.
- C. Indoor and outdoor unit shall be of the same manufacturer.

2.2 COMPRESSOR

- A. Compressor shall be fully hermetic rotary type. Compressor shall be equipped with oil system, operating oil charge, and motor. Internal overloads shall protect the compressor from over-temperature and over-current. Motor shall be NEMA rated class F, suitable for operation in a refrigerant atmosphere. Compressor assembly shall be installed on rubber vibration isolators.

2.3 COIL

- A. Evaporator coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion. A drip pan under the coil shall have a drain connection for hose attachment to remove condensate. Condensate pan shall have internal trap.
- B. Condenser coil shall be constructed of aluminum fins mechanically bonded to seamless copper tubes, which are cleaned, dehydrated, and sealed.

2.4 FANS

- A. Fan shall be tangential direct-drive blower type with air intake at the top of the unit and discharge at the bottom front. Automatic, motor-driven vertical air sweep shall be

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

provided standard. Air sweep operation shall be user selectable. The vertical sweep may be adjusted (using the remote control) and the horizontal air direction may be set manually.

2.5 AIR FILTERS

- A. Unit shall have filter track with factory-supplied cleanable filters.

2.6 BUILDING AUTOMATION SYSTEM INTERFACE:

- A. Controls shall consist of a microprocessor-based control system which shall control space temperature, determine optimum fan speed, and run self-diagnostics. The temperature control range shall be from 62° F to 84°F.
- B. The unit shall have integral controls provided by unit manufacturer to perform input functions necessary to operate the system. Factory installed hardware and software to enable building automation system to monitor, control, and display status and alarms.
 - 1. A factory provided and installed BACnet communication interface card with building automation system shall enable building automation system operator to remotely control and monitor the system from an operator workstation. Control features available, and monitoring points displayed, locally at fan coil controller shall be available through building automation system.
 - 2. The unit shall be compatible with interfacing with connection to BACnet networks or interfacing with connection to BMS system.
- C. The unit shall have the following functions as a minimum:
 - 1. An automatic restart after power failure at the same operating conditions as at failure.
 - 2. A timer function to provide a minimum 24-hour timer cycle for system Auto Start/Stop.
 - 3. Temperature-sensing controls shall sense return air temperature.
 - 4. Indoor coil freeze protection.
 - 5. Wireless infrared remote control to enter set points and operating conditions.
 - 6. Automatic air sweep control to provide on or off activation of air sweep louvers.
 - 7. Dehumidification mode shall provide increased latent removal capability by modulating system operation and set point temperature.
 - 8. Fan-only operation to provide room air circulation when no cooling is required.
 - 9. Diagnostics shall provide continuous checks of unit operation and warn of possible malfunctions. Error messages shall be displayed at the unit.

THIS SPECIFICATION SECTION SHALL BE BID AS AN ALTERNATE

10. Fan speed control shall be user-selectable: high, medium, low, or microprocessor controlled automatic operation during all operating modes.
11. Automatic heating-to-cooling changeover in heat pump mode. Control shall include dead band to prevent rapid mode cycling between heating and cooling.
12. Indoor coil high temperature protection shall be provided to detect excessive indoor discharge temperature when unit is in heat pump mode.

PART 3 -EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
 1. Leak Test: After installation, fill water coils with water and test coils and connections for leaks. Repair leaks and retest until no leaks exist.
 2. Charge refrigerant coils with refrigerant and test for leaks. Repair leaks and retest until no leaks exist.
 3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.

3.2 STARTUP SERVICE

- A. Refer to Section 23 05 93 Testing, Adjusting, and Balancing for HVAC.

3.3 CLEANING

- A. Clean units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.
- B. After completing system installation and testing, adjusting, and balancing fan coil and air-distribution systems clean filter housings and install new filters.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan coil units.

END OF SECTION 23 81 26

SECTION 23 82 39.19 - ELECTRIC UNIT HEATERS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Electric Unit Heaters.
- B. Related Sections:
 - 1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for hangers for placement by this section.
 - 2. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for vibration isolators for placement by this section.

1.3 REFERENCES

- A. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 90.1 - Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings.
 - 2. ASHRAE 103 - Methods of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers.
- B. Underwriters Laboratories Inc.:
 - 1. Units to be UL Listed.

1.4 ACTION SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.
- C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Plans, elevations, sections, and details.
 - 2. Location and size of each field connection.
 - 3. Details of anchorages and attachments to structure and to supported equipment.

4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.
5. Location and arrangement of integral controls.
6. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 1. Suspended ceiling components.
 2. Structural members to which unit heaters will be attached.
 3. Method of attaching hangers to building structure.
 4. Size and location of initial access modules for acoustical tile.
 5. Items penetrating finished ceiling, including the following:
 - a. Air outlets and inlets.
 - b. Speakers.
 - c. Sprinklers.
 - d. Access panels.
 6. Lighting fixtures.
 7. Perimeter moldings for exposed or partially exposed cabinets.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of thermostats or other products not mounted on unit.
- B. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listing.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Accept heaters and controls on site in factory packaging. Inspect for damage.

1.9 WARRANTY

- A. Furnish a five (5) year manufacturer warranty. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start-up will not be acceptable.

PART 2 - PRODUCTS

2.1 ELECTRIC UNIT HEATERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
1. Reznor
 2. Markel
 3. Raywall
- B. Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heat exchanger, controls, and accessories complying with ARI 440:
1. Discharge Louvers: Individually adjustable horizontal and vertical louvers to match cabinet finish.
 2. Control Voltage: 24-volt, 60 hertz
 3. Wall mounted adjustable thermostat.
 4. Location: Suspended overhead.
 5. Comply with UL 2021.
- C. Cabinet: 18-gauge steel with baked enamel finish, easily removed and secured access panels, insulated or double panel construction.
- D. Supply Fan: Propeller type with direct drive, dynamically balanced and mounted with rubber vibration insulators.
- E. Heat Exchanger: High mass, all steel tubular finned type, copper brazed elements.
- F. Controls: Wall mounted Thermostat with fan switch.
- G. Motor: Totally enclosed industrial rated. Motor on units to 20KW shall utilize sealed bearings. Motor on units larger than 20KW shall be 2-speed, permanent capacitor-type, continuous duty.
- H. Wiring:
1. Sub-divided circuits with individual fuse protection
 2. Internal 24V control transformer.
 3. Heavy duty magnetic contactors.
 4. Thermal cutouts on control circuit with automatic reset.

5. Low voltage thermostatic kit with fan switch.
6. Factory wired disconnect switch.
7. Performance: Provide equipment as scheduled on Drawings.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for electrical connections to verify actual locations before unit heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install cabinet unit heaters to comply with NFPA 90A.
- B. Install unit heaters level and plumb.
- C. Suspend cabinet unit heaters from structure with elastomeric hangers. Refer to Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- D. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- E. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.3 CONNECTIONS

- A. Comply with safety requirements in UL 1995.

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

- A. Adjust initial temperature set points.

3.6 DEMONSTRATION

- A.** Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters.

END OF SECTION 23 82 39.19

SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUBSTITUTIONS OF PRODUCTS

- A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability or record of satisfactory performance. It is not intended to preclude the use of equal or better materials or equipment provided that same meets the requirements of the particular project and is approved in an Addendum as a substitution prior to the submission of proposals.
- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect and Engineer at a minimum of seven (7) business days prior to the date for receipt of proposals. Each such request shall include a specification line by line review annotated to certify compliance, the name of the manufacturer and model, material or equipment for which it is to be substituted and a complete description of the proposed substitute including dimensional drawings, cutsheets, performance and test data and any other information necessary for an evaluation. The Engineers decision of approval or disapproval of a proposed substitution shall be final.
- C. If the Engineer approves any proposed substitution prior to receipt of proposals, such approval will be set forth in an Addendum. Offerors shall not rely upon approvals made in any other manner.
- D. The Engineer and Owner reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final.
- E. Availability of specified items:
 - 1. Verify prior to submittal of Proposal that all specified items will be available in time for installation during orderly and timely progress of the work.
 - 2. In the event specified items will not be so available, notify the Architect / Engineer prior to receipt of Proposals. Submit Request for Substitutions in accordance with this section.
 - 3. The request will not be considered if the product or method cannot be provided as a result of the Contractor's failure to pursue the work promptly or coordinate activities properly.

4. Costs of delays because of non-availability of specified items, when such delays could have been avoided by the Contractor, will be back-charged as necessary and shall not be borne by the Owner.
- F. A request constitutes a representation that Offeror:
1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
 2. Will provide same warranty for Substitution as for specified product, except when inability to provide specified Warranty is reason for request for substitution as described above.
 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 5. Will reimburse the Owner and pay for all costs, including Architect/Engineer's redesign and evaluation costs resulting from the use of the proposed substitution, or for review or redesign services associated with re-approval by authorities having jurisdiction.
- G. **No substitutions will be considered after the Award of Contract.**

1.3 SUMMARY

- A. Provide all work for electrical systems required in the project to be properly installed, tested and performing their intended function.

1.4 QUALITY ASSURANCE

- A. Perform all work in accordance with the latest edition of the national electrical code, and local codes.
- B. All electrical materials and distribution, and utilization equipment shall be UL Listed.
- C. All equipment and materials shall be new and unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.
- D. Eliminate any abnormal sources of noise that are considered by the architect not to be an inherent part of the electrical systems as designed.

1.5 COORDINATION WITH OTHER TRADES

- A. Coordinate the work of this division with all other divisions to ensure that all components of the electrical system will be installed at the proper time and fit the available space.
- B. Locate and size all openings in work of other trades required for the proper installation of the electrical system components.
- C. Make all electrical connections to all equipment furnished by this division and any other division.

- D. Make all electrical connections from all 120 volt and greater dampers and switches to associated exhaust fan(s) furnished by any other division.

1.6 DRAWINGS

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the electrical equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers will be acceptable, it is the responsibility of the Contractor to determine if the equipment that Contractor proposes to furnish will fit in the space. The drawings are not intended to show exact locations of conduit and wire, or to indicate all wire terminators, connectors, conduit fittings, boxes or supports, but rather to indicate distribution, circuitry, and control.
- B. The Electrical Drawings are necessarily diagrammatic in character and cannot show every connection in detail or conduit in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. ***In all open-to-structure spaces, including those with ceiling clouds of any size, all wiring less than 120V shall be installed in conduit.*** Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- C. When the mechanical and electrical Drawings do not give exact details as to the elevation of pipe, conduit and ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Exposed conduit is generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.

1.7 SUBMITTALS

- A. Specification Review:
 - 1. Include a paragraph-by-paragraph written specification review for each product listed requiring a submittal. Denote any proposed deviations from specifications.

1.8 EXISTING CONDITIONS

- A. Do all work required to maintain electrical services to the Owner occupied portions of the building during construction.
- B. No connection to existing services or utilities shall be made without Owner's knowledge and permission. All such connections shall be planned and scheduled to minimize the length of service interruption required. Request for shutdown shall be made to Owner at least two (2) weeks in advance and shall be accompanied by detailed written schedule of activities during shutdown and list of materials required for connection and renewal of service. It shall be understood that all such service interruptions shall be made at the Owner's convenience, not the Contractor's. No increase in contract amount will be

allowed for reasons of premium time, inefficiency of operations or other considerations not calculated in original bid.

- C. All items removed shall be stored on-site. Schedule a review of the items with the Owner. Remove from site all items the Owner does not choose to keep. Deliver Owner designated items to Owner's storage facility.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
- C. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

- A. Provide allowance in bid for twenty-five 20A/1p circuits of 100 feet in length from source for miscellaneous needs during the course of construction. Include one duplex receptacle per circuit, all associated labor and all necessary accessories (conductor, conduit, supports, etc.) required for proper installation.
- B. Provide allowance in bid for twenty-five light switching circuit drops of twenty feet in length for miscellaneous needs during construction. Include one 277V light switch per circuit, all associated labor and all necessary accessories (conductor, conduit, supports, etc.) required for proper installation.
- C. Provide allowance in bid for ten additional exit signs for miscellaneous needs during construction. Include circuiting, all associated labor and all necessary accessories required for proper installation.

PART 3 - EXECUTION

3.1 EXISTING WORK

- A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- B. Provide temporary wiring and connections to maintain existing systems in service during construction.
- C. When performing work on energized equipment or circuits, use personnel experienced and trained in similar operations.
- D. Remove, relocate, and extend existing installations to accommodate new construction.
- E. Repair adjacent construction and finishes damaged during demolition and extension work.

3.2 OWNER INSTRUCTION

- A. Provide on-site Owner training for all new equipment.

- B. Use Operation and Maintenance manuals and actual equipment installed as basis for instruction.
- C. At conclusion of on-site training program have Owner personnel sign written certification they have completed training and understand equipment operation. Include copy of training certificates in final Operation and Maintenance manual submission.

END OF SECTION 26 05 00

SECTION 26 05 19 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide a complete system of building wire and cable to all electrical loads.

1.3 SYSTEM DESCRIPTION

- A. Product Requirements: Provide products as follows:
 - 1. Provide stranded conductors for all wiring.
 - 2. Conductor not smaller than 12 AWG for power and lighting circuits.
 - 3. Conductor not smaller than 16 AWG for control circuits.
 - 4. 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet
 - 5. 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.
 - 6. Copper.
- B. Wiring Methods: Provide the following wiring methods:
 - 1. Concealed Dry Interior Locations: Use only Type THHN/THWN-2 insulation, in raceway.
- C. Branch Circuit Conductors: No branch circuit conductors are allowed in any slab or under slab on grade unless specifically indicated on drawings.

1.4 COORDINATION

- A. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

- A. Manufacturers:
 - 1. Diamond Wire & Cable Co.
 - 2. Southwire
 - 3. General Cable Co.
 - 4. IUSA Wire
 - 5. Encore
- B. Product Description: Single conductor insulated wire.
- C. Conductor: Copper.
- D. Insulation: NFPA 70; Type THHN/THWN-2 insulation for feeders and branch circuits.

2.2 TYPE AC CABLE

- A. Manufacturers:
 - 1. AFC
 - 2. Southwire
- B. Product Description: A fabricated assembly of insulated conductors in a flexible metallic enclosure.
- C. Comply with NEC 320.
- D. Support, provide separate support to structure for all Type AC cable, spacing not exceeding three (3) feet and at each junction box.
- E. Provide an insulated green grounding conductor in all Type AC cable.
- F. Acceptable Use: Install, at Contractor's option, only for service to light fixtures above accessible ceilings, limit length to six (6) feet whips from accessible junction box to light fixtures.
- G. Provide insulated throat fittings at all terminations of Type AC cable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify interior of building has been protected from weather.
- B. Verify mechanical work likely to damage wire and cable has been completed.
- C. Verify raceway installation is complete and supported.

3.2 EXISTING WORK

- A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.
- B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.
- C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.
- D. Extend existing circuits using materials and methods compatible with existing electrical installations, or as specified.

3.3 INSTALLATION

- A. Route wire and cable to meet Project conditions.
- B. Neatly train and lace wiring inside boxes, equipment, and panelboards.

- C. Identify and color code wire. Identify each conductor with its circuit number or other designation indicated.
- D. Special Techniques - Wiring Connections:
 - 1. Clean conductor surfaces before installing lugs and connectors.
 - 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 - a. MDF/IDF room branch circuits: All branch circuits shall be dedicated and unspliced. Provide dedicated branch circuit 20 or 30 amperes, #10 and or #12 wire, unspliced from wiring device all the way back to the overcurrent device. Do not share ground with any other circuit.
 - b. Computer branch circuits: All branch circuits shall be dedicated. Provide dedicated branch circuit 20 amperes, #10 and or #12 wire from wiring devices all the way back to the overcurrent device. Do not share neutral with any other circuit.
 - c. Kitchen branch circuits: All branch circuits for 125 volt, single phase, 15 and 20 ampere receptacles shall be dedicated. Provide dedicated branch circuit 20 amperes, #10 and or #12 wire from wiring devices all the way back to the overcurrent device. Do not share neutral or ground with any other circuit.
 - 3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
 - 4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
 - 5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
 - 6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

3.4 WIRE COLOR

A. COLOR CODES FOR CONDUCTORS FOR BRANCH CIRCUITS AND FEEDERS

System/Phase	Wire Sizes #10 and Smaller: Use Continuous Color Coded Insulation (Note 01)				Wire Sizes #6 and Smaller: Use Continuous Color Coded Insulation (Note 02)	
	A	B	C	N	G	IG
120/208	Black	Red	Blue	White	Green	Green/Yellow Stripe
120/240	Black	Orange	Blue	White w/color stripe (Note 03)	Green	Green/Yellow Stripe
277/480	Brown	Purple	Yellow	Gray	Green	Green/Yellow Stripe

Table Notes:

- 1. Wire size #8 and larger, black conductors with color marking tape at each termination and where accessible; colors as noted above.

2. Wire sizes #4 and larger, black conductor with green marking tape at each termination and where accessible.
 3. Provide white (no stripe) insulation when 120/208V system is not present at this installation.
- B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number and provide color coding at each junction box containing more than one neutral.
- C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.
- D. Branch circuit and Feeder Circuit Conductors: Uniquely color code each phase.
- E. A green ground conductor shall be pulled in all feeders and branch circuit wiring.
- E. Ground Conductors:
For 6 AWG and smaller: Green.
For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

3.5 GROUPING OF CIRCUITS

- A. Limit the number of current carrying conductors per conduit to 6. Neutrals serving computer receptacle branch circuits shall be counted as current carrying. Grounds shall not be counted.
- B. Grouping of different voltages is not allowed.
- C. Provide metal box sizes per NEC Table 314.16 (A).
- D. Provide conduit per NEC Annex C.
- E. Neutrals serving branch circuits shall not be shared. Provide dedicated neutral per circuit.

3.6 POWER LIMITED CIRCUIT INSTALLATION

- A. Provide a complete system of raceway and covered junction boxes for all power limited circuits installed in finished spaces and spaces without a ceiling.
- B. Provide raceway for all power limited circuit wiring within wall cavities and above sheet rock, plaster and other "hard" (non-lay-in) ceiling types of construction.
- C. Labeling: Provide label on all junction boxes.
 1. Provide permanent labeling with indelible black marker, in neat, legible print indicating the system wiring name.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide a continuous low-impedance grounding system for the entire electrical wiring system.

1.3 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - 2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.
- B. NFPA 70 - National Electrical Code.

1.4 SYSTEM DESCRIPTION

- A. Grounding systems use the following elements as grounding electrodes:
 - 1. Metal underground water pipe.
 - 2. Metal building frame.
 - 3. Concrete-encased electrode.
 - 4. Ground ring.
 - 5. Rod electrode.
 - 6. Plate electrode.

1.5 SUBMITTALS

- A. Product Data: Submit data on grounding electrodes and connections.

1.6 QUALITY ASSURANCE

- A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.

1.7 GROUND RING PRE-INSTALLATION MEETINGS

- A. This paragraph shall apply to buildings when a ground ring is specified.
- B. Convene minimum one (1) week prior to commencing work of this section.

- C. Coordinate with concrete pour schedule for footings to insure rebar in concrete is available for bonding.

1.8 MADE ELECTRODE INSPECTION

- A. Convene prior to cover up of work of this section.
- B. Coordinate inspection of made electrode, exothermic welds and test well installation.

PART 2 PRODUCTS

2.1 ROD ELECTRODES

- A. Manufacturers:
 - 1. Apache Grounding/Erico Inc.
 - 2. Copperweld, Inc.
 - 3. Erico, Inc.
 - 4. O-Z Gedney Co.
 - 5. Thomas & Betts
 - 6. VFC
- B. Product Description:
 - 1. Material: Copper-clad steel
 - 2. Diameter: 3/4 inch
 - 3. Length: ten (10) feet

2.2 WIRE

- A. Material: Stranded copper.
- B. Foundation Electrodes: #2 AWG.
- C. Grounding Electrode Conductor: Copper conductor bare.
- D. Bonding Conductor: Copper conductor bare.

2.3 MECHANICAL CONNECTORS

- A. Manufacturers:
 - 1. Apache Grounding/Erico Inc.
 - 2. Copperweld, Inc.
 - 3. Erico, Inc.
 - 4. ILSCO Corporation
 - 5. O-Z Gedney Co.
 - 6. Thomas & Betts, Electrical
 - 7. VFC
- B. UL Listed for grounding applications.

- C. Provide "ACORN" style ground clamp only for all driven ground rods unless noted to be exothermic connected in this specification. UL listed for connecting ground conductor to a driven ground rod.
- D. Description: Brass connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

2.4 EXOTHERMIC CONNECTIONS

- A. Manufacturers:
 - 1. Cadweld by Erico, Inc.
- B. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

2.5 GROUNDING BUSSES

- A. When indicated, provide copper ground busses on walls in areas where special grounding needs will arise. Bus shall consist of copper bar as follows:
 - 1. Ground bar cross section of nominal four (4) inches by 1/4 inch; 24 inches length.
 - 2. Drill to accommodate NEMA Pattern D 2-hole compression lugs for ground wires to be installed. Leave remainder of bar for future drilling by owner.
 - 3. Copper compression lugs to connect conductors to the bar. Lugs shall be 2-hole type for double bolting to ground bar.
 - 4. Install all bolts for compression with top and bottom steel washers plus a Belleville spring washer between top washer and bolt head.
 - 5. Grounding electrode conductor(s) shall be fusion-welded on buss (and not lugged on).
 - 6. Mounting Free air, no enclosure required. Install Harger WBKT-1 brackets to mount bar to wall. Isolate copper bar from mounting brackets with Harger 4200-Series two (2) inch insulators.
 - 7. Fasten clear pexiglass cover on standoff bolts over ground bar. Engrave cover "GROUND BUS". Cover by Harger Lightning Protection, Inc., or approved equal.
 - 8. Ground bar assembly shall be Harger Lightning Protection, Inc. GBI Series (800-842-7437, www.harger.com), Erico, Inc. (800-248-9353) or approved equal.

2.6 DRIVEN ELECTRODE ACCESS WELL AND COVER

- A. Eight (12) inch diameter concrete pipe with belled end.
- B. 24 inches long or longer to reach ground and set flush in grade.
- C. Provide cast iron cover with "GROUND" embossed on top.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify final backfill and compaction has been completed before driving rod electrodes.

3.2 PREPARATION

- A. Remove paint, rust, mill oils, and surface contaminants at connection points.

3.3 EXISTING WORK

- A. Modify existing grounding system to maintain continuity to accommodate renovations.
- B. Extend existing grounding system using materials and methods compatible with existing electrical installations.

3.4 INSTALLATION

- A. Install in accordance with NEC Article 250. Properly bond the system neutral to the system grounding electrode conductor at the main service entrance equipment. Route the grounding electrode conductor to, and bond to, the grounding electrode system. All other neutral busses, bars, etc. on the service voltage system shall be isolated from ground. This system shall be the solid grounded type.
- B. Bond all ground electrodes together to form the grounding electrode system including metal underground water pipe, metal frame of the building or structure, concrete encased electrodes, ground ring, rod and pipe electrodes and plate electrodes.
- C. Install grounding and bonding conductors concealed from view.
- D. Install grounding electrode conductor and connect to reinforcing steel in foundation footing.
- E. Install a green equipment grounding conductor in all feeders and branch circuits, minimum size per NEC Table 250.122.
- F. Transformers: Ground as a separately derived source.
 - 1. Where transformer secondary includes a neutral, the neutral shall be bonded to the equipment enclosure and connected to the system ground conductor.
 - 2. Size bonding jumper per NEC Table 250.66.
 - 3. Grounding conductor shall be in raceway and shall be bonded to nearest available point of interior metal water piping system.
- G. Bond together reinforcing steel and metal accessories in pool and fountain structures.
- H. Concrete-Encased Electrode (NEC 250-52):
 - 1. Concrete-encased electrode is also known as the "Ufer ground". Concrete footings or foundation that are in direct contact with the earth and located at the building periphery shall be made available for use as electrodes. Designated footings shall be used for grounding purposes. Unless otherwise noted on drawings, designated footings are the perimeter building corners plus perimeter footings approximately on 100 feet centers between corners.
- I. Made Electrode:
 - 1. Triple Ground Rod: Provide a building ground rod and bond it to the electrode system. The building ground rod shall consist of three ground rods, arranged in an equilateral triangular pattern located at least five (5) feet outside an exterior building wall or as otherwise directed. Space 15 feet apart and drive into the earth to a point two (2) feet below finished grade to top of rods. Grounding electrode conductor shall form a continuous loop around rods, and conductor shall be properly bonded to each rod by a fusion weld similar to "Cadweld".

2. Extend grounding electrode conductor from this ground rod(s) to the grounded service conductor (neutral) in the building main switchboard at an accessible point on the ground bus per NEC 250-24.
 3. Install grounding electrode conductor of 3/0 Copper.
- J. Main Bonding Jumper: Shall be sized in accordance with Section 250-66, if not indicated on the drawings, and installed within the same enclosure as the point of bonding of the system neutral service entrance.
- K. Grounding Busses:
1. Provide a copper bus bar where indicated on Drawings. Provide grounding electrode conductor and connection to the grounding electrode system. AWG No. 2 minimum.
 2. Provide in each IDF and MDF room.
 3. Provide at each CATV / MATV head-end mounting board.
 4. Provide at each building communications rack.
 5. Provide at each sound reinforcement equipment rack.
- L. Water Pipe Electrode: A ten (10) foot minimum length of electrically continuous underground metal water pipe. Bond around insulating joints or sections, insulating pipe, and water meters to make pipe electrically continuous.
- M. Metal Building Frame NEC 250-52.
1. The structural steel or other metal frame of the building. Effectively ground the steel structural columns to the ground ring electrode.
 2. Cadweld AWG #2 bare copper cable to base of steel column. Route bonding jumper down through column blockout in building floor slab, excavate under grade beam, and extend out to the ground ring. Cadweld jumper (also called "stinger") or install Burndy Hyground™ Type YGHP-C hydraulic compression connector onto ground ring. Install a ground rod at each point where a stinger from a building steel column lands on the ground ring.
- N. Ground Ring Electrode (NEC 250-52):
1. Provide a tinned, bare copper conductor, size AWG #2 or larger, ground loop in direct contact with the earth. Install around and below the entire periphery of the building at least 36 inches underground. The ring conductor shall be in direct contact with the earth and below any concrete mat or seal slab that may be part of the building structural foundation. Bond this ground ring to all other electrodes and to the grounded service conductor (neutral) in the building main switchboard at a point on the supply side of each service disconnect.
- O. Fuel Gas Piping:
1. Each above ground portion of a gas piping system upstream from the equipment shutoff valve shall be made electrical continuous and bonded to the building grounding electrode system, as required in NFPA 54, National Fuel Gas Code.
 2. Gas piping shall not be used as a grounding electrode.
- P. Engine Generator Neutral:
1. Ground the generator neutral as a separately derived system per NEC 250-20(d).
 2. Sign: Provide a sign at the service entrance equipment indicating type and location of on-site generator.
- Q. Outdoor Lighting Poles:
1. All metallic outdoor poles and luminaries on metallic or non-metallic lighting poles shall be grounded by bonding in an approved manner to the circuit grounding conductor. In addition to this, bond pole to a #8 bare copper wire which shall

also be bonded to a ground rod. Install the ground rod adjacent to the pole base with the top driven at least two (2) feet below grade.

3.5 OTHER GROUNDING SYSTEMS:

- A. General Check the drawings for special grounding system or grounding requirements.
- B. Telephone and data equipment grounding connections:
 - 1. Bond each telephone and data equipment ground (buss type or grounding conductor type) at each telephone terminal board and data rack back to the service entrance grounding electrode system with a bare #6awg ground wire.
- C. Other Buildings Served From Common Service:
 - 1. The main building service is the source for electric service to several out buildings on site.
 - 2. Isolate neutral bus from ground at each out-building main panel.
 - 3. Provide an equipment grounding conductor in feeder to each out-building main panel.
 - 4. Provide a local building ground rod at each out-building. Bond at least one building column footing to the ground rod.
 - 5. Bond grounding conductor of building main feeder to grounding electrode system established at the particular building.

3.6 EQUIPMENT GROUNDING SYSTEM

- A. General: Make a firm bond between all enclosures, equipment and metallic raceway system. Grounding conductors shall be continuous from origin to termination and properly bonded with lugs at both ends. The metallic raceway systems shall be made up properly to form a grounding path that has an impedance back to the main system ground that is as low as can be practically obtained.
- B. Over 250 Volts: Provide locknuts and/or listed fittings per NEC 250-97 for bonding of metal raceways in all circuits of over 250 Volts to ground. In case of oversized, concentric or eccentric knockouts, comply with NEC 250-92(B). The use of snap-in, wedge-type, or pivot-type connectors is prohibited.

3.7 FIELD QUALITY CONTROL

- A. Grounding Tests:
 - 1. Test the electrical system after installation is complete. Inspect and test for stray currents, unintended ground shorts, and proper physical condition of grounding system. Correct any deficiencies and re-test to verify satisfactory installation.
 - 2. Provide written test report to document all findings, test values, work done and certification of grounding system.
 - 3. Use true-RMS meters for all voltage and current measurements.
 - 4. Test telecommunications grounding riser to verify continuity.
 - 5. Check all isolated ground receptacles for correct polarity.
 - 6. Test all sub panels of separately derives systems to verify subpanel neutral is isolated from ground.
 - 7. Test theater isolated power system for the sound reinforcement system to verify isolation of ground system from other building systems.
 - 8. Verify continuity and isolation of audio system ground bus and grounding riser.
 - 9. Perform ground resistance and continuity testing in accordance with IEEE 142.
 - 10. When improper grounding is found on receptacle, check receptacles in entire project and correct. Perform retest.

3.8 TEST WELLS

- A. Install test well for designated outdoor driven ground rods. Set tops of well flush with finished grade. Provide mechanical connector for ground rod inside test well so that rod can be disconnected from ground ring or other grounding electrode system for testing.
 - 1. Designated Ground Rods:
 - a. One (1) at triple ground rod for High School Main Switchboard Electrical Room.
 - b. One (1) at each generator.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 1. Conduit supports.
 2. Formed steel channel.
 3. Spring steel clips.
 4. Sleeves.
 5. Mechanical sleeve seals.
 6. Firestopping relating to electrical work.
 7. Firestopping accessories.
 8. Equipment bases and supports.

1.3 REFERENCES

- A. Underwriters Laboratories Inc.:
 1. UL 263 - Fire Tests of Building Construction and Materials.
 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
 3. UL 1479 - Fire Tests of Through-Penetration Firestops.
 4. UL - Fire Resistance Directory.

1.4 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.5 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to Building Code and UL for fire resistance ratings and surface burning characteristics.

1.6 SUBMITTALS

- A. Product Data:
 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with the Building Code.

PART 2 - PRODUCTS

2.1 CONDUIT SUPPORTS

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. Electroline Manufacturing Company
 - 3. O-Z Gedney Co.
 - 4. Appleton
- B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.
- C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.
- D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.
- E. Conduit clamps - general purpose: One hole malleable iron for surface mounted conduits.
- F. Cable Ties: High strength nylon temperature rated to 185 degrees F. Self locking.

2.2 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. B-Line Systems
 - 3. Midland Ross Corporation, Electrical Products Division
 - 4. Unistrut Corp.
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.3 SLEEVES

- A. Sleeves for raceway Through Non-fire Rated Floors: 18 gage galvanized steel.
- B. Sleeves for raceway Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage galvanized steel.
- C. Sleeves for raceway Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL Listed.
- D. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.4 SPRING STEEL CLIPS

- A. Product Description: Mounting clamp, and screw.

2.5 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline Link-Seal, Inc.
 - 2. NMP Corporation

- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FIRESTOPPING

- A. Manufacturers:
 - 1. Dow Corning Corp.
 - 2. Fire Trak Corp.
 - 3. Hilti Corp.
 - 4. International Protective Coating Corp.
 - 5. 3M fire Protection Products .
 - 6. Specified Technology, Inc.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam Firestopping Compounds: Multiple component foam compound.
 - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral or ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 - 7. Firestop Pillows: Formed mineral fiber pillows.

2.7 FIRESTOPPING ACCESSORIES

- A. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- B. General:
 - 1. Furnish UL Listed products.
 - 2. Select products with rating not less than rating of wall or floor being penetrated.
- C. Non-Rated Surfaces:
 - 1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
 - 2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive sleeves.
- B. Verify openings are ready to receive firestopping.

3.2 INSTALLATION - HANGERS AND SUPPORTS

- A. Anchors and Fasteners:
 - 1. Concrete Structural Elements: Provide precast inserts, expansion anchors, powder actuated anchors or preset inserts as required.
 - 2. Steel Structural Elements: Provide beam clamps, spring steel clips, steel ramset fasteners or welded fasteners as required.
 - 3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors as required.
 - 4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts or hollow wall fasteners as required.
 - 5. Solid Masonry Walls: Provide expansion anchors or preset inserts as required.
 - 6. Sheet Metal: Provide sheet metal screws.
 - 7. Wood Elements: Provide wood screws.

- B. Inserts:
 - 1. Install inserts for placement in concrete forms.
 - 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over four (4) inches.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

- C. Install conduit and raceway support and spacing in accordance with NEC.

- D. Do not fasten supports to suspended ceiling support system, pipes, ducts, mechanical equipment, or conduit.

- E. Install multiple conduit runs on common hangers.

- F. Supports:
 - 1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
 - 2. Install surface mounted cabinets and panelboards with minimum of four anchors.
 - 3. In wet and damp locations install steel channel supports to stand cabinets and panelboards one (1) inch off wall.
 - 4. Support vertical conduit at every floor.

3.3 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.

- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating.

- D. Compress fibered material to maximum 40 percent of its uncompressed size.

- E. Place intumescent coating in sufficient coats to achieve rating required.
- F. Remove dam material after firestopping material has cured.
- G. Fire Rated Surface:
 - 1. Seal opening at all rated floors and walls as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL Listed fire resistive silicone compound to meet fire rating of structure penetrated.
 - 2. Where cable tray, bus, or conduit, penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.
- H. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated floors and walls as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Install type of firestopping material recommended by manufacturer.
 - 2. Install escutcheons where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - 3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.

3.4 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Provide mechanical sleeve seals.
- B. Interior conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Extend sleeves through floors and walls one (1) inch above finished floor level. Caulk sleeves.

END OF SECTION 26 05 29

SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. Section includes conduit and tubing, wireways, outlet boxes, pull and junction boxes, and

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
 - 2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
 - 3. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - 6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 - 7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 SYSTEM DESCRIPTION

- A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.
- B. Wet and Damp Locations: Provide rigid steel conduit. Provide cast metal junction and pull boxes. Provide flush mounting outlet box in finished areas.
- C. Concealed Dry Locations: Provide rigid steel intermediate metal conduit on electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.
- D. Exposed Dry Locations: Provide rigid steel conduit, intermediate metal conduit or electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

- E. In Slab or Under Slab on Grade: No branch circuit raceway is allowed in any slab or under slab on grade unless specifically indicated on drawings.

1.4 DESIGN REQUIREMENTS

- A. Minimum Raceway Size: 3/4 inch.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- B. Protect PVC conduit from sunlight.

1.6 COORDINATION

- A. Coordinate installation of outlet boxes and raceway for equipment connected under other Divisions.
- B. Coordinate installation of conduit for control wiring in mechanical rooms and in inaccessible locations such as walls and hard ceilings.
- C. Coordinate installation of conduit for all other low-voltage systems in inaccessible locations and all other locations required by drawings or specifications for those systems.
- D. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes. Refer to Architectural elevations and equipment specifications and coordinate device locations prior to electrical rough-in.

PART 2 - PRODUCTS

2.1 METAL CONDUIT

- A. Manufacturers:
 - 1. Carlon Electrical Products
 - 2. Hubbell Wiring Devices
 - 3. Thomas & Betts Corp
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Multi Cell
 - 7. O-Z Gedney
 - 8. Raco.
 - 9. or approved equal.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Intermediate Metal Conduit (IMC): Rigid steel.
- D. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit
- E. Electrical Metal Tubing (EMT): All EMT fittings shall be steel not die-cast metal. All conduit stub-ups above ceiling for low voltage and data to be provided with insulating bushing.

- F. Flexible Metal Conduit (Flex): Conduit fittings shall be steel. Provide plastic anti-short bushing for all flex fittings. Comply with NEC 348.
- G. Liquidtight Flexible Metal Conduit: Shall be same as flexible metal conduit specified above except Article 350 in NEC.
- H. PVC-Coated Rigid Steel Conduit: Galvanized rigid steel with additional external coating for 40 mil polyvinyl chloride jacket (PVC). Conforming to UL Standard 6. ANSI C80.1 and NEMA Standard No. RN.1.
 - 1. Manufacturer:
 - a. Ocal Inc.
 - b. Perma Cote Industries
 - c. Rob-Roy Industries
 - d. or Approved equal.
- I. PVC-Rigid Nonmetallic Conduit: PVC and fittings that are listed per the UL Standards. Comply with NEMA Standard TC-2.
- J. Nonmetallic Multi Duct: Provide nonmetallic multi duct that is UL Listed.
 - 1. Type: four (4) inches schedule 40 PVC outer duct, four 1.25 inch ducts of ribbed polyethylene. Duct shall have six (6) inch deep end bell on one end, spigot on the other end.
 - 2. Multi Duct shall have gaskets to seal the inside and outside walls of the inner duct.

2.2 ENCLOSURES

- A. Pull Boxes, Junction Boxes, Cabinets, and Wireways: Provide pull boxes, junction boxes, wireways, and cabinets wherever necessary for proper installation of various electrical systems according to the National Electrical Code and where indicated on the Drawings.
- B. Minimum Size: That size shown on the drawings, as required for the specific function, or as required by the National Electrical Code, whichever is larger.
- C. Construction:
 - 1. Indoors in Dry Areas and Not Buried in Slab: Code gage steel - NEMA 1 construction - sides formed and welded, screw covers unless indicated hinged cover or door on drawings. Hinged doors shall be similar to panelboard doors with the same type locking device. Knockouts shall be factory made or formed O-Z Gedney Type PB or approved equal.
 - 2. Outdoors or Indoors in Wet Areas and Not Buried in Slab: Same as specified above for indoor except provide NEMA 3R (designated by 3R or RT) unless indicated or specified to be NEMA 4 (designated by 4 or WP) or other type rating.
 - 3. Indoors Buried in Slab: Watertight, galvanized cast iron in floors on or below grade, otherwise concrete tight stamped steel.
 - 4. Outdoors Buried in Earth: Watertight, Polymer concrete similar to Hubbell Power System, Inc. "Quazite" or precast concrete type manufactured by Brooks Product, Inc brand for Oldcastle Precast, Inc. Precast box shall have appropriate structural rating for intended use. Install on a level poured concrete base to provide a solid bearing surface. Provide a bolted cast iron traffic cover with foundry-cast marking "Electrical", "Communications" or "Telephone" as applies. Top of enclosure shall be one (1) inch above finished grade in earth. Top of enclosure shall be flush with finished pavement.

2.2 WIREWAY

- A. Manufacturers: Same as Metal Conduit.

- B. Product Description: General purpose.
- C. Size: As determined by Contractor in accordance with NEC 376.
- D. Cover: Screw cover.
- E. Connector: Slip-in.
- F. Fittings: Lay-in type.
- G. Finish: Rust inhibiting primer coating with gray enamel finish.

2.3 OUTLET BOXES

- A. Manufacturers: Same as Metal Conduit.
- B. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.
 - 2. Concrete Ceiling Boxes: Concrete type.
- C. Cast Boxes: NEMA FB 1, Type FD, cast fer alloy. Furnish gasketed cover by box manufacturer.
- D. Wall Plates: As specified in Section 26 27 26.

2.4 FLOOR BOXES

- A. UL listed for wet application, watertight cast-iron, scrub-shield compliant.
- B. NEMA OS-1, sheet steel outlet boxes, device boxes, covers, and box supports.
 - 1. Floor: Fully adjustable before and after pour.
 - 2. UL Listed for wet application when installed into concrete, stone, tile or floor without carpet cover. Provide carpet flange where installed in carpet.
 - 3. Provide watertight, cast iron on floors at or below grade, and provide concrete tight stamped steel on all upper floors.
 - 4. Multi Gang Floor Box: Fully adjustable watertight cast iron gang floor boxes where shown on Drawings. Provide with removable partition and provide conduit openings in boxes as required. Install power circuits in separate raceway from data, telephone or other signal.
- C. Manufacturers:
 - 1. Appleton
 - 2. Carlon
 - 3. Crouse-Hinds
 - 4. Hubbell
 - 5. FSR
 - 6. Wiremold/Legrand

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 INSTALLATION - RACEWAY

- A. Ground and bond raceway and boxes in accordance with Section 26 05 26.
- B. Fasten raceway and box supports to structure and finishes in accordance with Section 26 25 29.
- C. Identify raceway and boxes in accordance with Section 26 05 53.
- D. Arrange raceway and boxes to maintain headroom and present neat appearance.
- E. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
- F. Arrange raceway supports to prevent misalignment during wiring installation.
- G. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- H. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29.
- I. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports
- J. Do not attach raceway to ceiling support wires or other piping systems.
- K. Construct wireway supports from steel channel specified in Section 26 25 29.
- L. Route exposed raceway parallel and perpendicular to walls.
- M. Route raceway installed above accessible ceilings parallel and perpendicular to walls.
- N. Maximum Size Conduit in Slab Above Grade: 3/4 inch.
- O. Maintain clearance between raceway and piping for maintenance purposes.
- P. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees Fahrenheit.
- Q. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- R. Bring conduit to shoulder of fittings; fasten securely.
- S. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.
- T. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes. DO NOT route conduit through the top of any outdoor disconnects, panels, etc. conduits must be routed through side or bottom only.
- U. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install hydraulic one-shot bender to fabricate factory elbows for bends in metal conduit larger than two (2) inch size.

- V. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
- W. Install fittings to accommodate expansion and deflection where raceway crosses expansion joints.
- X. Install suitable pull string or cord in each empty raceway except sleeves and nipples.
- Y. Install suitable caps to protect installed conduit against entrance of dirt and moisture.
- Z. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.
- AA. Close ends and unused openings in wireway.
- BB. Provide tracer wire on all underground raceway outside building slab on grade.

3.3 RACEWAY TYPES

- A. The following raceway types are to be used in the following locations:
 - 1. Under Slab on Grade: Schedule 40 PVC.
 - 2. Outdoor Locations, Above Grade: Rigid galvanized steel.
 - 3. Wet and Damp Locations: Rigid galvanized steel.
 - 4. Exposed or Concealed Dry Locations, Indoors: EMT, IMC, or rigid galvanized steel.
 - 5. Underground:
 - a. All underground electrical wire in schedule 40 PVC or rigid galvanized steel, 208 volts or greater shall be encased in red concrete two (2) inches thick on all sides. Encasement not required under building slabs, parking lots or other paved surfaces. Red dye may not be applied to the top of the concrete.
 - b. All underground electrical wire in schedule 40 PVC or rigid galvanized steel, 120 volts or less shall have red warning tape 6" above raceway.
 - 6. Transformers and Motors: 24 inch flexible metal conduit to equipment.
 - 7. Kitchens and outdoor motor and transformer connections: Liquidtight flexible metal conduit for all exposed raceway.
 - 8. Cooling Towers: PVC coated rigid galvanized steel within 50 feet of tower.

3.4 INSTALLATION - BOXES

- A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings and as approved by the Architect.
- B. Adjust box location up to ten (10) feet prior to rough-in to accommodate intended purpose.
- C. Orient boxes to accommodate wiring devices oriented as specified in Section 126 27 26.
- D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- F. Do not fasten boxes to ceiling support wires or other piping systems.

- G. Support boxes independently of conduit. Provide rigid support to structure for all junction boxes. Mount junction boxes within 18" of finished ceilings to facilitate future access. Locate junction boxes to allow ready access to junction box covers without removing any equipment.
- H. All outdoor boxes shall be UL listed for wet location service.
- I. Provide rigid support to structure for all junction boxes.
- J. Provide rigid support to structure for all conduit within 3 feet of each junction box and a maximum spacing of 10 feet.
- K. Install junction boxes above ceilings in readily accessible with no obstructions, locate within 18 inches of finished ceiling to facilitate easy access.
- L. For all flexible whips to light fixtures provide wire support at mid-length of whip to structure above with UL listed conduit support clip.
- M. Provide outlet boxes to meet depth requirement of Architectural walls. Refer to Architectural Spec Section 09250 and 10611 for wall partitions.

3.5 ADJUSTING

- A. Install knockout closures in unused openings in boxes.

3.6 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.
- B. Clean exposed surfaces and restore finish.

3.7 INSTALLATION - FLOOR BOXES

- A. Use cast floor boxes for installation in slab on grade.
- B. Set floor boxes level.
- C. Install boxes and fittings to preserve fire resistant rating of slabs and other elements, using materials and methods specified in Section 26 05 29.

3.8 ADJUSTING

- A. Adjust floor box flush with finish material.

3.9 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.

3.11 ABOVE CEILING JUNCTION BOXES

- A. Labeling: Provide label on all above ceiling junction boxes.
 - 1. Provide permanent labeling with indelible black marker, in neat, legible print indicating the panelboard name, branch circuit number(s) and voltage of conductors within the junction box. Junction boxes used for emergency power circuits to be painted red.

- B. Color Code: All Electrical junction boxes above ceiling shall be colored as follows.
1. Yellow for 277V lighting
 2. Blue for 120V regular power
 3. Green for 120V computer power
 4. Brown for 277/480V equipment
 5. Red for emergency power

END OF SECTION 26 05 33

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Underground Warning Tape.
 - 3. Lockout Devices.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of electrical identification, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and standards: Comply with the following:
 - 1. National Electrical Code, NFPA No. 70.
 - 2. NEMA standards applicable to the product provided.
 - 3. UL standards applicable to the product provided.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to the following:
 - 1. Panduit Corp.
 - 2. American Labelmark Co.
 - 3. Markal Corp.
 - 4. Calpico, Inc.
 - 5. Ideal Industries, Inc.

2.2 NAMEPLATES

- A. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.
- B. Emergency Power panels and Equipment: Laminated three-layer plastic with engraved white letters on **RED** background.
- C. Letter Size:
 - 1. 1/4 inch high letters for identifying individual equipment and loads.
- D. Minimum nameplate thickness: 1/8 inch.

2.3 UNDERGROUND WARNING TAPE

- A. Description: four (4) inch wide plastic tape, colored red with suitable warning legend describing buried electrical lines.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

- A. Install identifying devices after completion of painting.
- B. Nameplate Installation:
 - 1. Install nameplate parallel to equipment lines.
 - 2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
 - 3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.
 - 4. Secure nameplate to equipment front using screws, rivets, or adhesive.
 - 5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
 - 6. Install nameplates for the following:
 - a. Switchboards
 - b. Panelboards
 - c. Transformers
 - d. Service Disconnects
 - 1) Enclosed Switches
 - e. Motor Control Centers
 - f. Stand-alone Motor Controllers
 - g. Generators
 - h. Contactors
- C. Underground Warning Tape Installation:
 - 1. Install underground warning tape along length of each underground conduit, raceway, or cable six (6) to eight (8) inches below finished grade, directly above buried conduit, raceway, or cable. Where multiple lines installed in a common trench or concrete envelope, do not exceed an overall width of 16 inches; install a single line marker.
 - 2. Install line marker for underground wiring, both direct buried and in raceway.
- D. Printed Panelboard Directory:
 - 1. Provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker for that panel, switchboard, or motor control center.
 - 2. Panelboard directory shall include a legend indicating insulation color corresponding each phase and voltage in the building electrical system.
 - 3. Copy in Owner's Manual.

3.3 ABOVE CEILING JUNCTION BOXES

- A. Labeling: Provide label on all above ceiling junction boxes.
 - 1. Provide permanent labeling with indelible black marker, in neat, legible print indicating the panelboard name, branch circuit number(s) and voltage of conductors within the junction box. Junction boxes used for emergency power circuits to be painted red.

3.4 ARC FLASH WARNING LABEL

- A. Switchboards, panel boards and motor control centers requiring examination, adjustments, servicing or maintenance while energized shall be field marked to warn persons of arc flash hazards. Marking shall be located so as to be clearly visible to qualified persons before servicing or maintenance.

END OF SECTION 26 05 53

SECTION 26 05 73.19 - ARC-FLASH HAZARD ANALYSIS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard boundary distance and the incident energy to which personnel could be exposed during work on or near energized electrical equipment.

1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- D. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- E. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- F. SCCR: Short-circuit current rating.
- G. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- H. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS

- A. Product Data: Submit information regarding computer software program to be used for studies.
- B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals **[shall] [may]** be in digital form:

1. Arc-flash study report; signed, dated, and sealed by Power Systems Analysis Specialist.
2. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
3. Exported data from computer-based, one-line diagram detailing the system data used for the arc-flash calculations, provided in .csv or Microsoft Excel format.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
 1. For Power Systems Analysis Software Developer.
 2. For Power System Analysis Specialist.
- B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.6 CLOSEOUT SUBMITTALS

- A. Arc-Flash Hazard Analysis:
 1. Provide final arc-flash hazard analysis report in hard copy and digital format.
 2. Provide digital file containing electrical system model in a format consistent with power system analysis software used to perform study.
 3. Provide library files for power system analysis software used to perform study.

1.7 QUALITY ASSURANCE

- A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
- D. Power System Analysis Software Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 1. Computer program shall be designed to perform arc-flash analysis.
- E. Power Systems Analysis Specialist Qualifications: Professional or qualified engineer in charge of performing the arc-flash study, analyzing the arc-flash results, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional or qualified engineer.
- F. Arc-Flash Study Certification: Arc-Flash Study Report shall be signed and sealed by Power Systems Analysis Specialist.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide software developed and sold by EasyPower software with ANSI ShortCircuit, ArcFlash, PowerProtector, Scenario Manager, SmartDuty and SmartBreaker or comparable product by one of the following:
 - 1. CGI CYME.
 - 2. Power Analytics, Corporation.
 - 3. <Insert manufacturer's name>.
- B. Software must provide results consistent with the requirements of the latest versions of IEEE 1584 and NFPA 70E.
- C. Software capable of creation and storage of unlimited number of operating scenarios. All scenarios stored in the same project model file. System changes made to the base case automatically propagated to each operating scenario.

2.2 ARC-FLASH STUDY REPORT CONTENT

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram, indicating the following:
 - 1. Protective device designations, locations, and ampere ratings.
 - 2. Conductor types, sizes, and lengths.
 - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 - 4. Motor and generator ratings.
 - 5. Switchgear, switchboard, motor-control center, and panelboard designations.
 - 6. Utility sources.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Equipment Duty Report: As specified in Section 260573.13 "Short-Circuit Studies."
- F. Data on all protective devices; manufacturers, types, sizes and adjustable settings that were used for the arc-flash calculations.
- G. List of protective devices found to be inoperable or with signs of impending failure. These devices must be clearly listed and excluded from use in determination of the arc time.
- H. Equipment Duty Study: Report to verify that all protective devices have adequate short-circuit ratings to interrupt the calculated maximum short-circuit current.
- I. Arc-Flash Study Calculations and Output Reports:
 - 1. Arcing fault magnitude.
 - 2. Protective device clearing time.
 - 3. Duration of arc.
 - 4. Arc-flash boundary.
 - 5. Restricted approach boundary.
 - 6. Limited approach boundary.

7. Working distance.
 8. Incident energy.
- J. Arc-Flash Study input data, scenario descriptions, and arc-flash calculations including a definition of terms and guide for interpretation of the arc-flash hazard report. Study input data must be provided in electronic form as .csv or Excel files.

2.3 ARC-FLASH WARNING LABELS

- A. Provide a weatherproof, self-adhesive equipment label for each location requiring arc-flash hazard identification.
1. Minimum Size: 6 inches (150 mm) wide by 4 inches (100 mm) high.
 2. Sample label submitted for review prior to printing of actual labels.
- B. Content: Orange header with the wording, "WARNING, ARC-FLASH HAZARD, Arc-Flash and Shock Risk Assessment, Appropriate PPE Required." and the following information taken directly from the arc-flash hazard analysis:
1. Equipment ID.
 2. Nominal voltage.
 3. Protection boundaries.
 - a. Arc-flash boundary.
 - b. Restricted approach boundary.
 - c. Limited approach boundary.
 4. Available incident energy.
 5. Working distance.
 6. Engineering report number, revision number, and issue date.
- C. Completely machine printed, no field-applied markings.
- D. Compliance: NFPA 70E.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project electrical equipment submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study. The report shall clearly state any assumptions that were necessary to complete the analysis.

3.2 ARC-FLASH HAZARD ANALYSIS

- A. Comply with the latest versions of NFPA 70E for the arc-flash hazard analysis study.
- B. Study all operating scenarios to determine the maximum incident energy at each location.
- C. Submit proposed arc-flash analysis scenarios for review prior to performing arc-flash calculations. Arc-flash hazard analysis report shall indicate which scenario created the maximum arc-flash energy for each location. All arc-flash calculations must be performed in accordance with the procedures and recommendations contained in the latest version of IEEE 1584. Calculate the arc-flash hazard boundary and incident energy at all

locations in electrical distribution system where personnel could service or examine equipment while energized.

- D. Include all three-phase medium- and low-voltage equipment locations.
- E. Calculate the limited and restricted approach boundaries for each location.
- F. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources or fault current that changes with time during the fault. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented based on the recommendations in IEEE 399 and ANSI C37 where applicable.
- G. Arc-flash energy shall generally be reported for the maximum of line or load side of a circuit breaker. However, arc-flash computation shall be performed and reported for both line and load side of a circuit breaker as follows:
 - 1. When the circuit breaker is in a separate enclosure.
 - 2. When the line terminals of the circuit breaker are separate from the work location.
- H. Base arc-flash calculations on the time-current curve or operating time of the fastest upstream device using the predicted arcing current through that device. For medium-voltage circuit breakers, the breaker interrupting time must be automatically added to the relay operating time. Based on the recommendations in IEEE 1584 and sound engineering judgment, a maximum arc time of two seconds can be applied for situations where the protective device operating time is found to exceed two seconds.

3.3 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the arc-flash hazard analysis.
 - 1. Verify completeness of data supplied on one-line diagram on Drawings. Call any discrepancies or missing information to Owner's attention.
 - 2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.
 - 3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers.
- B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer. Data shall include, but are not limited to, the following:
 - 1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Obtain electrical power utility impedance or available short-circuit current at each service.
 - 3. Short-circuit current at each system bus (three phase and line to ground).
 - 4. Voltage level at each bus.
 - 5. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio if available, tap settings, and phase shift.

6. For reactors, provide manufacturer and model designation, voltage rating and impedance.
7. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, short-circuit rating, continuous current rating, and settings for all adjustable settings.
8. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
9. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
10. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
11. Motor horsepower.
12. Low-voltage conductor sizes, lengths, number, conductor material, and conduit material.
13. Medium-voltage conductor sizes, lengths, conductor material, conductor construction and metallic shield performance parameters, and conduit material.

3.4 LABELING

- A. Apply one arc-flash label on the front cover of each section of the equipment and one on side or rear covers with accessible live parts and hinged doors or removable plates for each equipment included in the study. Base arc-flash label data on highest values calculated at each location.
- B. Each piece of equipment listed below shall have an arc-flash label applied to it:
 1. Motor-control center.
 2. Low-voltage switchboard.
 3. Switchgear.
 4. Medium-voltage switch.
 5. Low voltage transformers.
 6. Panelboard.
 7. Safety switch.
 8. Fused disconnect switch.
 9. Enclosed circuit breaker.
 10. Adjustable frequency drive.
 11. Control panel.

3.5 APPLICATION OF WARNING LABELS

- A. Install arc-flash warning labels under the direct supervision and control of Power System Analysis Specialist.

3.6 DEMONSTRATION

- A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in potential arc-flash hazards associated with working on energized equipment and the interpretation of arc-flash warning labels.

END OF SECTION 26 05 73.19

SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 26.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the owner will manage the commissioning process.

1.3 RELATED WORK

- A. Section 01 00 00 GENERAL REQUIREMENTS.
- B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

1.4 SUMMARY

- A. This Section includes requirements for commissioning the Facility electrical systems, related subsystems and related equipment. This Section supplements the general requirements specified in Section 01 91 00 General Commissioning Requirements.
- B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.5 DEFINITIONS

- A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.6 COMMISSIONED SYSTEMS

- A. Commissioning of a system or systems specified in Division 26 is part of the construction process. Documentation and testing of these systems, as well as training of the OWNER's Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 and of Division 26, is required in cooperation with the OWNER and the Commissioning Agent.
- B. The Facility electrical systems commissioning will include the systems listed in Section 01 91 00 General Commissioning Requirements:

1.7 SUBMITTALS

- A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the OWNER prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.
- B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 CONSTRUCTION INSPECTIONS

- A. Commissioning of Electrical systems will require inspection of individual elements of the electrical systems construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 91 00 and the Commissioning plan to schedule electrical systems inspections as required to support the Commissioning Process.

3.2 PRE-FUNCTIONAL CHECKLISTS

- A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the OWNER and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.3 CONTRACTORS TESTS

- A. Contractor tests as required by other sections of Division 26 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All

testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

- A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

3.4 TRAINING OF OWNER PERSONNEL

- A. Training of the OWNER operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 91 00. The instruction shall be scheduled in coordination with the OWNER Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 26 Sections for additional Contractor training requirements.

END OF SECTION 26 08 00

SECTION 26 09 43 - DIGITAL LIGHTING CONTROLS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Digital Occupancy and Daylighting Sensor Control
 - 2. Emergency Lighting Control
- B. Related Section
 - 1. Section 260926 – Lighting Control Panel Boards: Lighting panels (switching) controlled by Digital Network Lighting Control System.
 - 2. Section 260936 – Modular Dimming Controls: Digital Lighting Management
 - 3. Section 262726 - Wiring Devices: Receptacles
 - 4. Section 265113 – Interior Lighting Fixtures, Lamps, and Ballasts: Fluorescent electronic dimming ballasts.
 - 5. Section 25000 – Integrated Automation Building integrator shall provide integration of the lighting control system with Building Automation Systems.
 - 6. Drawings and general provision of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section
 - 7. Electrical Sections, including wiring devices, apply to the work of this Section.
- C. Control Intent – Control Intent includes, but is not limited to:
 - 1. Defaults and initial calibration settings for such items as time delay, sensitivity, fade rates, etc.
 - 2. Initial sensor and switching zones
 - 3. Initial time switch settings
 - 4. Task lighting and receptacle controls
 - 5. Emergency Lighting control

1.3 REFERENCES

- A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE)
- B. Underwriter Laboratories of Canada (ULC)
- C. International Electrotechnical Commission
- D. International Organization for Standardization (ISO)
- E. National Electrical Manufacturers Association (NEMA)
- F. WD1 (R2005) - General Color Requirements for Wiring Devices.
- G. Underwriters Laboratories, Inc. (UL)
 - 1. 916 – Energy Management Equipment.
 - 2. 924 – Emergency Lighting

1.4 SYSTEM DESCRIPTION & OPERATION

- A. The Lighting Control and Automation system as defined under this section covers the following equipment:
1. Digital Room Controllers – Self-configuring, digitally addressable one, two or three relays controllers with **integral current thyristor**, 0-10 volt control for ballasts.
 2. Digital Occupancy Sensors – Self-configuring, digitally addressable and calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications.
 3. Digital Switches – Self-configuring, digitally addressable pushbutton switches, dimmers, and scene switches with two-way active infrared (IR) communications.
 4. Digital Photosensors – Single-zone closed loop and multi-zone open loop daylighting sensors with two-way active infrared (IR) communications can provide switching or dimming control for daylight harvesting.
 5. Configuration Tools – Handheld remote for room configuration provides two way infrared (IR) communications to digital devices and allows complete configuration and reconfiguration of the device / room from up to 30 feet away. Unit to have Organic LED display, simple pushbutton interface, and allow send and receive of room variables and store of occupancy sensor settings. Computer software also customizes room settings.
 6. Handheld remotes for personal control – One-button dimming, two-button on/off, or five-button scene remotes provide control using infrared communications. Remote may be configured in the field to control selected loads or scenes without special tools.
 7. Digital Lighting Management (DLM) local network – Free topology, plug-in wiring system (Cat 5e) for power and data to room devices.
 8. Network Bridge – provides BACnet MS/TP-compliant digital networked communication between rooms, panels and the Segment Manager or building automation system (BAS).
 9. Segment Manager – provides web browser-based user interface for system control, scheduling, power monitoring, room device parameter administration and reporting.
 10. Emergency Lighting Control Unit (ELCU) – allows a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building

1.5 SUBMITTALS

- A. Submittals Package: Submit the shop drawings, and the product data specified below at the same time as a package.
- B. Shop Drawings:
1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed (standard diagrams will not be accepted).
 2. Scale drawing for each area showing exact location of each sensor, room controller, and digital switch.
- C. Product Data: Catalog sheets, specifications and installation instructions.
- D. Include data for each device which:
1. Indicates where sensor is proposed to be installed.
 2. Prove that the sensor is suitable for the proposed application.

1.6 QUALITY ASSURANCE

- A. Manufacturer: Minimum [10] years' experience in manufacture of lighting controls. Provide list of (5) projects that have been complete for more than (1) year within 100 miles of new project location.

1.7 PROJECT CONDITIONS

- A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
 - 1. Ambient temperature: 0° to 40° C (32° to 104° F).
 - 2. Relative humidity: Maximum 90 percent, non-condensing.

1.8 WARRANTY

- A. Provide a five year complete manufacturer's warranty on all products to be free of manufacturers' defects.

1.9 MAINTENANCE

- A. Spare Parts:
 - 1. Provide 5 spares of each product listed below to be used for maintenance. Electrical contractor shall deliver items to PAISD maintenance within 30 days of substantial completion.
 - a. Room Controllers
 - b. Occupancy Sensors
 - c. Emergency Bypass controllers
 - d. Low voltage switches
 - e. Daylighting harvesting photocells

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer:
 - 1. WattStopper DLM (basis of design)
 - 2. Acuity – nLight
 - 3. Eaton Corporation, PLC – System - Greengate

2.2 SINGLE / DUAL RELAY WALL SWITCH OCCUPANCY SENSORS

- A. Type PW: Manual-ON, Automatic-OFF passive infrared (PIR) wall switch occupancy sensor
Furnish the Company's model which suits the electrical system parameters, and accommodates the square-foot coverage and wattage requirement for each area (and type of lighting) controlled; WattStopper PW-100, PW-200, PW-103, PW-203, PW-301, PW-302, WS-301.
- B. Type UW: Manual-ON, Automatic-OFF ultrasonic wall switch occupancy sensor with
Furnish the Company's model which suits the electrical system parameters, and accommodates the square-foot coverage and wattage requirement for each area (and type of lighting) controlled; WattStopper UW-100, UW-200.

- C. Type DW: Manual-ON, Automatic-OFF dual technology (passive infrared and ultrasonic) wall switch occupancy sensor. Furnish the Company's model which suits the electrical system parameters, and accommodates the square-foot coverage and wattage requirement for each area (and type of lighting) controlled; WattStopper DW-100, DW-200, DW-103, DW-203, DW-311, DSW-100, DSW-200, DW-103, DW-203, DSW-301, DSW-302.

2.3 DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR SYSTEM

- A. Wall or ceiling mounted (to suit installation) passive infrared (PIR), ultrasonic or dual technology digital (passive infrared and ultrasonic) occupancy sensor. Furnish the Company's system which accommodates the square-foot coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors and accessories which suit the lighting and electrical system parameters. Passive infrared only sensors shall not be used for classroom applications.
- B. Digital Occupancy Sensors shall provide graphic LCD display for digital calibration and electronic documentation. Features include the following:
 - 1. Digital calibration and pushbutton programming for the following variables:
 - a. Sensitivity – 0-100% in 10% increments
 - b. Time delay – 1-30 minutes in 1 minute increments
 - c. Test mode – Five second time delay
 - d. Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
 - e. Walk-through mode
 - f. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
 - 2. One or two RJ-45 port(s) for connection to DLM local network.
 - 3. Two-way infrared (IR) transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls.
 - 4. Device Status LEDs including:
 - a. PIR Detection
 - b. Ultrasonic detection
 - c. Configuration mode
 - d. Load binding
 - 5. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.
 - 6. Manual override of controlled loads.
- C. Units shall not have any dip switches or potentiometers for field settings.
- D. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.
- E. All devices shall be hard wired. No wireless devices shall be permitted.
- F. WattStopper product numbers: LMPX, LMDX, LMPC, LMUC, LMDC

2.4 DIGITAL WALL SWITCHES

- A. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configuration; available in white, light almond, ivory, grey and black; compatible with wall plates with decorator opening. Wall switches shall include the following features:
 - 1. Two-way infrared (IR) transceiver for use with personal and configuration remote controls.
 - 2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.

3. Red configuration LED on each switch that blinks to indicate data transmission.
 4. Blue Load/Scene Status LED on each switch button with the following characteristics:
 - a. Bi-level LED
 - b. Dim locator level indicates power to switch
 - c. Bright status level indicates that load or scene is active
 5. Dimming switches shall include seven bi-level LEDs to indicate load levels using 14 steps.
- B. Two RJ-45 ports for connection to DLM local network.
- C. Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required to achieve multi-way switching.
- D. The following switch attributes may be changed or selected using a wireless configuration tool:
1. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).
 2. Individual button function may be configured to Toggle, On only or Off only.
 3. Individual scenes may be locked to prevent unauthorized change.
 4. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
 5. Ramp rate may be adjusted for each dimmer switch.
 6. Switch buttons may be bound to any load on a room controller and are not load type dependant; each button may be bound to multiple loads.
- E. WattStopper product numbers: LMSW-101, LMSW-102, LMSW-103, LMSW-104, LMSW-105, LMSW-108, LMDM-101.

2.5 ROOM CONTROLLERS

- A. Room Controllers automatically bind the room loads to the connected devices in the space without commissioning or the use of any tools. Room Controllers shall be provided to match the room lighting load and control requirements. The controllers will be simple to install and will not have, dip switches, potentiometers or require special configuration. The control units will include the following features:
1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
 2. Simple replacement – Using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf unit without requiring any configuration or setup.
 3. Device Status LEDs to indicate:
 - a. Data transmission
 - b. Device has power
 - c. Status for each load
 - d. Configuration status
 4. Quick installation features including:
 - a. Standard junction box mounting
 - b. Quick low voltage connections using standard RJ-45 patch cable
 5. Plenum rated UL 2043
 6. Manual override and LED indication for each load
 7. Dual voltage (120/277 VAC, 60 Hz)
 8. Zero cross circuitry for each load.
- B. On/Off/Dimming enhanced Room Controllers shall include:
1. Real time current monitoring
 2. One, two or three relay configuration
 3. Efficient 250 mA switching power supply

4. Four RJ-45 DLM local network ports.
5. One 0-10 volt analog output per relay for control of compatible ballasts and LED drivers.
2. The following dimming attributes may be changed or selected using a wireless configuration tool:
 - a. Establish preset level for each load from 0-100%
 - b. Set high and low trim for each load
 - c. Set lamp burn in time for each load up to 100 hours
6. WattStopper product numbers: LMRC-211, LMRC-212, LMRC-213, LMRC-221, LMRC-222

2.6 DIGITAL PHOTSENSORS

- A. Digital photosensors work with room controllers to provide automatic switching or dimming daylight harvesting capabilities for any load type connected to a room controller. Closed loop photosensors measure the ambient light in the space and control a single lighting zone. Open loop photosensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones. Photosensors shall be interchangeable without the need for rewiring.
- B. Digital photosensors include the following features:
 1. An internal photodiode that measures only within the visible spectrum, and has a response curve that closely matches the photopic curve. The photodiode shall not measure energy in either the ultraviolet or infrared spectrums. The photocell shall have a sensitivity of less than 5% for any wavelengths less than 400 nanometers or greater than 700 nanometers.
 2. Sensor light level range shall be from 1-10,000 footcandles (fc).
 3. The capability of switching one-third, one-half or all lighting ON and OFF, or raising or lowering lighting levels, for each controlled zone, depending on the selection of room controller(s) and load binding to room controller(s).
 4. For switching daylight harvesting, the photosensor shall provide a deadband or a separation between the "ON Setpoint" and the "OFF Setpoint" that will prevent the lights from cycling after they turn off.
 5. For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a user-selectable minimum level.
 6. Optional programmable wall switch override to allow occupants to reduce lighting level to increase energy savings or, if permitted by system administrator, raise and lower lighting levels for a selected period of time or cycle of occupancy.
 7. Infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.
 8. Red configuration LED that blinks to indicate data transmission.
 9. Blue status LED indicates test mode, override mode and load binding.
 10. Recessed switch to turn controlled load(s) ON and OFF.
 11. One RJ-45 port for connection to DLM local network.
 12. An adjustable head and a mounting bracket to accommodate multiple mounting methods and building materials. The photosensor may be mounted on a ceiling tile, skylight light well, suspended lighting fixture or backbox.
- C. Closed loop digital photosensors include the following additional features:
 1. An internal photodiode that measures light in a 100 degree angle, cutting off the unwanted light from bright sources outside of this cone.
 2. Automatic self-calibration, initiated from the photosensor, a wireless configuration tool or a PC with appropriate software.
 3. Automatically establishes setpoints following self-calibration.

4. A sliding setpoint control algorithm for dimming daylight harvesting with a “Day Setpoint” and the “Night Setpoint” to prevent the lights from cycling.
 5. WattStopper Product Number: LMLS-400.
- D. Open loop digital photosensors include the following additional features:
1. An internal photodiode that measures light in a 60 degree angle cutting off the unwanted light from the interior of the room.
 2. Automatically establishes setpoints following calibration using a wireless configuration tool or a PC with appropriate software.
 3. A proportional control algorithm for dimming daylight harvesting with a “Setpoint” to be maintained during operation.
 4. WattStopper Product Number: LMLS-500.

2.7 EMERGENCY LIGHTING

- A. Emergency Lighting Control Unit – A UL 924 listed device that monitors a switched circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:
1. 120/277 volts, 50/60 Hz., 20 amp ballast rating
 2. Push to test button
 3. Auxiliary contact for remote test or fire alarm system interface
- B. WattStopper Product Numbers: ELCU-100, ELCU-200.

2.8 ROOM NETWORK (DLM Local Network)

- A. The DLM local network is a free topology lighting control physical connection and communication protocol designed to control a small area of a building. Digital room devices connect to the network using CAT 5e cables with RJ-45 connectors which provide both data and power to room devices. Features of the DLM local network include:
1. Plug n’ Go automatic configuration and binding of occupancy sensors, switches and lighting loads to the most energy-efficient sequence of operation based upon the device attached.
 2. Simple replacement of any device in the network with a standard off the shelf unit without requiring commissioning, configuration or setup.
 3. Push n’ Learn configuration to change the automatic configuration, including binding and load parameters without tools, using only the buttons on the digital devices in the local network.
 4. Two-way infrared communications for control by handheld remotes, and configuration by a handheld tool including adjusting load parameters, sensor configuration and binding, within a line of sight of up to 30 feet from a sensor, wall switch or IR receiver.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Contractor shall provide to the manufacturer all quantities for system including but not limited to relays, room controllers, relay panels, plug load controllers, switches, sensors and wire lengths and configurations for both network and device cable at least 1 week before bid.
- B. When using wire for connections other than the DLM local network (Cat 5e with RJ-45 connectors), provide detailed point to point wiring diagrams for every termination. Provide wire specifications and wire colors to simplify contactor termination requirements

- C. All MSTP network and Cat 5e low voltage wiring must have "WattStopper" printed on the wire jacket. Any cable substitutions shall be removed and replaced at the contractor's expense.
- D. All MSTP network terminations shall utilize wire ferrules for terminations and MSTP network manufacturer's instructions. Any network deficiencies shall be repaired at the contractor's expense.
- E. Electrical contractor must provide a detailed as-built plan in CAD showing MSTP network cable routing and network bridge serial numbers to the manufacturer at least 3 weeks prior to factory commissioning. Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated.
- F. Electrical contractor shall be responsible for scheduling the following onsite coordination meetings through the duration of the project. Attendance shall be required for the GC, EC, representative from MEP firm, BAS Integrator and lighting control rep.
 - 1. Pre-Installation- After submittals have been approved and material has arrived onsite and before installation of any devices begins. Review lighting control layout plans, required as-built information and MSTP Terminations.
 - 2. Pre-Factory startup- Electrical contractor must have all lighting control devices installed, wired and tested at least 90 days prior to substantial completion deadline. At this coordination meeting the electrical contractor shall walk the site with attendees and go room by room to ensure they are ready for factory technician to start the system programming. Electrical contractor shall have his as built documentation of the system completed for this meeting.
 - 3. Move in- 30 days prior to owner move in all parties shall meet onsite to review completed system. At this time all installation and factory programming shall be completed.

3.2 FACTORY COMMISSIONING

- A. Upon completion of the installation, the system shall be commissioned by the manufacturer's factory authorized representative who will verify a complete fully functional system.
- B. The factory commissioning shall include the following services. Programming of all button stations, configuration of all occupancy sensors and photocells. Verification of a complete and working system including MSTP network status. Provide written or computer-generated documentation on the commissioning of the system including room by room description including:
 - 1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
 - 2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
 - 3. Load Parameters (e.g. blink warning, etc.)
- C. The electrical contractor shall request factory commissioning by submitting a startup request form at least (4) weeks before startup is required.
- D. Electrical contractor must schedule lighting control factory start-up to begin at **least 60 days prior to substantial completion deadline.**
- E. Lighting control technician shall issue daily reports notifying of the project status, open issues, challenges, etc. at the end of each day he/ she is onsite commissioning the system. Reports shall be sent directly to EC, GC and Engineer.
- F. At the completion of the first visit of the lighting control technician, all parties shall meet onsite to walk the project and evaluate any open issues. At this meeting the schedule for owner training shall be determined.
- G. The electrical contractor shall provide at least (1) journeyman electrician, familiar with the installation of the system, dedicated to assisting the factory start-up technician for the entire duration of the commissioning process.

- H. Upon completion of the system commissioning the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system.
- I. Re-commissioning – After 90 days from occupancy the factory authorized representative and electrical contractor shall re-calibrate all sensor time delays and sensitivities to meet the Owner's Project Requirements. Provide a detailed report to the Architect / Owner of re-commissioning activity
- J. Owner operation memo- Lighting control manufacturer shall prepare an operational memo for owner to distribute informing building occupants of the operation of their lighting control system. Memo shall explain the following but not limited to: auto on/ vs manual on, occupancy sensors, daylight harvesting, plug load control, after hours time delays.

END OF SECTION 26 09 43

SECTION 26 20 00 - ELECTRICAL DISTRIBUTION EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Conditions of the Contract Documents and Division 1 - General Requirements as applicable, apply to this Section.

1.2 SUMMARY

- A. Provide all electrical distribution and motor control equipment and accessories required to distribute electrical power to all motors, outlets and systems requiring power.

1.3 QUALITY ASSURANCE

- A. New: Provide all new equipment.
- B. Single Manufacturer: All equipment of each type shall be the product of one manufacturer.
- C. UL: Equipment shall be UL listed. Service entrance equipment shall bear UL Service Entrance label.
- D. NEC: Equipment and installation shall comply with the National Electrical Code.
- E. Wet Locations: Equipment and enclosures installed outdoors and in wet locations shall be approved for the purpose.
- F. IEEE: Institute of Electrical and Electronics Engineers Standard 1015-1997 (Blue Book) Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.

1.4 LABELING

- A. and labeling shall be provided in accordance with Section 26 05 53. All feeders shall be labeled at the feeder device.

1.5 FINISHES

- A. All equipment shall have a factory applied gray finish applied over a rust inhibiting treatment. Any items which have the finish marred shall be touched up or refinished to a new condition before final acceptance. This shall include, but shall not be limited to, sanding and properly removing rust or other contaminants and completely repainting equipment if damage is extensive. Overall acceptance is subject to approval of the Engineer.

1.6 SUBMITTALS

- A. Provide complete product data for each equipment type. Provide electric service studies when required.
- B. Submittal shall include written recommendation from manufacturer of settings for all electronic trip adjustment setting on all equipment furnished with adjustable trip settings. Contractor is responsible for adjusting all electronic trip settings per manufacturer recommendations.

- C. Electrical connections to all equipment furnished by any other division shall be coordinated with final approved equipment submittals from other divisions including but not limited to circuit breaker sizes, conduit sizes, wire sizes, fuse sizes, disconnect switch sizes and starter sizes that differ from those shown on the drawings prior to submitting Electrical Distribution Equipment submittal.

1.7 SHORT CIRCUIT CURRENT RATINGS

- A. General: All switchboards and panelboards shall be fully rated and marked with a maximum short circuit current rating. The equipment manufacturer shall have verified this rating with high-amperage testing. All short circuit current ratings are expressed as amperes RMS symmetrical at the applied voltage unless otherwise noted. All equipment shall withstand the specified level of fault current. All overcurrent devices shall interrupt the specified level of fault current.

1.8 ELECTRIC SERVICE STUDIES

- A. Standard: Submit studies in accordance with ANSI/IEEE Standard 242 Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
- B. Submit one-line diagram for each electrical service. Key all equipment and components on diagram to items in the studies.
- C. Provide a short-circuit current analysis for each main switchboard. Short-circuit analysis shall calculate short-circuit levels at service transformer secondary, switchboard main breaker, each feeder breaker and all levels of downstream distribution equipment. Assume infinite source bus.
- D. Provide a time-current coordination study for each main switchboard. Coordination study shall compare the operating levels and times of the protective devices to the withstand levels and times that the equipment can sustain without damage or failure. Determine electronic trip unit settings necessary to achieve optimal selective coordination between 480 volt main service circuit breaker and first level of feeder distribution devices. Determine setting for all adjustments of trip units of all electronic circuit breakers that are linked by zone-selective-interlocking. Furnish time-current curves for the two (or more) levels of distribution protected with electronic trips, plus the first additional distribution level served from the switchboard feeder. Show a separate composite plot for each feeder breaker trip rating with the main breaker. Plot composite time-current curves on log-log background. Add a typical frame size of downstream molded-case circuit breaker to each switchboard feeder composite plot.
- E. Contractor shall make all adjustments to circuit breakers per electric service study and provide written documentation that all adjustments have been made.

1.9 INFRA-RED SCAN

- A. An infra-red scan of the main switchboard, sub panels and transformers under full load and a certificate must be provided.

1.10 OWNER'S INSTRUCTION

- A. Provide a four-hour period of instruction to the Owner's designated personnel upon completion of the main switchboards installation. [Instruction shall include a functional training session on digital metering system operation and system test procedures.]

[Demonstrate the transfer of metered values to the Building Automation System.] Review manufacturer's recommended switchboard maintenance. The Operations and Maintenance Manual shall be complete and on-site at the time of Owner instruction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Unless indicated otherwise, all equipment in this section shall be provided from a single manufacturer. The product designations listed are to establish a level of quality. Acceptable manufacturers are,
1. Square D
 2. Siemens
 3. G.E.
 4. Cutler-Hammer

2.2 ENCLOSED SWITCHES

- A. General: Provide heavy duty enclosed switches similar to Square D Class 3100 Type HD.
- B. Switch Interior:
1. All switches shall have switch blades which are visible when the switch is OFF and the cover is open.
 2. Lugs shall be front removable and UL Listed for 75 degrees Celsius conductors.
 3. All current carrying parts shall be plated to resist corrosion.
 4. Switches shall have removable arc suppressors to facilitate easy access to line side lugs.
 5. Switches shall have provisions for a field installable electrical interlock.
- C. Switch Mechanism:
1. Switch operating mechanism shall be quick-make, quick-break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started.
 2. The operating handle shall be an integral part of the box, not the cover.
 3. Provisions for padlocking the switch in the OFF position with at least three padlocks shall be provided.
 4. The handle position shall travel at least 90 degrees between OFF and ON positions to clearly distinguish and indicate handle position.
 5. All switches shall have a dual cover interlock mechanism to prevent unintentional opening of the switch cover when the switch is ON and prevent turning the switch ON when the cover is open. The cover interlock mechanism shall have an externally operated override but the override shall not permanently disable the interlock mechanism. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.
- D. Switch Enclosures:
1. Switch covers shall be attached with welded pin-type hinges.
 2. The enclosure shall be finished with gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated steel.
 3. The enclosure shall have ON and OFF markings stamped into the cover.
 4. The operating handle shall be provided with a dual colored, red/black position indication,
 5. All switches shall have provisions to accept up to three (3) 3/8 inch hasp padlocks to lock the operating handle in the OFF position.

6. Tangential knockouts shall be provided to facilitate ease of conduit entry.
- E. Switch Ratings:
 1. Switches shall be horsepower rated for ac and/or dc as indicated on the plans.
 2. The UL Listed short circuit current rating of the switches shall be 200,000 rms symmetrical amperes when used with or protected by Class J fuses.
 3. Non-Fusible: 10,000 rms symmetrical amps.
- F. Fuse Clips: NEMA FU 1, Class J fuses.

2.3 SINGLE CIRCUIT BREAKERS WITH ENCLOSURES

- A. Product Description: Enclosed, molded-case circuit breaker conforming to NEMA AB 1, suitable for use as service entrance equipment where applied.
- B. Circuit Breakers: Molded case, quick make, quick break, trip free, common thermal magnetic trip.
- C. Ratings: Continuous current, poles as required, 480 volt system breaker shall interrupt short circuits up to 14,000 rms amps symmetrical; on 120/208 - 240 volt system, 10,000 amp rms symmetrical.
- D. Enclosure: NEMA AB 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 1. Interior Dry Locations: Type 1.
 2. Exterior Locations: Type 3R.
- E. Nameplate: Provide a nameplate showing load served.

2.4 FRACTIONAL HORSEPOWER MANUAL MOTOR CONTROLLER

- A. Square D - Class 2510 Type F.
 1. Description: NEMA ICS 2, ac general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, red pilot light and toggle operator.
 2. Enclosures: ANSI / NEMA ICS 6, Type as indicated.

2.5 MAGNETIC MOTOR CONTROLLERS

- A. Square D - Class 8536 Type S.
 1. Description: NEMA ICS 2, ac general-purpose Class A magnetic controller for induction motors rated in horsepower.
 2. Coil Operating Voltage: Provide as required to interface with controls system, including control power transformer.
 3. Coil: Be of encapsulated type.
 4. Poles: as indicated.
 5. Size: as indicated.
 6. Contacts: Totally enclosed, double-break, silver-cadmium-oxide power contacts. Contact inspection and replacement shall be possible without disturbing line or load wiring.
 7. Wiring: Straight-through wiring with all terminals clearly marked.
 8. Overload Relay: NEMA ICS.
 - a. Solid State: Trip current rating will be established by selection of overload relay and shall be adjustable (3 to 1 current range). The overload shall be

- self-powered. Provide phase loss, phase unbalance protection, permanent tamper guard, Trip Class 10 or 20 and a mechanical test function.
- b. Outputs: Units shall be designed for addition of either a normally open or normally closed auxiliary contact and shall be field convertible. Provide one (1) set of N.O. and N.C. contacts in each starter.
 - c. Reset: Unit shall include both manual reset and remote reset using an external module.
 - d. Select overload current setting based on the motor nameplate data of the actual motor to be protected. All standard NEMA sizes may be used for the overload relay, including Size 00.
9. Enclosure: ANSI / NEMA ICS 6, Type 1, 3R or 4X.
 10. Control Power Transformers: 120 volt secondary. VA minimum, in each motor starter. Provide fused primary and secondary.
 11. Provide red LED running pilot light and H-O-A switch.

2.6 MAGNETIC MOTOR CONTROLLERS - TWO - SPEED

- A. Square D - Class 8810 Type S.
 1. Description: Include integral time delay transition between FAST and SLOW speeds. Starters shall be electrically and mechanically interlocked to prohibit both starters being energized simultaneously.
 2. Coil operating voltage: Provide as required to interface with controls system, including control power transformer.
 3. Coil: Be of encapsulated type.
 4. Poles: as indicated.
 5. Size: as indicated.
 6. Contacts: Totally enclosed, double-break, silver-cadmium-oxide power contacts.
 7. Contact inspection and replacement shall be possible without disturbing line or load wiring.
 8. Wiring: Straight-through wiring with all terminals clearly marked.
 9. Overload Relay: NEMA ICS.
 - a. Solid State; Trip current rating will be established by selection of overload relay and shall be adjustable (3 to 1 current range). The overload shall be self-powered. Provide phase loss, phase unbalance protection, permanent tamper guard, Trip Class 10 or 20 and a mechanical test function.
 - b. Outputs: Units shall be designed for addition of either a normally open or normally closed auxiliary contact and shall be field convertible. Provide one (1) set of N.O. and N.C. contacts in each starter.
 - c. Reset: Unit shall include both manual reset and remote reset using an external module.
 - d. Select overload current setting based on the motor nameplate data of the actual motor to be protected. All standard NEMA sizes may be used for the overload relay, including Size 00.
 10. Enclosure: ANSI / NEMA ICS 6, Type 1, 3R or 4X.
 11. Two speed motor controllers shall be designed for type of motor winding specified in Division 23 Mechanical Specifications, Drawings, or Equipment Schedule. Coordinate with Division 23 prior to submittal.
 12. Provide red-high, amber-low running pilot lights and H-O-L-A switch.
 13. Provide two speed motor controllers for all two speed motors specified in Division 23 Mechanical Specifications, Drawings, or Equipment Schedule. Coordinate with Division 23 prior to submittal.

2.7 COMBINATION DISCONNECT / MOTOR STARTERS

- A. Square D - Class 8538 Type S (Fusible or no fuse, as shown on plans).

1. Description: Combine magnetic motor controllers with fusible switch disconnect in common enclosure. Switch shall have a color coded externally operated handle. Operating handle shall give positive visual indication of ON/OFF with red and black color-coding.
2. Fusible Switch Assemblies: NEMA KS 1, enclosed knife switch with externally operable handle. Fuse clips: Designed to accommodate Class J fuses and visible blades. Operating handle shall give positive visual indication of ON/OFF with color-coded operating handle.
3. Magnetic Motor Controllers: Refer to paragraph(s) specifying magnetic motor controllers for requirements.

2.8 FUSES (600 VOLTS AND BELOW)

- A. Manufacturers:
 1. Bussmann.
 2. Little Fuse
 3. Ferraz Shawmut
- B. Dimensions and Performance: NEMA FU 1, Class as specified or as indicated on Drawings.
- C. Voltage: Rating suitable for circuit phase-to-phase voltage.
- D. Class J (Time Delay) Fuses
 1. Dimensions and Performance: NEMA FU 1.
 2. Voltage: Rating suitable for circuit phase-to-phase voltage.
 3. Dual-element, time delay ten (10) seconds (minimum) at 500 percent rated current.
- E. Spares: Spare fuses shall be provided in the amount of ten (10) percent of each type and size installed. Replacement for fuses and limiters blown during construction shall not count as spares.

2.9 TWO-WINDING TRANSFORMERS

- A. Product Description: Provide transformers in accordance with the following standards, where applicable:
 1. Underwriter's Laboratory 1561, Standard for Safety for Dry-Type General Purpose and Power Transformers
 2. Underwriter's Laboratory 506, Standard for Safety for Specialty Transformers
 3. NEMA ST 20, Dry Type Transformers for General Applications
 4. NEMA 250, Enclosures for Electrical Equipment (1000 V Max)
 5. ANSI / IEEE C57.12.91, Standard Test Code for Dry-Type Distribution and Power Transformers
 6. U.S. Department of Energy 10 CFR Part 431 Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule, dated April 18, 2013. These efficiency standards shall take effect January 1, 2016. All transformers covered in the scope of this document and this specification, manufactured after December 31, 2015, shall be compliant with the new standard.
- B. Ratings as indicated on Drawing.
- C. Primary Voltage: 480 volts, 3 phase or as indicated on plans.
- D. Secondary Voltage: 208Y/120 volts, 3 phase or as indicated on plans.

- E. Insulation system and average winding temperature rise 150 degrees Celsius over 40 degrees Celsius ambient.
- F. Winding Taps:
 - 1. 2 at 2.5 percent above rated voltage.
 - 2. 4 at 2.5 percent below rated voltage.
- G. Sound Levels: NEMA ST 20. Noise levels shall not exceed NEMA and ANSI Standards.
- H. Basic Impulse Level: 10 kV for transformers less than 300 kVA.
- I. Ground core and coil assembly to enclosure by means of visible flexible copper grounding strap.
- J. Mounting:
 - 1. 1-15 kVA: Suitable for wall mounting.
 - 2. 16-75 kVA: Suitable for floor mounting.
 - 3. Larger than 75 kVA: Suitable for floor mounting.
- K. Coil Conductors: Continuous copper windings with terminations brazed or welded.
- L. Enclosure: NEMA ST 20, Type 1 or Type 3R ventilated. Furnish lifting eyes or brackets.
- M. Isolate core and coil from enclosure using vibration-absorbing mounts.
- N. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.10 TRANSFORMERS FOR NONLINEAR LOADS

- A. Nonlinear load transformer shall be as specified for two winding transformers except as modified by this Section.
- B. Product Description: NEMA ST 20, factory-assembled, air cooled dry type transformers, designed to supply nonlinear load, UL K-9 rated.
- C. Primary Voltage: 480 volts, 3 phase.
- D. Secondary Voltage: 208Y/120 volts, 3 phase.
- E. Insulation and temperature rise: Class 220 insulation system with 115 degrees Celsius average winding temperature rise over 40 degrees Celsius ambient.
- F. Coil Conductors: Continuous copper windings with terminations brazed or welded. Individually insulate secondary conductors and arrange to minimize hysteresis and eddy current losses at harmonic frequencies. Size secondary neutral conductor at 1.73 times the phase conductor ampacity.
- G. Enclosure: NEMA ST 20, Type 1 or Type 3R ventilated. Furnish lifting eyes or brackets.
- H. Isolate core and coil from enclosure using vibration-absorbing mounts.
- I. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.11 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Square D I-Line, Class 2110.
- B. Product Description: NEMA PB 1, circuit breaker type panelboard.
- C. Panelboard Bus: copper current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard.
- D. Continuous current rating shall be sufficient to protect wiring and equipment served.
 - 1. Panels 400A and smaller, 35,000 amperes rms symmetrical.
 - 2. Panels greater than 400A: 65,000 amperes rms symmetrical.
- E. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
- F. Main Circuit Breaker:
 - 1. When distribution panel has main circuit breaker, provide molded case circuit breaker with electronic trip unit. Current sensing to be true-rms.
 - 2. Main breaker shall have minimum interrupting rating of 65,000 amperes rms symmetrical at applied voltage.
 - 3. Electronic trip shall be Square D micrologic with adjustable long-time, short-time and instantaneous pick-up set points.
- G. Cabinet Front: Safety dead front type. Conform to NEMA 1; NEMA 3R if located outdoors. All panelboards located in kitchen areas shall be flush mount with NEMA 4X Stainless Steel enclosures.

2.12 BRANCH CIRCUIT PANELBOARDS

- A. Manufacturers: Square D Type NQ for 208/120V, type NF for 480/277V.
- B. Product Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.
- C. Panelboard Bus: Copper current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard;
- D. For non-linear load applications subject to harmonics furnish 173 percent rated, plated copper, solid neutral.
- E. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 208-240/120 volt panelboards; 22,000 amperes rms symmetrical for 480 volt panelboards.
- F. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers as indicated on Drawings. Do not use tandem circuit breakers.
- G. Enclosure: NEMA PB 1, Type 1 or Type 3R. All panelboards located in kitchen areas shall be flush mount with NEMA 4X Stainless Steel enclosures.
- H. Cabinet Front: Safety dead front type with concealed trim clamps, concealed hinge, metal directory frame, and flush lock keyed alike. Finish in manufacturer's standard gray enamel.

- I. Provide ground-fault circuit breaker for each heat trace branch circuit.
- J. Panelboards indicated to have thru-feed lugs shall be furnished with thru-feed lugs in all sections of panelboard.

2.13 MOTOR CONTROL CENTERS

- A. General:
 - 1. Provide totally enclosed, freestanding, motor control center with sections joined together to form one rigid unit. Motor control centers shall be similar to Square D Model 6 Class 8998.
 - 2. NEMA Class: I.
 - 3. NEMA Wiring Class: Type B.
 - 4. Standard: NEMA Standard ICS 2 Industrial Control and Systems.
 - 5. Underwriters Laboratories: UL 845 "Electric Motor Control Centers". Each vertical section shall be UL listed. Each motor control unit shall be UL listed.
- B. Installation: Freestanding on a four (4) inch concrete pad. Both the entire enclosure to the pad.
- C. Structure:
 - 1. Fabricated of code gage steel with steel doors formed into standardized units. Each vertical section shall have an independent isolated vertical wiring trough with full height hinged door. Back to back mounted devices in the same vertical bus module are unacceptable.
 - 2. Structures shall be totally enclosed, dead front, freestanding assemblies.
 - 3. Structure shall be NEMA type 1 gasketed general purpose.
 - 4. Motor control center structures shall have continuous removable base channels. The top plate(s) shall be removable to facilitate cutting of conduit entry openings.
 - 5. All steel parts shall be provided with a UL listed acrylic baked enamel or powder coat paint finish, except plated parts used for ground connections. All painted parts shall undergo a multi-stage treatment process, followed by the finishing paint coat.
 - 6. Structures shall contain a minimum 12 inch high horizontal wireway at the top of each section and a minimum six (6) inch high horizontal wireway at the bottom of each section. These wireways shall run the full length of the motor control center to allow room for power and control cable to connect between units in different sections.
 - 7. A vertical wireway shall be provided in each motor control center section that accepts modular plug-in units. The vertical wireway shall connect with both the top and bottom horizontal wireways. The vertical wireway shall be barriered from control units and have a separate hinged door.
 - 8. Unused spaces and spares shall have hinged doors.
- D. Bussing:
 - 1. Provide complete horizontal and vertical bussing with wiring spaces at top, bottom, and vertically in each section. All bussing shall be silver plated 98 percent conductivity copper.
 - 2. The main horizontal bus shall be fully rated and shall extend the full length of the motor control center. Include provisions for splicing additional sections onto either end of the motor control center.
 - 3. Each section that accepts plug-in units shall be provided with a vertical bus for distributing power from the main bus to the individual plug-in starter units. This bus shall be of the same material and plating as the main bus, and shall be rated no less than 125 percent of motor FLA in that section. Vertical bus shall extend full height of section, including all spare and space units. For purposes of calculating vertical bus

- ampacity, each space shall count no less than FLA of smallest motor served in that section.
4. A tin or silver plated copper ground bus shall be provided that runs the entire length of the motor control center. The ground bus shall be rated no less than 1/3 of horizontal main bus amps. Provide a vertical ground bus in each section used for plug-in units. Plug-in units shall have a ground stab arranged for first-make, last-break relative to the power bus stabs.
 5. Motor control centers shall be separated into shipping blocks of no more than three vertical sections each.
 6. All power bussing and splice connections shall be isolated from the unit compartments and the wireways. The horizontal bus shall be isolated from the horizontal wireways and starters. Barriers shall be removable to allow access to the bus and connections for maintenance.
 7. The vertical bus shall be housed in modular glass filled polyester supports that provide bus insulation. These supports shall have openings every three (3) inches for unit stab-on connections. Each opening shall be provided with a closing plug to close off the stab opening.
- E. Terminations:
1. Provide proper incoming line lugs. Size lugs to accommodate wire which is to be installed.
 2. All starter units shall be provided with unit control terminal blocks.
 3. Terminal blocks shall be the pull-apart type rated at 20 amps. The stationary portion shall be used for field connections and will remain attached to the cubicle when the unit is removed. The removable portion of the terminal blocks shall be used for the unit wiring factory connections.
- F. Protective Devices:
1. Class J Fusible Switch-Starter Units: Plug in type with silver plated pressure type line disconnecting stabs of high strength copper alloy. Each unit shall be totally enclosed and effectively barriered, and shall be so designed that it can be located anywhere within the structure using the same overload heaters for the same load. Fusible switches shall be manually operated quick make, quick break, horsepower rated. Coordinate fuses and overload heaters for proper acceleration time of motors provided. Operating handle shall clearly indicate ON or OFF. Provide for locking each switch in OFF position by 1 to 3 padlocks. Provide Class J fuse clips. Provide magnetic starter components as specified in Article MOTOR CONTROLLERS. Provide fuses field-installed in accordance with Article FUSES.
 2. Circuit Breakers (with no motor controller): Molded case, bolted type, quick make, quick break, trip free, common thermal magnetic trips. Operating handle shall clearly indicate ON or OFF. Means shall be provided for locking each breaker in OFF position by one to three padlocks. Automatic tripping indicated by handle at center position.
 3. Fused Switch (with no motor controller): Quick make, quick break, horsepower rated. Operating handle shall clearly indicate ON or OFF. Provide for locking each switch in OFF position by one to three padlocks. Provide Class J Type fuse clips. Provide fuses in accordance to Article FUSES located in this section.
 4. Starters: all starters for motor control center to be size 1 minimum or larger.
- G. Short Circuit Current Ratings:
1. Protective devices, together with the bussing and bracing, shall safely and without failure withstand and interrupt short circuits on a system capable of delivering up to 65,000 amps RMS symmetrical at nominal system voltage. Provide higher ratings when indicated on the Drawings.

2. Bus bracing shall be provided for the entire bus network to withstand the mechanical forces generated during the specified short circuit.
 3. The main device serving the motor control center, every motor control unit and other overcurrent devices installed in the motor control center shall have an interrupt rating no less than the specified short circuit.
 4. The entire motor control center shall be suitable for operation at the specified available fault current. The motor control center shall be labeled by the manufacturer to indicate the maximum available fault current rating, taking into account the structure, bussing, main feeder and all units and devices included in the motor control center. This fault current withstand rating shall be the basis for the UL Short-Circuit Current Rating.
- H. Nameplate:
1. Identify each device with nameplate showing load served. Refer to "Labeling" in Section 16050.
 2. Provide a master nameplate on face of units similar to following, with correct data shown:
Motor Control Center
480 Volts, 3 Phase, 3 Wire, 60 Hertz
Main Bus: ___ amps. braced for ___ amperes RMS Symmetrical
Date Installed:
 3. Provide a nameplate for each vertical section marked with section characteristics and factory identification. This nameplate may be manufacturer's standard construction.
 4. Provide UL listing marks on each section and unit in manufacturer's standard format.
- I. Submittal: Include at least the following:
1. Manufacturer and Model Numbers
 2. Dimensions
 3. Cable Termination Provisions
 4. Current Ratings
 5. Voltage Ratings
 6. Short Circuit Ratings including proof of any UL-listed series ratings (if series rating allowed by specification).
 7. Motor Controller and Protective Device Ratings, including catalog pages for all current-limiting devices.
 8. Identify NEMA Class of submitted mcc.
 9. Identify NEMA Wiring Type of submitted mcc.
 10. Single Phase Relay
 11. Unit Elevation
 12. Bussing Schematic, Sizes and statement of Conductor and Plating Material.
 13. Original Manufacturer Brochure and Specifications

2.14 MAIN SWITCHBOARDS:

- A. General: Provide universal building-type switchboards fabricated in accordance with NEMA Standard PB-2, UL Standard 891, and bearing a UL Service Entrance Label. Switchboard characteristics are 480/277 volts, 3 phase, 4 wire. Main connection and unit-mounted branch connections shall be from the rear. Group mounted branch connections shall be from the front or the rear. The entire switchboard assembly shall be similar to Square D Type QED-2.

- B. Structure:
1. The switchboard shall be freestanding and have front and rear alignment. Provide rear access to main device(s) and all unit-mount branch devices (2000A and less can be front access only). Provide front or rear access to group-mounted devices. Formed up steel channels bolted together to form a rigid structure to which formed up fronts, side sheets, and rear covers are bolted. Galvanized 1-1/2" x 3" mounting channels on bottom, rear, left, and right sides to close all openings at the bottom. Arrange for easy addition of future cubicles at end. Provide pull box, fabricated with unit at factory, on top of switchboard if required for proper entrances and exits of feeders.
 2. When "SPACE" is indicated on one-line diagram, provide full bussing extension to serve that space and all overcurrent device mounting hardware for the given frame size.
- C. Installation: Freestanding, level and bolted to a four (4) inch concrete pad.
- D. Instrumentation:
1. General: Monitor the incoming line with a Square D PM 5563 meter with BACnet IP communication port protocol.
Meter shall have digital display adjustable to select phase. Monitor with an ammeter any feeder devices indicated on the Drawings.
 2. Wiring Lugs: Provide ring lugs for all wiring terminations of potential transformers (PTs), current transformers (CTs) and current sensors. Fork lugs are not acceptable. Ring lugs are intended to minimize the chance of leads pulling apart and creating an open circuit. (Zero current reading).
- E. Phase, Neutral and Ground Bussing: Silver plated 98% conductivity copper sized to comply with NEMA Temperature Rise Standard. In addition, copper bus shall be sized on the basis of a maximum temperature rise of 65 degree C. The vertical bussing per cubicle shall be sized not less than the sum of all devices, including spare spaces, to be served from that cubicle. **The vertical bus shall be a minimum of 2000 amperes and shall be full height.** Bus supports, connections, and joints shall be bolted with SAE Grade 5 medium carbon steel bolts employing Belleville washers. Provide complete bussing, mounting provisions for circuit protective devices and space screw cover wherever the drawings indicate space only. Arrange and drill bussing for **future full capacity extension**. Provide a full length ground bus, with minimum ampacity of 1/3 phase bus ampacity. Provide full-size neutral rated at 100 percent of phase bus.
- F. Terminations: Provide proper incoming line lugs to accommodate cable shown on plans.
- G. Short Circuit Ratings:
1. Switchboard assembly of protective devices, together with the bussing and bracing, shall be fully-rated to withstand and interrupt short circuits on a system capable of delivering up to 65,000 (or 100,000) amps RMS symmetrical at nominal system voltage.
- H. Provisions for Auto Power Factor Controller (APFC):

1. Provide a circuit breaker with adjustable electronic tripping to protect and disconnect the automatic power factor controller.
 2. Set amp trip at minimum 150 percent of ampacity for the actual KVAR installed.
 3. Provide buss CTs on main incoming buss for use by the remote auto pf controller. These CTs shall be separate and in addition to all other CTs required for switchboard metering. Install a shorting terminal block on CT until the auto pf controller is installed at the job site.
 4. Refer to Section 26 35 33 for additional requirements of auto pf controller.
- I. Protective Devices:
1. Switchboard Main Breaker:
 - a. Stationary mounted, manually operated, 100 percent rated molded case circuit breakers with electronic tripping system and stored energy closing mechanisms. The electronic tripping system shall be similar to Square D Micrologic Full Function Trip unit. Main breakers shall be Square D NW (3000-4000), [RJ (1600-2500A) 65KA or RL (1600-2500A) 100KA] ampere frame size.
 - b. The breaker shall be UL Listed for continuous duty at 100% of the current rating.
 - c. Minimum interrupting rating of 65,000 (or 100,000) amperes rms symmetrical at 480/277 Volts.
 - d. Local trip indicators: overload, short circuit and ground fault.
 - e. Electronic sensing systems shall be true-RMS sensing and not susceptible to adverse harmonic current effects.
 - f. Adjustments:
 - 1) The electronic trip unit shall have LSIG Trip functions.
 2. Feeder Devices:
 - a. Breakers 700 Amps and Larger:
 - 1) Branch feeder breakers 700 amp and larger shall be molded case circuit breakers rated 100% with electronic trip units, similar to Square D [NW (3000-4000A), [RJ (1600-2500A 65kaic 100%)], [RL (1600-2500A 100kaic 100%)], [PJ (700-1200A 65kaic 100%)], [PL (700-1200A 100kaic 100%)]
 - 2) Interrupting rating shall be at least 65,000 (or 100,000) amperes rms symmetrical at 480/277 Volts.
 - 3) The electronic trip unit shall have LSI trip functions.
 - 4) The breaker shall be UL Listed for continuous duty at 100% of the current rating.
 - b. Breakers 600 amps and smaller shall be type L (600A and 400A frame), J (250A frame), and H (150A frame) molded circuit breakers, AIC rating to match main breaker.
 - c. The breaker shall be UL Listed for continuous duty at 100% of the current rating
- J. Transient Voltage Surge Suppressor (TVSS):
1. General: Provide a Square D Class 1310 240kA surge current rated mounted in the switchboard mounted above the main circuit breaker compartment.
- K. Lightning and Overvoltage Surge Arrester:
1. General: Provide a Square D SDSA3650 lightning and overvoltage surge arrester inside the switchboard housing, connected between the service entrance bussing and the ground bus.

2. Description: Device shall be a heavy duty, three-phase, zinc metal oxide varistor (MOV), secondary class arrester rated for 650 volts and U.L. listed in Category (OWHX) of the Electrical Construction Materials Directory (Green Book). Device shall comply with ANSI/IEEE C62.11-1987 Standard for Metal Oxide Surge Arresters for AC Power Circuits.
3. Installation shall comply with NEC Article 280. Provide fusing if required by installation instructions from arrester manufacturer.

L. Identification:

1. General: Identify each device and meter with a nameplate showing load served. Refer to Article on LABELING in Section 26 05 00.
2. Master Nameplate: Provide a master nameplate on face of boards similar to following, with correct data shown:

Main Switchboard _____
480/277 Volts, 3 Phase, 4 Wire, 60 Hertz
Main Bus: ___amps. braced for ___ RMS sym. amps.
Date Installed:

M. Submittal: Include at least the following:

1. Manufacturer and Model Numbers
2. Dimensions
3. Cable Termination Provisions
4. Current Ratings
5. Voltage Ratings
6. Short Circuit Ratings
7. Protective Device Ratings
8. Electronic metering system
9. Surge Arrester
10. Unit Elevation
11. Bussing Schematic, Sizes and Statement of Conductor and Plating Materials
12. Original Manufacturer Brochure and Specifications
13. Coordination drawing using dimensions of actual switchboard submitted. Show board footprint, proper clearances, and other equipment in same room.

N. Testing: Test all devices and systems to assure proper operation.

2.15 SERVICE ENTRANCE CABLE TAP BOX (CTB):

A. Cable Tap Box:

1. General: Provide weatherproof, freestanding phase collection and cable tap box. Fabricate in strict accordance with Electric Utility requirements. Line side connection from building pad-mounted transformer shall be through underground conduit and wire, load side connections to the building main switchboard(s) shall be weatherproof outdoor busway.
2. Structure: Formed up steel channels bolted together to form a rigid structure to which formed-up fronts, side sheets, and rear covers are bolted. Front and rear doors shall be hinged. Galvanized 1-1/2 inch x 4 inches mounting channels on bottom, rear left, and right sides to close all side openings at the bottom. Interior framing shall be galvanized steel 1-5/8" rigid channel or approved equal system. Enclosure shall be tamper proof and outdoor weatherproof.
3. Installation: Freestanding and level on an outdoor concrete pad. Provide anchor bolts. Pad shall be outside all Electric Utility easements. Stub up conduits for

Electric Utility service lateral and customer-side service entrance conduits. All underground conduit to/from CTB shall be concrete-encased.

4. Bussing: Insulated bussing, silver plated 98 percent conductivity copper. Bussing shall be sized in accordance with UL and NEMA Standards. In addition, size copper bus for not more than 1000 Amperes per cubic inch current density. Provide 3 phase, 4 wire, (100 percent neutral) bussing. Install with rigid supports to meet fault current rating.
5. Fault Current Rating: Bussing and bracing shall safely and without failure withstand short circuits on a system capable of delivering up to 100,000 amperes rms symmetrical at nominal system voltage. Install rope tie as required after cable installation to maintain bracing for short circuit current rating.

B. Electric Utility Requirements:

1. Prior to fabrication, submit three (3) prints of proposed cable tap box (CTB) to the representative designated by the Electric Utility. Submit prints only after shop drawings have been submitted and review cycle is complete with the Architect. Allow at least eight weeks time for review by Electric Utility prior to desired date of new service cut-in. Allow additional time for Architect/Engineer review prior to submittal to Electric Utility.
2. Cable tap box enclosure shall be tamper proof and weatherproof. Entire cabinet shall be tamper-resistant.
3. Form roof with cross-kink to force water to run off the cabinet.
4. Paint Finish Color: Match color of Electric Utility padmount transformer. Minimum finish shall be prime coat plus at least 6 mils of finish coat paint in two (2) applications.
5. Provide full-height doors on both utility side and customer side. Each door shall be hinged and have a vault-style handle with padlocking provisions. Electric Utility will install its padlock. Provide weatherproof padlock on customer door and give Owner ten (10) copies of key.
6. Fabricate CTB with two separate compartments; one side for Electric Utility connections and the opposite side for Customer connections. Compartments shall be separated with an insulating barrier. Size cabinet to maintain necessary wire bending radius in Electric Utility and Customer compartments.
7. All insulating barriers shall be one (1) inch black phenolic resin, NEMA Grade N-1 or XX, or phenolite (Grade GPO-3).
8. Each bus bar shall be copper, minimum 1/4 inch x 4 inches. Drill and tap for six (6) sets of 2-hole compression lugs per bus bar on Electric Utility side or other configuration stipulated by E.U. Lowest edge of all bus bars shall be 36 inches above top of concrete foundation. All bus bar dimensions, quantities, bracing and exact layout shall be per approved details from the Electric Utility for this specific job site. Parallel sufficient bus bars to achieve ampacity shown on Electrical Drawings for both Electric Utility and Customer side of CTB. Drill and tap for 2-hole NEMA D-tang compression lugs for termination of Customer cables.
9. Install CTB level and bolted to a concrete foundation. Locate outside work space clearance and easements associated with Electric Utility padmount transformer and primary ductbank.
10. Cable Termination: Terminate all cables with NEMA-pattern, two-hole, compression lugs.

C. Submittal to A/E: Include at least the following:

1. Manufacturer and Model Numbers
2. Dimensions: plan, elevations, bus bars.
3. Cable Termination Provisions
4. Current Rating
5. Voltage Rating
6. Short Circuit Withstand Rating

7. Bussing Sizes, Layout and Statement of Conductor and Plating Materials
8. Certify weatherproof cabinet construction. Certify paint finish type and thickness.
9. Coordination Drawing showing cable tap box, Electric Utility padmount transformer with required work space clearances, meter location, and underground conduit entrances.
10. After A/E shop drawing cycle is complete, submit three complete copies to Electric Utility.

2.16 SEQUENCING PANELBOARD FOR THEATER SOUND REINFORCEMENT SYSTEM:

- A. Features:
1. Supply all ac circuits for audio/visual equipment in the high school theater A/V room from time sequence panelboard capable of being remote controlled from multiple locations.
 2. 41 sequenced circuits per panelboard.
 3. A means of visual operator feedback shall provide an indication of the progress of the power turn-on and turn-off sequence at each control point.
 4. Sequencing shall have an adjustable time delay between the low level equipment circuits and the power amplifier circuits.
 5. The sequencing system shall be capable of shedding the load within three (3) seconds after a power failuer and re-sequencing when power resumes without operator intervention.
 6. Provide one LynTec Cat. No. SS-2 Sequencer Switch Set with every 41-circuit panelboard.
 7. Provide one LynTec Cat. No. SS-2PL Remote Locking Switch Plate with every 41-circuit panelboard.
 8. Provide for each sequencing panelboard a LynTec Model No. SLC 341-41 filled with MB-Motorized Breakers, 3 phase, 4 wire, 208Y/120 Volt 225 Amp Main Breaker panel or approved equal.
 9. Acceptable Manufacturer: LynTec Inc., 8401 Melrose, Lenexa, KS 66214-1647; telephone 800-724-4047, fax 888-722-4157, www.lyntec.com or email info@lyntec.com .
- B. Cabinet: Safety dead front type; box made of Code gage galvanized steel; minimum gutter space 4" on all sides but not less than NEC requirements; door with flush type latch. Enclosure shall conform to NEMA 1.
- C. Circuit Breakers:
1. General: Provide a breaker for each audio branch circuit to protect wiring and equipment served.
 2. Description: Each breaker shall have motor drive for individual breaker remote control. Breakers shall be quick make, quick break, trip free, thermal magnetic trip. Automatic trip shall be indicated by the handle at the midpoint position. Multiple pole breakers shall have common trip.
- D. Short Circuit Ratings: 120/208 volt systems 10,000 amperes RMS symmetrical.
- E. Phase, Neutral and Ground Bussing: Silver or tin plated 98 percent conductivity copper sized in accordance with NEMA Temperature Rise Standards and installed completely throughout panel for installation of future breakers where schedule shows space only. Provide an equipment grounding bus bonded to the panel cabinet. Ground bus shall have a terminal screw for every breaker in the panel.
- F. Termination: Provide proper incoming line lugs. Size lugs to accommodate wire which is to be installed.

- G. Surge Protective Device: Install a Transient Voltage Surge Suppressor (TVSS) on the sequencing panelboard. TVSS shall be Current Technology TransGuard TG60 Series or Liebert Interceptor Model 111 Series.
- H. Nameplate: Nameplate on front face showing panel name and voltage. Coordinate to give same name as shown on Drawings.
- I. Directory: Complete at end of job, typewritten, contained in frame on the inside of the panel door. Frame shall have a protective plastic shield. Label every breaker to match directory.

2.17 ELEVATOR SHUNT TRIP DISCONNECT

- A. Provide Bussman Power Module Switch PS Series; amperage size and operating voltage shall match elevator branch circuit indicated on drawings.
- B. Provide control power transformer, fire alarm system interface relay, key-to-test switch, mechanical interlock auxiliary contact for hydraulic elevators with automatic recall.
- C. Interconnect with local heat detectors to provide elevator shutdown prior to the discharge of fire protection water in elevator machine room.

2.18 ROOF MOUNTED PEDESTALS

- A. Roof Utility Pedestal with 20 Amp GFCI/Weatherproof receptacle - Provide MAPA Products utility roof pedestal #MPX-20G: 36/12.
- B. Roof Pedestal with Non-Fused Disconnect Switch and 20 Amp GFCI/Weatherproof receptacle - Provide MAPA Products roof pedestal #MDP – (XX). See plans for disconnect sizes.

PART 3 - EXECUTION

3.1 MOUNTING:

- A. General: All equipment shall be securely fastened in place.
- B. Locations: In all cases mounting locations shall comply with the requirements of the National Electrical Code. This shall include providing suitable working clearances.
- C. Concrete Pads:
 - 1. Provide concrete in accordance with the Division of the Specifications for that product.
 - 2. Indoor concrete pads shall consist of a four (4) inch pad with beveled edges extending two (2) inches beyond the perimeter of supported equipment. Switchboards, motor control centers, transformers greater than 15 KVA, and engine generators shall be installed on a pad. Refer to the drawings and the specifications for each piece of equipment to determine what other equipment shall be mounted on a pad.
 - 3. All equipment, ground mounted outdoors, shall be mounted on a pad. Outdoor pads shall be minimum of one foot thick reinforced with #4 rebar one (1) foot on center each way. Size outdoor pads with at least four (4) feet working clearance in front of equipment and one (1) foot on all sides. Provide anchor bolts for pad-mounted equipment. Refer to Detail on drawings.
- D. Wall Mounted Equipment: Wall mounted equipment shall be suitably positioned on the wall. Equipment mounted on exterior basement wall shall have unistrut channels between the wall and the equipment to prevent condensation problems. Where wall mounted equipment is

specified, but a convenient wall not available, a suitable unistrut mounting stanchion anchored in concrete shall be provided. In lieu of this stanchion, small devices may be mounted on to the equipment served if approved by the equipment manufacturer.

- E. Motor rated disconnects: Install disconnects in a vertical orientation with off in the down position.

3.2 DELIVERY, STORAGE AND HANDLING:

- A. General:
 - 1. Store all types of electrical power distribution equipment in a clean, heated building affording appropriate physical protection. Control access to prevent unauthorized tampering with the equipment. However, equipment may be stored in other inside or outside environments under approved conditions.
 - 2. Inspect equipment when received at Project site for shipping damage. Report as required by freight carrier to recover repair or replacement costs from the freight carrier in the event damage was sustained.
 - 3. Covers are required unless indoor, ventilated storage conditions exist. Canvas tarpaulins or the equivalent are preferred over other coverings because they provide better humidity control and enclosure scuff protection. Where exposed to moisture, covers shall be waterproof.
 - 4. The manufacturer's shipping skids shall be left on the equipment to provide structural support until the equipment is set in final resting place.
 - 5. Refer to Section 26 05 00 for additional requirements. Contractor shall furnish new equipment to replace any equipment that is exposed to weather or subjected to other deleterious effects of construction.
- B. Approved Conditions for Equipment Storage:
 - 1. General: Where storage conditions specified above are not available, indoor or outdoor storage shall comply with the following.
 - 2. Switchboards, Motor Control and Other General Distribution and Utilization Equipment:
 - a. Store metal-enclosed equipment in the upright position. Provide good ventilation of the shelter and protection from dirt, moisture and physical damage.
 - b. Space heaters furnished with the equipment shall be connected to a continuous source of power of the proper rating. Where space heaters are supplied from auxiliary power transformers, care shall be taken that low-voltage heater circuits are properly isolated before power source connection to prevent inadvertent energizing of the auxiliary transformer and associated high-voltage primary wiring.
 - c. Ambient conditions may allow condensation inside waterproof covers. If condensation is occurring, temporary heaters or lamp banks shall be provided of sufficient wattage to prevent condensation.
 - d. Contractor shall ensure that equipment stored in shipping cases receives adequate ventilation to avoid mildew and prevent condensation.
- C. Transformer
 - 1. Indoor storage shall be provided for all transformers.

3.3 GROUND FAULT PROTECTION OF EQUIPMENT:

- A. General: Provide for system performance testing as required by the National Electrical Code. Provide each ground fault relay, sensing device or ground fault protection system with instructions and a test form. The form shall be retained by those in charge of the building's

electrical installation and be available to the authority having jurisdiction. The instruction content shall be as required by UL.

3.4 TRANSFORMER VIBRATION ISOLATION:

- A. Floor Mounted Transformers: Install on concrete housekeeping pad with Mason Industries Type WM Neoprene Waffle pad, or equal. Provide Type WM isolation for elevated rack installation.
- B. Wall Mounted Transformers: Install Mason Industries Type WM Neoprene Waffle pad between the wall brackets and the wall.
- C. Suspended Transformers: Install Mason Industries PC30 Pre-compressed spring hanger with neoprene isolator.
- D. Floor Mounted Transformers Greater than 150 kVA: Install on Mason Industries, Inc, or equal, unhoused spring isolators with acoustical pad bonded to bottom. Isolators shall be undamped free-standing spring isolators sized for a minimum of two (2) inches of static deflection. The spring outside diameter shall be no less than 80 percent of the spring operating height. The spring shall have remaining travel to solid of no less than 50 percent of the static deflection. Provide a 1/4 inch neoprene friction pad bonded to the spring base. Bolt each vibration isolator unit to concrete pad, and bolt transformers to the vibration isolator units, using the leveling bolts and nuts provided with the unit.

3.5 TRANSFORMER VENTILATION:

- A. Transformers with ventilating openings shall be installed so that the ventilating openings are not blocked by walls or other obstructions. The required clearances shall be clearly marked on the transformer.

3.6 POWER SHUT OFF UNDER KITCHEN HOODS:

- A. NFPA:
 - 1. Comply with NFPA 96 Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations. The operation of any extinguishing system shall automatically shut off all sources of fuel and heat to all equipment requiring protection by that extinguishing system.
 - 2. Comply with NFPA 17, Standard for Dry Chemical Extinguishing Systems.
 - 3. Comply with NFPA 17A, Standard for Wet Chemical Extinguishing Systems.
- B. Shunt Trip: All electrical sources located under the ventilating equipment (cooking equipment hood) shall be shut off upon the operation of a wet chemical or water fire extinguishing system. Provide shunt trip accessory on each circuit breaker serving an electrical appliance under the hood. Install control wiring between shunt trips and the hood extinguishing system. Coordinate all wiring with supplier of hood fire suppression system for proper selection of shunt trip coil voltage, momentary or maintained-contact closure to activate shunt trip and inter-connections. Operation of a hood extinguishing system shall automatically shunt trip all associated circuit breakers.
- C. Fire Alarm System: The operation of any extinguishing system shall automatically signal the building fire alarm system. Refer to Section 26 05 53 for additional fire alarm system requirements.

3.7 LABELING:

- A. Nametag: Provide a nametag for each piece of distribution equipment; see Section 26 05 53, Electrical Identification.

END OF SECTION 26 20 00

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes wall switches; wall dimmers; receptacles; device plates and box covers. All devices shall be installed in outlet boxes of required size and volume.

1.3 REFERENCES

- A. National Electrical Manufacturers Association: Wiring devices shall comply with NEMA Standards WD-1 and WD-6.
- B. Wet Locations: Wiring devices and their enclosures installed outdoors and in wet locations shall be approved for that purpose.
- C. Minimum Raceway Size: 3/4 inch.

1.4 SUBMITTALS

- A. Submit manufactures product data for all wiring devices, indicate intended color and coverplate.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All devices shall be suitable for use intended and have voltage and current ratings adequate for loads being served.
- B. For all devices with cover plates shall have the panel /circuit number engraved on device cover plate.

2.2 WALL SWITCHES

- A. Single Pole Switch, Toggle Style:
 - 1. Leviton 1221 Series, 20A, 120/277V.
- B. Double Pole Switch, Toggle Style:
 - 1. Leviton 1222 or 3032 Series, 20A or 30A, 120/277V.
- C. Three-way Switch, Toggle Style:
 - 1. Leviton 1223 Series, 20A, 120/277V.
- D. Four-way Switch, Toggle Style:
 - 1. Leviton 1224 Series, 20A, 120/277V.
- E. Indicator Switch, Toggle Style:
 - 1. Leviton 1201 Series, 20A, 120/277V. Switch illuminated when load is on.

- F. Locator Switch, Toggle Style:
 - 1. Leviton 1221 Series, 20A, 120/277V. Switch illuminated when load is off.

- G. Digital Time Switch:
 - 1. Wattstopper TS-400 digital time switch with optional visual warning to flashlights at 5 minutes and 1 minute prior to time-out.

- H. Key lock switches:
 - 1. Provide key lock switches for corridor lighting and other locations indicated on electrical drawings.
 - 2. 20 Amp rated.
 - 3. 120/277 Volt ac rated.
 - 4. Key-lock mechanism can only be turned ON or OFF with key.
 - 5. Single pole: Leviton 1221-2KL or approved equal.
 - 6. 3-Way: Leviton 1223-2kl or approved equal.
 - 7. 4-Way: Leviton 1224-2kl or approved equal.
 - 8. Provide 302 stainless steel wall plate for each switch.
 - 9. Provide 2 keys on ring for each switch.
 - 10. Include a brass tag on every key switch ring. Engrave tag; Example: "Hall East Lights".
 - 11. Key all switches alike to match the owner's standard key. Coordinate with school District for key match.

- I. Color: As selected by Architect.

2.3 MOTOR RATED SWITCHES

- A. Provide where a switch is indicated as a local disconnect for all mechanical and plumbing equipment.

- B. Leviton MMS Series.

2.4 WALL DIMMERS

- A. Manufacturers:
 - 1. Lutron Nova "T" Series.

- B. Product Description: Semiconductor dimmer for incandescent lamps with ON-OFF switch.

- C. Body and Handle: Linear slide handle, color as selected by Architect.

- D. Voltage: 120 volts.

2.5 RECEPTACLES

- A. Single Convenience Receptacle:
 - 1. Leviton 5362A Series, 20A/125V.

- B. Duplex Convenience Receptacle:
 - 1. Leviton 5362 Series, 20A/125V, respectively.

- C. GFCI Receptacle:

1. Leviton 7899 Series, 20A/125V.
 2. Provide GFCI receptacles for all receptacles on 120v circuits installed in kitchens, bathrooms and outdoors (including rooftops).
- D. Isolated Ground Duplex Receptacle:
1. Leviton 5362-IG, 20A/125V.
- E. Duplex Tamper Resistant Receptacle/ USB Charger
1. Leviton T5832. Duplex 20A/125V receptacle with two 3.6A, 5VDC, 2.0 Type A USB Chargers.
- F. Provide 20-amp receptacle for single-receptacle branch circuits.
- G. For locations where a quadruplex or fourplex is required, provide 2-duplex receptacles under common coverplate.
- H. Color: As selected by Architect.

2.6 WALL PLATES

- A. Type 302 Stainless Steel with matching mounting screws.

2.7 MANUFACTURERS

- A. Each type of wiring device shall be furnished by one (1) manufacturer. The following will be acceptable providing the project specifications:
 1. Leviton
 2. Pass & Seymour
 3. Hubbell / Bryant
 4. Cooper

PART 3 - EXECUTION

3.1 EXISTING WORK

- A. Disconnect abandoned circuits and remove raceway, wire, and cable. Remove abandoned boxes when connecting wire and cable is abandoned and removed. Install blank cover for remaining abandoned boxes.
- B. Maintain access to existing boxes and wiring connections remaining active and requiring access.
- C. Extend existing circuits using materials and methods compatible with existing electrical installations, or as specified.

3.2 INSTALLATION

- A. Route raceway and cable to meet Project conditions.
- B. Set wall mounted boxes at elevations to accommodate mounting heights indicated.
- C. Adjust box location up to ten (10) feet prior to rough-in when required to accommodate intended purpose.

- D. Do not install flush mounting box back-to-back in walls; install boxes with minimum 24 inches separation.
- E. Install devices plumb and level.

3.3 MOUNTING HEIGHTS

- A. As indicated on Drawings or if not indicated in accordance with the Architects instructions. All other telephone, Data, TV, etc. outlets shall be same as receptacle.

3.4 GANGED SWITCHES

- A. Install permanent barrier between all 277 Volt light switches ganged into one outlet box.
- B. Where multiple switches are grouped on one location, install switches under a one-piece, multi-gang cover plate.
- C. Other telephone, data, TV, etc. outlets shall be same as receptacle.

3.5 GFCI

- A. Provide ground-fault circuit-interrupter type receptacles for all 15 and 20 amp receptacles shown on drawings in bathrooms, kitchens, mechanical rooms and outdoors.

END OF SECTION 26 27 26

SECTION 26 43 00 - SURGE PROTECTION DEVICES (SPDs) FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Section 16400 – Surge Protection Devices, individually mounted and switchboard mounted. Switchboards: Surge Protection Device integrated in switchboards.

1.3 REFERENCES

- A. IEEE C62.41.1, IEEE Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits,
- B. IEEE C62.41.2, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits,
- C. IEEE C62.45, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits.
- D. National Electrical Code: Article 285
- E. UL 1283 - Electromagnetic Interference Filters
- F. UL 1449, Third Edition, effective September 29, 2009 – Surge Protection Devices

1.4 SUBMITTALS

- A. Product Data: Submit capacity, dimensions, weights, details, and wiring configuration.
- B. Submittals shall include UL 1449 4th Edition Listing documentation verifiable by visiting www.UL.com, clicking “Certifications” link, searching using UL Category Code: VZCA and VZCA2:
 - 1. Short Circuit Current Rating (SCCR)
 - 2. Voltage Protection Ratings (VPRs) for all modes
 - 3. Maximum Continuous Operating Voltage rating (MCOV)
 - 4. I-nominal rating (I-n)
 - 5. SPD shall be UL listed and labeled as Type 1 or Type 4 intended for Type 1 or Type 2 applications.
- C. Upon request, an unencapsulated but complete SPD formally known as TVSS shall be presented for visual inspection.
- D. Minimum of ten (10) year warranty Manufacturer's Installation Instructions: Submit installation instructions and connection requirements.

1.5 QUALITY ASSURANCE

- A. List individual units under UL 1449 (Forth Addition) and UL 1283.
- B. Single manufacturer: All equipment of each type shall be the product of one manufacturer.
- C. SPD shall comply with NEC Article 285 and shall be permanently marked with the short-circuit current rating of the device.
- D. Manufacturer Qualifications: Engage a firm with at least 5 years experience in manufacturing transient voltage surge suppressors.
- E. Manufacturer shall be ISO 9001 or 9002 certified.
- F. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of ten (10) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- G. The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept equipment on site in factory packaging. Inspect for damage.
- B. Protect equipment from damage by providing temporary covers until construction is complete in adjacent space.
- C. Handle and store equipment in accordance with manufacturer's Installation and Maintenance Manuals. One (1) copy of this document to be provided with the equipment at time of shipment.

PART 2 - PRODUCTS

2.1 SURGE PROTECTION DEVICES (SPDs)

- A. Manufacturers:
 - 1. Current Technology
 - 2. Southern Tier Technology
 - 3. Siemens
 - 4. Square D
 - 5. GE
- B. Product Description: Surge protection devices for protection of AC electrical circuits.
- C. Unit Operating Voltage: As indicated on Drawings.
- D. Construction:
 - 1. Finish: Factory finish of baked enamel.
 - 2. Balanced Suppression Platform: Equally distribute surge current to Metal Oxide Varistor (MOV) components to ensure equal stressing and maximum

performance. Furnish surge suppression platform with computer matched +/-1% MOV for equal load share.

3. Internal Connections: Hardwired with connections using low impedance conductors and compression fittings.
4. Safety and Diagnostic Monitoring: Equipped with standard overcurrent protection:
 - a. Continuous monitoring of fusing system.
 - b. Monitor individual MOV's (including neutral to ground). Capable of identifying open circuit failures not monitored by conventional fusing systems.
 - c. Monitor for overheating in each mode due to thermal runaway.
 - d. Furnish green and red solid state indicator light on each phase. Absence of green light and presence of red light indicates which phases have been damaged. Fault detection activates flashing trouble light. Units not capable of detecting open circuit damage, thermal conditions, and over current will not be accepted.
5. Labeling: Permanently affix UL 1449 (Forth Addition) suppression voltage ratings and CSA to unit.

E. Types:

1. Switchboards; locate as integral part of switchboard, coordinate mounting with switchboard manufacturer.
2. Panelboards; locate as stand-alone. Component in housing adjacent to protected panelboard. Install less than 10ft from the panel with minimum bends in the wire.

F. Protection Modes: For Wye configured system, furnish device with directly connected suppression elements between line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G). For Delta configured system, furnish device with suppression elements between line to line (L-L) and line to ground (L-G).

G. Swithboards:

1. The SPD shall be UL 1449 labeled as Type 1 or as Type 4 intended for Type 1 or Type 2 applications.
2. SPD shall meet or exceed the following criteria:
 - a. Maximum 7-Mode surge current capability shall be 300kA per phase.
 - b. UL 1449 – 4th Edition Revision; effective September 29, 2009, Voltage Protection Ratings shall not exceed the following:

<i>VOLTAGE</i>	L-N	L-G	N-G	L-L	<i>MCOV</i>
208Y/120	700V	700V	700V	1200V	150V
480Y/277	1200V	1200V	1200V	2000V	320V

3. UL 1449 Listed Maximum Continuous Operating Voltage (MCOV) (verifiable at UL.com):

<u>System Voltage</u>	<u>Allowable System Voltage Fluctuation (%)</u>	<u>MCOV</u>
208Y/120	25%	150V
480Y/347	15%	320V

4. SPD shall incorporate a UL 1283 listed EMI/RFI filter with minimum attenuation of - 50dB at 100 kHz.
5. Suppression components shall have redundant protection designed to share surge currents.
6. SPD shall include a serviceable, replaceable module.
7. SPD shall be equipped with the following diagnostics:

- a. Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.
- b. Audible alarm with on/off silence function and diagnostic test function (excluding branch).
- c. Form C dry contacts one normally open (NO) and one normally closed (NC) for remote status monitoring.
- d. Surge Counter

No other test equipment shall be required for SPD monitoring or testing before or after installation.

- 8. SPD shall have a response time no greater than 1/2 nanosecond.
- 9. SPD shall have a 10 year warranty.

H. Distribution and Lighting Panelboards:

- 1. Listing requirements: SPD shall bear the UL Mark and shall be Listed to most recent editions of UL/ANSI 1449 and UL 1283. "Manufactured in accordance with" is not equivalent to UL listing and does not meet the intent of this specification.
- 2. Listing requirements: SPD and performance parameters shall be posted at www.UL.com under Category Code: VZCA. Products or parameters without posting at UL.com shall not be approved. (To access UL Category Code click on Certifications in the left menu bar of UL's home page. Type "VZCA" into the Category Code search box and click Search.)
- 3. SPD shall be UL 1449 labeled with 200kA Short Circuit Current Rating (SCCR). Fuse ratings shall not be considered in lieu of demonstrated withstand testing of SPD, per NEC 285.6.
- 4. SPD shall be UL 1449 labeled as Type 1 intended for use without need for external or supplemental overcurrent controls. Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal overtemperature controls. SPDs relying upon external or supplementary installed safety disconnectors do not meet the intent of this specification.
- 5. SPD shall be UL 1449 labeled with 20kA I-nominal (I-n) (verifiable at UL.com) for compliance to UL 96A Lightning Protection Master Label and NFPA 780.
- 6. Standard 7 Mode Protection paths: SPD shall provide surge current paths for all modes of protection: L-N, L-G, L-L, and N-G for Wye systems; L-L, L-G in Delta and impedance grounded Wye systems
- 7. If a dedicated breaker for the SPD is not provided in the switchboard, the service entrance SPD shall include an integral UL Recognized disconnect switch. A dedicated breaker shall serve as a means of disconnect for distribution SPD's.
- 8. SPD shall meet or exceed the following criteria:
- 9. Minimum surge current capability (single pulse rated) per phase shall be:
 - a. Distribution applications:
 - 1) Southern Tier Technologies T45XXX050AWAJ2C with Maximum surge current capability of 100kA per phase

- 10. UL 1449 Listed Voltage Protection Ratings (VPRs) shall not exceed the following:

VOLTAGE	L-N	L-G	N-G
208Y/120V	700V	700V	700V
480Y/277V	1500V	1500V	1500V

UL 1449 Listed Maximum Continuous Operating Voltage (MCOV) (verifiable at UL.com):

System Voltage	Allowable System Voltage Fluctuation (%)	MCOV
208Y/120	25%	150V

480Y/277V	20%	320V
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11. SPD shall include a serviceable, replaceable module (excluding Distribution). (Deletable note: Delete or adjust as appropriate.)
12. Service Entrance ul Type 2 devices SPD shall have UL 1283 EMI/RFI filtering with minimum attenuation of -50dB at 100kHz.
13. SPD shall have a warranty for a period of ten (10) years, incorporating unlimited replacements of suppressor parts if they are destroyed by transients during the warranty period.
14. SPDs shall be equipped with the following diagnostics:
 - a. Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.
 - b. Audible alarm with on/off silence function and diagnostic test function (excluding branch).
 - c. Form C dry contacts one normally open (NO) and one normally closed (NC) for remote status monitoring.
 - d. Surge Counter

No other test equipment shall be required for SPD monitoring or testing before or after

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify mounting area is ready for equipment.
- B. Verify circuit rough-ins are at correct location.

3.2 INSTALLATION

- A. Install in accordance with IEEE 1100.
- B. Install service entrance suppressors in switchboard.
- C. Install suppressors for panelboards adjacent to panel.
- D. Install surge counter in face of switchboard.
- E. Include surge counter for stand-alone SPD.
- F. Install with maximum conductor length of 24 inches. Install suppressor with internal fusing.
- G. Provide 30 amp, 3 pole circuit breaker in panelboards to feed SPD.

END OF SECTION 26 43 00

SECTION 26 50 00 - LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes interior luminaires, lamps, ballasts, and accessories. Provide all luminaires complete with all new lamps, completely wired, controlled, and securely attached to supports.

1.3 SUBMITTALS

- A. Product Data: Submit dimensions, ratings, and performance data.
- B. Photometric data for each luminaire, lamp and ballast. Include indications of all options and accessories as well as finish color.
- C. Specification Review: A complete item by item, line by line specification review.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Provide luminaires listed by U.L.
 - 2. Luminaires installed in outdoor areas unprotected from weather to be U.L. Listed for wet locations.
 - 3. Insulated ceilings: Luminaires installed into insulated ceilings shall be U.L. Listed Type IC.
- B. Certification: Certify that fixtures submittal have trim compatible with ceilings being installed.
- C. Concrete for outdoor lighting poles foundations shall be provided per Section 03 30 00 - Concrete.

1.5 EXTRA MATERIALS

- A. Provide extra materials for Owners use. All parts shall packaged in suitable carton.
- B. Provide two (2) spare drivers for each fixture type. Deliver to Owner in original packaging.

PART 2 - PRODUCTS

2.1 LUMINAIRES

- A. Acceptable Manufacture: Provide per Fixture Schedule on drawings.

1. Approved equal: Contractor may submit luminaires from other manufacturers. Contractor shall provide a full set of submittals per paragraph 1.2 of this specification section for Engineer and Architects approval. Contractor must have approved submittals stamped and dated from the Engineer and Architect minimum 10 days prior to bid.
- B. Product Description: Complete luminaire assemblies, with features, options, and accessories as scheduled.
- C. All luminaires shall be new and of specification grade.
- D. Manufacturer nomenclature in fixture schedule or otherwise described on the Drawings is given only to show the general fixture series. Contractor shall provide fixture with all required accessories and mounting frame type.
- E. Wire guard at fixtures in mechanical, electrical, and high abuse areas.

2.2 LED LUMINAIRES

- A. Quality Assurance
 1. DOE Lighting Facts certified.
- B. LED Specifications
 1. Lumen maintenance of the LEDs has been tested in accordance with IESNA LM-80-08 reporting methodology.
 2. CRI:>82 minimum (general); >90 healthcare and retail.
 3. SDCM: <2.5 in linear pendants and linear recessed; <3.5 in discrete recessed.
 4. R9: .0 (general office/school environments); >50 in healthcare and retail environments.
 5. Outdoor luminaires to be rated at a minimum of 40⁰ C.
- C. Lumen Maintenance
 1. Minimum L70 at 50K hours based on TM-21 Addendum A Lifetime report at an ambient temperature of 25⁰ C, outdoors at an ambient temperature of 40⁰ C.
- D. Thermal Testing
 1. ISTM testing in accordance to UL 1598-2008.
- E. Driver
 1. 0-10V enabled.
 2. Output Class 2 rated.
 3. Dimming range: 5-100%.
 4. Constant current.
 5. THD @ max load: <20%.
 6. Power factor: >0.95
 7. Environment protection rating: UL Damp and dry.
 8. Approbations: certified to UL8750, UL1310, UL935, CSA-C22.2 No. 250.13-12, CSA 22.2 No. 223.
 9. ROHS Compliant
- F. Fixture photoetry

1. Conducted by a NVLAP accredited testing lab with IESNA LM 79-08.
2. System flux measured in delivered lumens.

- G. Warranty
1. 5 year total system warranty.

2.3 EMERGENCY LIGHTING AUTOMATIC TRANSFER SWITCHES

- A. Provide automatic transfer switch on all lighting fixtures shown to be on emergency.

2.4 DOWNLIGHT FIXTURES

- A. Provide recessed light fixtures with trim rings compatible with the ceiling material where fixture is to be installed.

2.5 EXIT SIGNS

- A. Exit signs shall meet visibility requirements and be listed per UL 924 " Emergency Lighting and Power Equipment". Also shall meet Federal, State and Local Codes.
- B. Chevron Directional Indicator: Provide Chevron per NFPA 101 Section 5-10.4.1.2.
- C. Product Description:
1. LED Exit Sign:
 - a. Provide exit sign with Light Emitting Diodes (LED) illuminance source. Cover LED with diffuser.
- D. Housing: Diecast aluminum with stencil face and matte white paint finish.
- E. Input Voltage: 120/277 volt, dual input voltage.
- F. EPA Energy Star Label.
- G. Wire Guards: Install wire guard on all exit signs installed in gyms, lockers rooms, and athletic wing.

2.6 OUTDOOR LUMINAIRE POLE ASSEMBLIES

- A. Outdoor Pole assemblies shall consist of a pole base, pole, luminaire or group and lighting circuit wiring.
- B. Diesel Standard: 2000 (IBC) International Building Code. Section 1609 requires wind forces on structure to be determined by the provisions of ASCE 7.
- C. Minimum Wind Speed: 120 miles per hour.
- D. Metal poles shall comply with NEC 410-15(b).
- E. Pole Material: Steel.
- F. Pole Shape: Round tapered.
- G. Pole finish shall match luminaires along mounting arms and bolt covers. Provide polyester powder coat finish on pole and luminaire, 3 mil thick.

- H. Pole accessories to include handhole and cover, full matching anchor bolt cover, anchor bolt kit, template, washers and leveling nuts.

PART 3 - EXECUTION

3.1 EXISTING WORK

- A. Disconnect and remove abandoned luminaires, lamps, poles and accessories.
- B. Extend existing luminaire installation using materials and methods compatible with existing installation, or as specified.
- C. Clean and repair existing luminaires to remain or to be reinstalled.

3.2 INSTALLATION

- A. General: All luminaires shall have proper supports.
- B. Install suspended luminaires using pendants supported from swivel hangers.
- C. Locate recessed ceiling luminaires as indicated on Drawings.
- D. Install surface mounted ceiling luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- E. Chain Hung: Unless otherwise indicated all fluorescent fixtures in Mechanical, Electrical and Elevator Equipment Rooms shall be chain hung. Verify exact mounting height with Architect before installing fixtures. Provide pendant hangers when equipment room has fire-resistive ceiling.
- F. Suspended Ceilings:
 - 1. Provide means of support for luminaires per NEC 410-36. T-bar clips shall be installed on the luminaire and shall be field secured to the inverted ceiling tees so that the luminaire is securely fastened to the ceiling system framing members.
 - 2. Ceiling tiles shall not bear the weight of luminaires. Surface mount luminaires, recessed downlights, light track, exit signs, etc. shall be supported by proper frames or other attachment to main ceiling system grid or building structure above ceiling.
 - 3. Luminaires shall be centered in ceiling tile.
 - 4. Luminaire shall have flange or trim ring for closure of ceiling cutout or opening.
 - 5. Fire-rated Ceiling Assembly: For Luminaires to be flush-mounted into a fire-rated ceiling or surface mounted to a fire-rated ceiling, install with independent, secure support. Raceway, cable assemblies, boxes and fittings located above a fire-rated floor/ceiling or roof ceiling assembly shall not be secured to, or supported by, the ceiling assembly including the ceiling support wires. Provide an independent means of secure support. Independent support wires shall be distinguishable by color, tagging, or other effective means from those that are part of the fire-rated design.
- G. Verify weights and recommended mounting methods of all luminaires with manufacturers. Furnish and install supports. Luminaires weighing more than 30 pounds shall be supported independently of the outlet box.

3.3 LOCATIONS

- A. Luminaires shown on the Electrical Drawings represent general arrangements only. Refer to Architectural Drawings and to Architect on jobsite for more exact locations. Coordinate location with all other trades before installation. Coordinate all light fixtures in Mechanical Rooms with the final installed piping and ductwork layouts. Adjust fixture mounting height and location if required so that light output is not obstructed by piping and ductwork.

3.4 FIRE INTEGRITY OF CEILING PENETRATIONS

- A. Where ceiling is part of a fire-rated assembly, maintain integrity of that assembly with methods given in Section Electrical Hangers and Supports. Obtain ceiling system UL Fire Resistance Directory Design Number from Architectural Drawings.

3.5 AIMING AND ADJUSTMENT

- A. General: All adjustable lighting units shall be aimed, focused, and locked by the Contractor under the supervision of the Architect/Owner. All aiming and adjusting shall be carried out after the entire installation is complete.

CLEANING

- A. Lens: Clean lenses of all luminaires after space is finished and prior to project acceptance.
- B. Louvers: Remove plastic bag from parabolic louver luminaires after space is finished and prior to project acceptance. Do not remove bags until luminaires have been cleared by the air-balance subcontractor.

3.6 OUTDOOR LUMINAIRE POLES

- A. Pole Base: Do not grout space between pole base plate and top of concrete pole foundation. Leave open to allow water to drain and for pole to breathe. If grout is recommended by pole manufacture in space between pole base plate and top of concrete pole foundation, provide grout with drain hole through grouting.
- B. Pole Delivery: Unwrap pole upon delivery to job site, unless otherwise instructed by pole manufacturer. Wrapped poles exposed to weather that show wrapper striping or other deterioration of finish shall be replaced at Contractor expense. Replacement shall be new pole or pole refinished at pole factory.
- C. Installation:
 - 1. Poles shall be erected only with luminaire(s) or equivalent damping device, unless otherwise instructed by pole or luminaire manufacturer. Poles installed without luminaires are subject to increased modes of vibration.
 - 2. Do not level pole with shims; leveling nuts above and below pole baseplate provide flexible adjustment and long-term holding of pole position.
 - 3. Provide anchor bolts and pole manufacturer's bolt template prior to concrete formwork for pole bases.
 - 4. Minimum wire size for circuit tap inside pole shall be AWG #12.
 - 5. Install pole base cover. Cover shall rest on top of concrete pole foundation and completely conceal air space under pole base plate.

- D. Fusing:
 - 1. Install fuse holder and fuses as noted in pole base detail on Drawings.
 - 2. All ballast-controlled luminaires shall be protected by Bussmann Fuses FNQ with Holders HEB (1-pole) or (2-pole) HEX. Fuse(s) and holder shall be mounted inside pole at handhole. Size of fuse to be recommended by the luminaire manufacturer.

3.7 RFI

- A. Provide flexible braided metal electrical bonding strap from grounded housing to door frame of all fluorescent parabolic fixtures in designated rooms. Bonding strap shall be braided conductor designed for field installation to either long door side.

END OF SECTION 26 50 00

SECTION 27 00 00 - BASIC MATERIALS AND METHODS

PART 1 – GENERAL

1.01 RELATED WORK

- A. The entire drawing and specification package apply to the work specified in the telecommunications sections of the specifications and shall be complied with in every respect. The Contract Documents are comprised of the drawings and specifications. The Contractor shall examine these Contract Documents, and coordinate required work indicated in each.

1.02 SCOPE OF WORK

- A. The work covered by the specifications includes furnishing materials, labor, transportation, tools, permits, fees, utilities, and incidentals necessary for the complete installation of work required in the Contract Drawings.
- B. It is the intent of the Contract Documents to provide an extension of the existing installed systems interfaced with new systems, complete in every respect.
- C. The Contractor shall be responsible for coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with the existing site conditions, details of the work and the working conditions, and verify dimensions in the field. The Contractor shall advise the Engineer of any discrepancy prior to bidding. The submission of bids shall be deemed evidence of the Contractor's site visit; coordination of existing conditions and include consideration for existing conditions.
- D. Provide line-by-line specification review for each Division 27 section annotated to certify compliance or deviation.

1.03 DRAWINGS AND SPECIFICATIONS

- A. The drawings and these specifications are complementary to each other, and what is required by one shall be as binding as if required by both.
- B. If variations or departures from the drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted to the Engineer for review. No departures shall be made without prior written acceptance of the Engineer.
- C. Should the drawings or specifications disagree in themselves or with their counterpart, the better quality or greater quantity of work or materials shall be estimated upon, and unless otherwise directed by the Engineer in writing, shall be performed or furnished. In case the specifications should not fully agree with the Schedules, the latter shall govern. Figures indicated on drawings govern scale measurements and large scale details govern small scale drawings.
- D. Items specifically mentioned in the specifications but not shown on the drawings and/or items shown on the drawings but not specifically mentioned in the specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.

1.04 CODES AND STANDARDS

- A. All work shall comply with the applicable articles of the National Electrical Code, the National Electrical Safety Code, the National Fire Codes (published by National Fire Protection Association), and City Codes and Ordinances, as well as any other authorities that may have lawful jurisdiction pertaining to the work specified. None of the terms or provisions of this specification shall be construed as waiving any of the rules, regulations, or requirements of these authorities.
- B. Contractor is responsible for knowledge and application of current versions of all applicable standards and codes. In cases where listed standards and codes have been updated, Contractor shall adhere to the most recent revisions, including all relevant changes or addenda at the time of installation.
- C. ANSI/TIA:
1. ANSI/TIA-526-7-A (July 2015) Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
 2. TIA-526.2-A (July 2015) Effective Transmitter Output Power Coupled into Single-Mode Fiber Optic Cable - Adoption of IEC 61280-1-1 ed. 2 Part 1-1: Test Procedures for General Communication Subsystems – Transmitter Output Optical Power Measurement for Single-Mode Optical Fiber Cable
 3. ANSI/TIA-4994 (March 2015) Standard for Sustainable Information Communications Technology
 4. ANSI/TIA-526-14-C (April 2015) Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
 5. ANSI/TIA-568.0-D (September 2015) Generic B (supersedes TIA-568-C.0 and TIA-568-C-1)
 6. ANSI/TIA-568.1-D (September 2015) Commercial Building Telecommunications Infrastructure Standard (supersedes ANSI/TIA-C.1)ANSI/TIA-568.2-D (September 2018) Balanced Twisted-Pair Telecommunications Cabling and Components Standard
 7. ANSI/TIA-568.3-D (June 2016) Optical Fiber Cabling Components Standard
 8. ANSI/TIA-568.4-D (August 2020) Broadband Coaxial Cabling Components Standard
 9. ANSI/TIA-569-E (May 2019) Telecommunications Pathways and Spaces
 10. ANSI/TIA-598-D (July 2014) Optical Fiber Cable Color Coding
 11. ANSI/TIA-570-C (August 2012) Residential Telecommunications Infrastructure Standard
 12. ANSI/TIA-606-C (June 2017) Administration Standard for Telecommunications Infrastructure
 13. ANSI/TIA-607-D (July 2019) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
 14. ANSI/TIA-758-B (March 2012) Customer-Owned Outside Plant Telecommunication Infrastructure Standard
 15. ANSI/TIA-862-B (February 2016) Structured Cabling Infrastructure Standard for Intelligent Building Systems
 16. ANSI/TIA-942-B (July 2017) Telecommunications Infrastructure Standard for Data Centers
 17. ANSI/TIA-1005-A (May 2012) Telecommunications Infrastructure Standard for Industrial Premises
 18. ANSI/TIA-1005-A-1 (January 2015) Telecommunications Infrastructure Standard for Industrial Premises, Addendum 1- M12-8 X-Coding Connector - Addendum to TIA-1005-A
 19. ANSI/TIA-1183 (August 2012) Measurement Methods and Test Fixtures for Balun-Less Measurements of Balanced Components and Systems
 20. ANSI/TIA-1183-1 (January 2016) Measurement Methods and Test Fixtures for Balun-Less Measurements of Balanced Components and Systems, Extending Frequency Capabilities to 2 GHz - Addendum to TIA-1183
 21. TIA-1152 (November 2016) Requirements for Field Test Instruments and

Measurements for Balanced Twisted-Pair Cabling

22. TIA-1179-A (September 2017) Healthcare Facility Telecommunications Infrastructure Standard
23. ANSI/TIA-4966 (May 2014) Telecommunications Infrastructure Standard for Educational Facilities
24. TIA-455-104-B (February 2016) FOTP 104- Fiber Optic Cable Cyclic Flexing Test (supersedes TIA-455-104-A)
25. TIA/EIA-455-25-D (February 2016) FOTP-25 Impact Testing of Optical Fiber Cables
26. TIA-604-18 (November 2015) FOCIS 18 Fiber Optic Connector Intermateability Standard – Type MPO-16
27. TIA-604-5-E (November 2015) FOCIS 5 Fiber Optic Connector Intermateability Standard- Type MPO
28. TIA-5017 (March 2016) Telecommunications Physical Network Security Standard
29. TIA-TSB-155-A (Reaffirmed 10-6-2014) Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T
30. TSB-184 (July 2009) Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling
31. TSB-4979 (August 2013) Practical Considerations for Implementation of Multimode Launch Conditions in the Field
32. TSB-190 (June 2011) Guidelines on Shared Pathways and Shared Sheaths
33. TIA-TSB-162-A (November 2013) Telecommunications Cabling Guidelines for Wireless Access Points
34. TSB-5018 (July 2016) Structured Cabling Infrastructure Guidelines to support Distributed Antenna Systems
35. TIA-492AAAE (June 2016) Detail Specification for 50- μ m Core Diameter/125- μ m Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers with Laser-Optimized Bandwidth Characteristics Specified for Wavelength Division Multiplexing
36. TIA-492AAAB-A (November 2009) Detail specification for 50- μ m core diameter/125- μ m cladding diameter class 1a graded-index multimode optical fibers
37. TIA-455-243 (March 2010) FOTP-243 Polarization-mode Dispersion Measurement for Installed Single-mode Optical Fibers by Wavelength-scanning OTDR and States-of-Polarization Analysis
38. TSB-172-A (February 2013) Higher Data Rate Multimode Fiber Transmission Techniques

D. ISO/IEC:

1. ISO/IEC TR 11801-99-01 Information technology – Generic cabling for customer premises: Guidance for balanced cabling in support of at least 40 GBit/s data transmission: Parts 1 and 2
2. ISO/IEC TR 29106 AMD 1 Information technology -- Generic cabling -- Introduction to the MICE environmental classification
3. ISO/IEC 24764 AMD 1 Information technology – Generic cabling for data centers
4. ISO/IEC 11801 AMD 1 AMD 2 Information technology – Generic cabling for customer premises
5. ISO/IEC 15018 AMD 1 Information technology – Generic cabling for homes
6. ISO/IEC 24702 AMD 1 Information technology – Generic cabling – Industrial premises
7. ISO/IEC 14763-1 AMD 1 Information technology – Implementation and operation of customer premises cabling – Part 1: Administration
8. ISO/IEC 14763-2 Information technology – Implementation and operation of customer premises cabling – Part 2: Planning and installation
9. ISO/IEC 14763-2-1 Information technology – Implementation and operation of customer premises cabling – Part 2-1: Planning and installation – Identifiers within administration systems
10. ISO/IEC 14763-3 Ed 2.0 Information technology -- Implementation and operation of customer premises cabling -- Part 3: Testing of optical fiber cabling

11. ISO/IEC TR 24704 Information technology – Customer premises cabling for wireless access points
 12. ISO/IEC TR 24750 Information technology – Assessment and mitigation of installed balanced cabling channels in order to support 10GBASE-T
 13. ISO/IEC TR 29125 IT Telecommunications cabling requirements for remote powering of terminal equipment
- E. BICSI – Building Industry Consultative Services International – Published Standards
1. ANSI/BICSI 001-2009, Information Transport Systems Design Standard for K-12 Educational Institutions
 2. ANSI/BICSI 002-2014, Data Center Design and Implementation Best Practices
 3. ANSI/BICSI-003-2014 Building Information Modeling (BIM) Practices for Information Technology Systems
 4. BICSI 004-2012, Information Technology Division Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities
 5. ANSI/BICSI 005-2016, Electronic Safety and Security (ESS) System Design and Implementation Best Practices
 6. BICSI 006-2015 Distributed Antenna System (DAS) Design and Implementation Best Practices
 7. ANSI/NECA/BICSI 568-2006, Standard for Installing Commercial Building Telecommunications Cabling
 8. NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
 9. BICSI – Building Industry Consultative Services International – Manuals
 10. Telecommunications Distribution Methods Manual, 14th Edition (2020)
 11. Information Transport Systems Installation Methods Manual (ITSIMM), 6th Edition
 12. Outside Plant Design Reference Manual, 5th Edition
 13. BICSI's ICT Terminology Handbook, Version 1.0
 14. Telecommunications Project Management Manual (TPMM), 1st edition
 15. Telecommunications Project Management Reference Document (TPMRD), 2nd Edition
 16. BICSI's Special ICT Design Considerations, Version 1.0
 17. Essentials of Bonding and Grounding, Version 1.0
- F. National Electric Codes
1. National Electrical Safety Code (NESC) (IEEE C2-2012)
 2. NFPA 70-2020, National Electrical Code® (NEC®)
 3. ANSI/IEEE C2-207, National Electrical Safety Code®
 4. National Electrical Code (NEC) (NFPA 70)
 5. NFPA 72 National Fire Alarm and Signaling Code
- G. ASHRAE
1. ASHRAE Standard 90.4P, Energy Standard for Data Centers and Telecommunications Buildings
- H. OSHA Standards and Regulations – all applicable
- I. Local Codes and Standards – all applicable
- J. Anywhere cabling standards conflict with one another or with electrical or safety codes, Contractor shall defer to the NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either.
- K. Knowledge and execution of applicable standards and codes is the sole responsibility of the Contractor.

- L. Any violations of applicable standards or codes committed by the Contractor shall be remedied at the Contractor's expense.
- M. In any instance where these Specifications call for materials for construction of a better quality or larger size than required by the codes, the provisions of these Specifications shall take precedence. The codes shall govern in case of direct conflict between the Codes and the Drawings.

1.05 EXISTING UTILITIES

- A. The Contract Documents reflect the general location and routing for all telecommunications services known to exist on this project.

1.06 BUILDING CONSTRUCTION AND LAYOUT OF WORK

- A. General: It shall be the responsibility of the Contractor to consult the Engineering Drawings and Details so as to thoroughly familiarize himself with the type and quality of construction to be provided on this project.
- B. The drawings are diagrammatic in nature and do not show every connection in detail or every line or conduit in its exact location. These details are subject to the requirements of all codes and ordinances as well as all structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases unless specifically noted or indicated to be exposed. Work shall be installed to avoid crippling of structural members; therefore, inserts to accommodate conduit hangers shall be set before concrete is poured, and proper openings through floors, walls, beams, etc. shall be provided as hereinafter specified or as otherwise indicated or required before concrete is poured. All work shall be run parallel or perpendicular to the lines of the building unless otherwise noted.
- C. The approximate location of equipment items is indicated on the drawings. Exact locations are to be determined by coordination of dimensions from approved equipment submittals and site-verified field measurements and will in all cases be subject to the approval of the Engineer. The Engineer reserves the right to make any reasonable changes in the indicated locations prior to installation for no additional cost.
- D. In areas of existing special ceiling construction the removal and restoration must be carefully planned such that the existing condition of the ceilings is maintained. It may be necessary for the Contractor to procure a Subcontractor familiar with this work to achieve this requirement.

PART 2 – PRODUCTS

2.01 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

- A. Materials, in general, shall conform to the National Electrical Code requirements and shall be listed, inspected, and approved by the Underwriters Laboratories and shall bear the UL label where labeling service is available. The label or listing of the Underwriters Laboratories, Inc. will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this listing, the Contractor may submit a statement from a nationally recognized, adequately equipped testing agency, indicating that the items have been tested in accordance with required procedures, and that the materials and equipment comply with all Contract requirements.

2.02 STANDARD PRODUCTS

- A. Materials and equipment shall be the standard catalog products of manufacturers regularly engaged in the manufacture of products conforming to these specifications, and shall essentially duplicate materials and equipment that have been in satisfactory use at least two (2) years prior to bid opening. Where custom or special items are required, these shall be fully described using drawings, material lists, etc., which fully describe in detail the item proposed for use on this project.

2.03 MANUFACTURER'S INSTRUCTIONS

- A. The Contractor is responsible for furnishing the proper telecommunications equipment and/or material and for seeing it is installed as intended by the manufacturer. The Contractor shall, wherever necessary, request advice and supervisory assistance from equipment manufacturers as required for the proper installation, operation, or start-up. The Contractor shall notify the Engineer in writing of any conflict between the Contract Documents and the manufacturer's recommendations and shall obtain from the Engineer instructions/direction before proceeding with the work. The Contractor shall pay for all costs resulting from deficiencies created by installation not in accordance with the manufacturer's recommendations or the instructions of the Engineer.

2.04 RUST PREVENTION

- A. Metallic materials shall be protected against corrosion. Exposed metallic parts of equipment exposed to the elements shall be given a rust inhibiting treatment and standard finish by the manufacturer. Components such as boxes, bodies, fittings, guards, and miscellaneous parts shall be protected in accordance with the ASTM A123 or A153, except where other equivalent protective treatment is specifically approved in writing.

2.05 STORAGE AT SITE

- A. The Contractor shall not receive material or equipment at the job site until ready for installation or until there is suitable space provided to properly protect equipment from rust, weather, humidity, dust, or physical damage.

2.06 CONDITION OF MATERIALS

- A. All materials required for the installation of the telecommunications systems shall be new and unused. Any material or equipment damaged in transit from the factory, during delivery to premises, while in storage on premises, while being erected and installed, or while being tested, until time of final acceptance, shall be replaced by this Contractor without extra cost to Owner.

2.07 NAMEPLATES

- A. Factory assembled components and equipment shall be provided with embossed nameplates, securely attached to the equipment with rivets or screws. Nameplates will have information required to specifically identify the equipment in the future such as the manufacturer's name, address, catalog number, serial number, etc. All data on nameplates shall be legible at the time of final inspection.

PART 3 – EXECUTION

3.01 ACCEPTABLE MANUFACTURERS

- A. The specifications contain the names of manufacturers which are considered acceptable based on the quality of the product.
- B. Where acceptable manufacturers are listed, only products of those manufacturers may be provided. Additionally, the product must meet all the detailed requirements of the specifications.
- C. If no manufacturer's name is mentioned, the Contractor shall provide equipment and material which meet the specifications.
- D. The drawings represent the manufacturer's equipment scheduled. The listing of acceptable manufacturers in the specifications is not intended to imply that equipment of these other manufacturers will fit in the space provided or have the same electrical, structural or other requirements as the equipment scheduled. The Contractor must ensure that the equipment provided will meet all project requirements prior to submitting data on that equipment.

3.02 SPACE AND EQUIPMENT ARRANGEMENT

- A. Equipment and components shall be installed in a manner to permit access to parts requiring service. Telecommunications equipment shall be installed in such a manner as to allow removal for service without disassembly of adjacent equipment.
- B. Large equipment or apparatus which is to be installed in the building, and which is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed. Following placement in the space, such apparatus shall be thoroughly protected from damage.
- C. Equipment shall have working clearances as required by applicable codes and standards.

3.03 SUBMITTAL AND REVIEW OF MATERIALS

- A. After the Contract is awarded, but prior to proceeding with the Work, the Contractor shall obtain, check, certify, and submit complete Shop Drawings and Brochures from Manufacturers, Suppliers, Vendors, etc., for all materials and equipment specified herein. Submit Shop Drawings and Brochures in sufficient time so as not to impede the progress of work. Three weeks will be required for the processing of Shop Drawings and Brochures in the Engineer's office, exclusive of transmittal time. This time shall be considered by the Contractor when scheduling submittal data. After the Contract is awarded, the Contractor will advise the Engineer in writing of the schedule for submission of shop drawings and product data and the persons authorized to sign submittal data on behalf of the Company.
- B. The Engineer's review of Shop Drawings and Brochures shall not relieve the Contractor of the responsibility for dimensions, errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the Engineer's noting some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the submittal data review.
- C. Before submission of Shop Drawings and Brochures, the Contractor shall certify that each Shop Drawing and each item of material or equipment complies with the Contract Documents for this Project. Such certification shall be made by the Owner, a Partner, a Corporate Officer of the Contractor, or by a person duly authorized to sign for the Contractor.

Unless so certified, Shop Drawings and/or Brochures will be returned for resubmittal. Certifications shall be in the form of rubber stamp impressions or typed letter which states:

I hereby certify that this Shop Drawing and/or brochure and the equipment and material shown on this Shop Drawing and/or Brochure complies in all aspects (except as noted*) with the requirements of the Contract Documents for this Project. I further certify that all data shown herein as to performance, dimensions, construction, materials, and other pertinent items are true and correct.

Name of Contractor _____

Signed _____

Position _____

Date _____

*Refer to exception requirements herein.

- D. Each Shop Drawing shall indicate in the lower right hand corner and each Brochure shall indicate on the front cover the following: Title of the Sheet or Brochure; name and location of the building; names of the Engineer, Contractor, Manufacturer, Supplier, Vendor, etc., the date of submittal; and the date of each correction and revision. So far as is practical, each Shop Drawing and/or Brochure shall bear a cross-reference note to the sheet number or numbers of the Contract Drawings and Specifications showing the same work. Shop Drawings and Brochures shall be prepared as follows:

1. Shop Drawings: Drawings shall be newly prepared and not reproduced from the Contract Documents, drawn to a scale that can be easily read and shall contain sufficient plans, elevations, sections, and isometrics to describe clearly the items in question. Drawings shall be prepared by a draftsman skilled in this type of work. All equipment layouts and similar Shop Drawings shall be drawn to at least 1/4-inch = 1'-0" scale.
2. All Shop Drawings shall indicate the equipment actually purchased. The elevation, location, support points, load imposed on the structure at support and anchor points, shall be indicated. All beam penetrations and slab penetrations shall be indicated and sized and shall be coordinated. All Design Drawing space allocations shall be maintained, such as ceiling height, chase walls, equipment room size, etc., unless proper written authorization is required from the Engineer to change them. All associated equipment shall be coordinated and clearly shown on the Shop Drawings.
3. Brochures: Brochures submitted to the Engineer shall be published by the Manufacturers and shall contain complete and detailed engineering and dimensional information to show that the equipment will fit into the allotted space.
4. Brochures submitted shall contain only information which is relevant to the particular equipment or materials to be furnished. Do not submit catalogs that describe several different items other than those items to be used unless all irrelevant information is marked out or relevant information is clearly marked.

- E. The submittal format shall follow the Specifications format with a submittal required for each required section. The submittal shall be contained in a three-ring hard back binder. Copies of each submittal shall be three-hole punched and arranged (or folded if required) for the Engineer's filing convenience. Provide one copy of updated TABLE OF CONTENTS and

progressive-tabbed index sheets also for the Engineer's filing convenience.

- F. Submittal data for each section must be complete. Partial submittals will not be reviewed. To the greatest extent possible all sections shall be submitted with the first submission. No more than three additional submissions will be allowed to complete the submittal package.
- G. Unless a greater number is indicated within Division One of these specifications, submit six (6) copies of all Brochures for review. Submit one (1) reproducible and one (1) blueprint of shop drawings for review. Comments will be made on the reproducible to facilitate copying.
- H. Any submittal that is disapproved must be resubmitted within two (2) weeks following notification of such disapproval. If no satisfactory material is submitted within the two-week period, the Engineer reserves the right to require the Contractor to furnish items exactly as described in the Contract Documents.
- I. No allowances will be made for submittals which are not made in a timely fashion or which are turned down because they do not meet the specifications. Should delivery problems arise due to the above, affecting the completion time of the project, the Contractor will furnish and install acceptable alternates until the proper materials arrive and then replace the alternate materials with the approved materials, all at no cost to the Owner. If the Contractor is not able to furnish an acceptable alternate until the proper materials arrive, he will assume all costs for furnishing and installing all alternates as directed by the Engineer and/or will pay a suitable penalty for the inconvenience experienced by the Owner. This penalty will be set by the Owner based on the particular circumstances.

3.04 SUPERVISION

- A. A competent certified foreman or superintendent, approved by the Engineer, shall be maintained at the project site to receive instructions and to act for the Contractor. Once this superintendent has been approved, no change shall be made without approval of the Owner or his authorized representative. The Owner and his authorized representative shall have the right to observe the work at any time. The Contractor shall have a representative present when his work is being observed, and he shall give assistance as required.

3.05 CUTTING AND PATCHING

- A. Where it is necessary to cut through walls, floors, or ceilings to permit installation of work under this section of the Contract, or to repair any defects that may appear, up to the expiration of guarantee period, such cutting shall be done under the supervision of the Engineer. The Contractor shall not be permitted to cut or modify any structural members without the written permission of the Engineer.
- B. Patching of all openings and repairing of any damage to the work of other trades occasioned by cutting operations, or occasioned by the failure of any part of work installed under this Contract, shall be performed by the trade whose work is involved, and shall be paid for by the Contractor.
- C. Openings cut through exterior walls or roofs shall be provided with suitable covers to protect the property or materials involved. Openings cut through walls below grade shall be properly protected to prevent entrance of water or other foreign elements. Openings cut between fire zones or plenums shall be sealed to maintain the fire integrity of the wall or floor. Conduits and cable tray through plenum wall shall be sealed using materials complying with UL 1479, NEC 300-21, and NEC 800-3(C), and shall be UL classified.

3.06 HOISTING, SCAFFOLDING, AND TRANSPORTATION

- A. Provide hoisting and scaffolding facilities as required to set materials and equipment in place.

3.07 CLEANING

- A. The Contractor shall at all times keep the premises free from accumulations of waste material or rubbish. Debris shall be removed from the site and from any street or alley adjacent to the site.
- B. At completion of the project, the Contractor shall remove all tools, scaffolding, and surplus materials. Contractor shall leave the area "broom clean". Before final acceptance, vacuum all panels, cabinets, racks and other equipment enclosures. Wipe clean all fixture lenses and reflectors, all panelboard and switchboard interior and exterior surfaces, being careful to remove all stray paint, construction materials, dust, and particles. Touch-up all marred surfaces to restore existing conditions to those provided by the manufacturer.

3.08 CONDUIT SLEEVES

- A. Where conduits pass through walls or floors not on fill, galvanized sheet metal sleeves shall be provided and shall be sealed to prevent air and noise transmission. In walls, they shall be flush with each finished surface. In pipe chases, they shall extend 1-1/2 inches above floor slab and be cemented in a water tight manner. Size of these sleeves shall be at least 1/2 inch greater than outside diameter of the conduit.
- B. For conduits passing through outside walls, provide and install galvanized steel sleeves having an inside diameter at least 4 inches greater than the outside diameter of contained conduit. Where these occur in walls having a waterproof coating applied, the sleeves shall have welded flanges to build into waterproofing. When conduits are installed, the annular space between pipe and sleeve shall be effectively sealed, using shredded lead hammered in place or an approved mastic sealer.
- C. Pipe and duct sleeves, pitch pockets, and flashings compatible with the roofing installation shall be provided for roof penetrations.

3.09 GROUNDING

- A. Ground buses shall be provided in each Telecommunications room by Division 16 Contractor unless noted on Contract Drawings.
- B. Telecommunications grounding system shall be a single point grounding from the building entrance electrical ground to each Telecommunications room. This Grounding system shall be provided by Division 16 Contractor unless notes on Contract Drawings.
- C. All Conduit systems, cabinets' racks, cable trays, protector blocks, SCTP patch panels and/or miscellaneous equipment, etc. shall be grounded by being connected to the common telecommunications grounding system. The conductors shall be a # 6awg solid with a green jacket

3.10 RECEDENCE OF WORK

- 1. This Contract includes many different systems furnished and installed by different trades. All trades shall coordinate their work with that of all other trades so that it may be installed in the most direct and workmanlike manner without hindering or handicapping other trades.

3.11 RECORD DRAWINGS

- A. The Contractor shall keep a set of Drawings on the job, noting daily all changes made in these Drawings in connection with the final installation, including exact dimensioned locations of all new and uncovered existing active and inactive utilities outside the building, and shall turn over a clean, neatly marked set of mylar reproducible Drawings showing "as-installed" work to the Engineer for delivery to the Owner. All underground utilities, services, and systems shall be accurately located by the Contractor and dimensioned on the "as-installed" Drawings.

3.12 OPERATING AND MAINTENANCE MANUAL

- A. The Contractor shall furnish indexed operating and maintenance manuals with complete technical data for each system, piece of equipment, and material installed under this Contract.
- B. Two (2) copies of the manual, bound in hardback binders or an approved equivalent, shall be provided. One copy shall be completed and delivered to the Engineer prior to the time that system and equipment tests are performed. The second copy shall be delivered prior to final acceptance.
1. Provide one (1) operation and Maintenance manual for each building. Provide one (1) as-built floor plan and one CD for each building.
- C. The manual shall include the following information
1. Manufacturer's installation instructions.
 2. Manufacturer's local representative and/or distributor's name and address.
 3. Manufacturer's operating and maintenance instructions.
 4. Manufacturer's internal wiring diagrams.
 5. Contractor's installation wiring diagrams.
 6. Replacement part number listings and descriptions.
 7. Framed operating instructions, when required, in individual Specification sections.
 8. Warranties and guarantees.
 9. Provide an approved submittal at the front of each section.
- D. The manuals shall be identified on the cover as "Operating and Maintenance Manual" with additional cover display of the name and location of project, the Owner, the Engineers, the General Contractor, and the Subcontractors installing equipment represented in the brochure.
- E. The manual shall have a Table of Contents and shall be grouped in sections according to the sections of Division 27. Each section shall have a copy of the pages of the Specifications covered within the section. Sections shall be organized as follows:
1. Each section in the manual shall identify the grouping of all literature required for the system or equipment included.
 2. The contents of each section shall be arranged in the following sequence: First, the approved engineering submittals with complete performance and technical data; second, the manufacturer's installation brochure; third, the manufacturer's operating and maintenance brochure; fourth, the manufacturer's installation wiring diagram; fifth, the Contractor's field wiring diagram, if different; and sixth, the manufacturer's brochure listing replacement part numbers and description.
 3. Provide a final section entitled, "Warranties and Guarantees", for all equipment, etc.

3.13 EXISTING FACILITIES

1. The Contractor shall be responsible for loss or damage to the existing facilities and shall be responsible for repairing or replacing such loss or damage. The Contractor shall send proper notices and receive written permission from the Owner to enter existing areas. Before beginning work in existing areas, the Contractor shall make necessary arrangements and perform other services required for the care, protection, and in-service maintenance of all electrical, communication, plumbing, heating, air condition, and ventilating services for new and existing facilities. The Contractor shall erect temporary barricades with necessary safety devices to protect personnel from injury, removing all such temporary protection upon completion of the work.
2. The Contractor shall provide temporary or new services to existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.
3. Where existing construction is removed to provide working and extension access to existing utilities, the Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air condition ductwork, and equipment, etc. to provide this access and shall reinstall same upon completion of work.
4. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed, the Contractor shall remove and reinstall in locations approved by the Engineer all devices required for the operation of the electrical systems installed in the existing construction. This is to include, but is not limited to, temperature control system devices, electrical switches, relays, fixtures, piping, conduit, etc.

3.14 DEMOLITION AND RELOCATION

1. The Contractor shall modify, remove, and relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain as directed by the Owner. Materials and items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to the approval of the Owner. The Contractor may substitute new materials and items of like design and quality in lieu of materials and items to be relocated, if approved by the Owner.
2. All items scheduled for relocation and/or reuse shall be inspected by the Contractor and the Owner or his authorized representative. A written report of the condition of each item shall be made and provided to the Engineer. Where items scheduled for relocation and/or reuse are considered unsuitable for reuse, the Contractor shall so notify the Engineer and await reinstallation instructions before proceeding with removal. Items damaged in reinstallation shall be repaired or replaced by the Contractor as directed by the Owner at not additional cost to the Owner or the Engineer.
3. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocation and to restore the items to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.
4. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points as indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied off or connections into the existing facilities in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted.

without prior specific written approval of the Engineer.

3.15 OUTAGES

1. Outages of services as required by the project will be permitted, but only at a time approved by the Owner. The Contractor shall notify the Owner in writing two (2) weeks in advance of the requested outage in order to schedule required outages. No outages shall be taken unless written approval has first been received from the Owner. The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner. All costs of outages, including overtime charges, shall be included in the Contract amount.

END OF SECTION

SECTION 27 32 43 – CAMPUS RADIO ANTENNA SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

The General Provisions of the Contract, including General and Supplementary Conditions, apply to the work specified in this Section.

1.2 WORK INCLUDED

- A. Provide a complete and tested radio system as detailed in the project specifications and associated project drawings. Provide system only for campuses shown to have a "CRAS" as noted on the drawings. The systems shall include:
1. UHF base station radio repeater supporting at least 450MHz – 470MHz.
 2. Install antenna on a mast in an area to provide optimum performance for internal and external communications
 3. Accessory devices and powersupplies
 4. Installation of equipment and cabling between antenna and radio repeater
 5. System setup, frequency programming and testing per the District Communications Department Requirements.
 6. FCC Licensing of all equipment prior to installation.
 7. Training shall include demonstration and instructing district and campus staff on operation.
 8. Contractor responsible for all cabling and terminations between repeater and antenna and all other devices in order to provide fully functional systems.

1.3 CONTRACTOR REQUIREMENTS

- A. Contractor shall have at least 5 years of experience installing, servicing and supporting building radio antenna communication systems and factory authorized representative of Motorola equipment.
- B. Installation and programming shall be performed by FCC licensed technicians for this type of equipment.
- C. Contractor to provide wiring riser diagram and detailed product listing as part of project submittal.

1.4 WARRANTY

One year from date of substantial completion.

1.5 SUBMITTALS

- A. Product Literature: Complete manufacturer's product literature showing electrical characteristics and connection requirements.
- B. Wiring Diagram: Indicate system wiring diagram showing each device and wiring connection. Indicate partition layout.
- C. Operations and Maintenance Data: Submit manufacturer's standard operating and maintenance instructions.

1.6 DEMONSTRATION AND TRAINING

A written test report from an authorized representative that the system has been 100% tested and is functioning properly shall be submitted prior to training and demonstration. Contractor shall demonstrate system operation to District personnel and project manager and provide one hour of instruction at each site with the manufacturer's representative.

PART 2 - PRODUCTS AND MATERIAL

2.1 EQUIPMENT (Provide one system at each campus as noted on the drawings.)

- A. UHF base station repeater radio repeater supporting between 450 Mhz – 470 Mhz.
- B. Install antenna system on roof mounted mast, preferably with first responder antenna system (FRAS) mounting bracket.
- C. FCC licensing of entire system.
- D. Product listing per campus shall be the following:
 - a. 1 qty. Motorola SLR5700 - 450 - 512MHz (UHF2) - Repeater - AAR10TCGANQ1AN
 - b. 1 qty. Motorola DSCP10725UNTUNED - UHM DUPLEXER 406 - 500MHz
 - c. 1 qty. Laird FG4500 - UHF 450-470 UNITY GAIN ANTENNA with compatible mount.
 - d. 1 qty. IS-B50LN-C2 - Polyphaser 125-1000 MHz
 - e. 1 qty. Motorola PMLE5031 Bracket
 - f. Times Microwave Systems GK-S400TT - LMR Ground Kit – Quantity as required to provide a fully functional system.
 - g. 343019 - 3 RG142P Jumper NM BM – Quantity as required to provide a fully functional system.
 - h. 324975 - 3 RG142P Jumper NM NM – Quantity as required to provide a fully functional system.
 - i. TMC-EZ-400-NM-X - COAX Cable Connector – Quantity as required to provide a fully functional system.
 - j. FCC LICENSING: Frequency coordination & acquisition for repeater.
 - k. INSTALLATION MATERIALS: Connectors, lightning protection, mounting brackets, 5' antenna mast and all other required installation materials for a complete and operational system.
- E. Cabling shall be Provide and install Times LMR-400-LLPL-Black, low loss, plenum rated, indoor/outdoor coax antenna cable with connectors (or 1/2" equivalent). Provide all requisite cabling and connectors between all devices.

2.2 CABLES

Provide and install Times LMR-400-LLPL-Black, low loss, plenum rated, indoor/outdoor coax antenna cable with connectors (or 1/2" equivalent). Provide all requisite cabling and connectors between all devices.

END OF SECTION

SECTION 27 51 23 – INTEGRATED ELECTRONIC COMMUNICATIONS AND CLOCK NETWORK

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 GENERAL REQUIREMENTS

- A. The conditions of the General Contract (General, Supplementary, and other Conditions) and the General Requirements are hereby made a part of this Section.
- B. All bids shall be based on the equipment as specified herein. The catalog numbers and model designations are that of the Bogen Nyquist E7000 Series Educational System. No alternates or substitutions shall be accepted.
- C. The contractor shall provide the FCC registration number of the proposed system, where applicable.
- D. The contractor for this work shall have read all the bidding requirements, the general requirements of Division 1, and the contract proposal forms, and shall be held to the execution of this work. The contractor shall be bound by all the conditions and requirements therein.
- E. The contractor shall be responsible for providing a complete functional system, including all necessary components whether included in this specification or not.
- F. In preparing the bid, the contractor should consider that no claim will be made against the owner for any costs incurred by the contractor for any equipment demonstrations requested by the owner.
- G. Should any discrepancy exist between the specifications and the drawings, the contractor shall provide the most valuable / highest in quantity devices and materials noted.

1.3 SCOPE OF WORK

The contractor shall furnish and install all new equipment, accessories, cabling, and materials in accordance with the specifications and drawings to provide a complete and operating VoIP school communications system including but not limited to:

- A. Nyquist NQ-E7030 Analog Station Bridge (ASB)
 - 1. 24 station interface supporting analog speakers and call switches
 - 2. Built-in 2x120W power amplifiers
 - 3. Two speech links
 - 4. Category wiring
 - 5. 25/70-volt speaker(s), ceiling-mounted, wall-mounted, and paging horns
 - a. Ceiling Mounted Speakers: CSD2X2U Drop-In Ceiling Speaker
 - b. Ceiling Mounted Speakers: S810T725PG8U Ceiling Speaker
 - c. Wall Baffle Speakers: MB8TSQ/SL Metal Box Speaker
 - 6. Analog/Mechanical Call Switches capable of placing Normal, Urgent, or Emergency priority calls
 - a. CA-15C rocker style momentary call button
 - b. CA-21B rocker style momentary call button with a push on position for privacy
 - c. All wall mount Call Button back boxes shall be flush mount where possible. In the case where it is not possible to flush mount the back boxes, provide Legrand

surface mount boxes, Legrand 2400 series and Legrand 700 series metal raceway, unless otherwise noted. Paint boxes and raceway to match surface prior to installation.

7. CAN Bus 2.0 interface designed for future support of Nyquist Digital Call Switch (DCS) NQ-E7020 that can initiate Normal, Urgent, or Emergency priority calls, all with options for Privacy Mode
 - a. All wall mount Call Button back boxes shall be flush mount where possible. In the case where it is not possible to flush mount the back boxes, provide Legrand surface mount boxes, Legrand 2400 series and Legrand 700 series metal raceway, unless otherwise noted. Paint boxes and raceway to match surface prior to installation.

- B. Nyquist NQ-P0100 Matrix Mixer Pre-Amplifier (MMPA)
 1. Four Mic/Line inputs that are user-configurable
 2. Line-Level/Monitor output
 3. Digital AES/EBU (AES3) input

- C. Nyquist NQ-E7010 Input/Output (I/O) Controller
 1. Eight inputs to monitor third-party device events
 2. Eight outputs to initiate third-party device actions
 3. Power over Ethernet (PoE) Class-1 (IEEE 802.3af compliant)

- D. Nyquist NQ-S1810WT Classroom VoIP Wall Baffle Speaker(s)
 1. Adjustable volume via web browser, 100 steps minimum
 2. Built-in 10W amplifier
 3. MEMS digital microphone for full duplex talkback
 4. PoE Class-3 (IEEE 802.3af compliant)
 5. Connection to optional Nyquist DCS NQ-E7020, which is capable of placing Normal, Urgent, or Emergency priority calls and can provide station status and the ability for the user to enable and disable Privacy Mode

- E. Nyquist NQ-S1810CT Classroom VoIP Ceiling Speaker(s)
 1. Adjustable volume (100 steps minimum) via web browser
 2. Built-in 10W amplifier
 3. MEMS digital microphone for full duplex talkback
 4. PoE Class-3 (IEEE 802.3af compliant)
 5. Connection to optional Nyquist DCS NQ-E7020, which can place Normal, Urgent, or Emergency priority calls and can provide station status and the ability for the user to enable and disable Privacy Mode

- F. Built-in Master Clock with the following minimum features:
 1. Unlimited Events
 2. Unlimited Concurrent Schedules
 3. Unlimited Holidays

- G. Nyquist E7000 Series Educational System Software shall be installed on a dealer or a customer-supplied server with the following minimum specifications:
 1. Web Server for full system configuration and operation
 2. Nyquist web-based Administrative User Interface (Admin Web UI) for programming and day-to-day system operation, including but not limited to:
 - a. Station intercom two-way calling
 - b. Zone Paging with software-adjustable volume per zone
 - c. Emergency Paging
 - d. Playing Emergency Tones
 - e. Playing Tones
 - f. Playing Announcement Files
 - g. Managing Bell Schedules

- h. Weekly Bell Schedule Review at-a-glance
 - i. Audio Distribution
 - j. System muting
- H. Teacher's Dashboard web-based UI for teachers, including but not limited to:
- 1. Directory
 - 2. Dial Pad
 - 3. Voicemail
 - 4. Call Forwarding
 - 5. Single-click or touch Normal or Emergency calling
 - 6. Single-click or touch 911 calling
- I. VoIP Admin Phone, PoE, 7" 800 x 480-pixel color touch screen with backlight
- J. VoIP Staff Station, PoE, 132 x 64-pixel graphical LCD with backlight
- K. Owner Telephone System Connectivity
- 1. System shall be capable of connecting to the Public Switched Telephone Network (PSTN), analog Public Branch Exchange (PBX), or digital PBX/IP-PBX by connecting to an unlimited number of SIP trunks, analog FXO/FXS lines, or CO Trunks.
 - 2. Telephone service with public utilities will be arranged by the owner in conjunction with the equipment supplier. Equipment supplier shall generate a one-page document that will provide the owner with the number of outside lines.

1.4 SUBMITTALS

- A. Spec Sheets on all items including cable types
- B. Outline drawing of system control cabinet showing relative position of all major components
- C. Shop drawings, detailing integrated electronic communications network system including, but not limited to, the following:
 - 1. Station wiring arrangement
 - 2. Equipment cabinet detail drawing
- D. Wiring diagrams showing typical connections for all equipment
- E. Numbered Certificate of Completion for installation, programming, and service training, which identifies the installing technician(s) as having successfully completed the Nyquist E7000 technical training course provided by the Bogen Communications, Inc.

1.5 QUALITY ASSURANCE

- A. All items of equipment shall be designed by the manufacturer to function as a complete system and shall be accompanied by the manufacturer's complete service notes and drawings detailing all interconnections.
- B. The contractor shall be an established communications and electronics contractor that maintains a locally run and operated business and has done so for at least 10 years. The contractor shall be a duly authorized distributor of the equipment supplied with full manufacturer's warranty privileges.
- C. The contractor shall show satisfactory evidence, upon request, that he or she maintains a fully equipped service organization capable of furnishing adequate inspection and service to the system. The contractor shall maintain at his or her facility the necessary spare parts in the proper proportion as recommended by the manufacturer to maintain and service the equipment being supplied.

1.6 SINGLE SOURCE RESPONSIBILITY

- A. Except where specifically noted otherwise, all equipment supplied shall be the standard product of a single manufacturer of known reputation and a minimum of 20 years of experience in the industry. The supplying contractor shall have attended the manufacturer's installation and service training classes. A certificate of this training shall be provided with the contractor's submittal.

1.7 SAFETY / COMPLIANCE TESTING

- A. The communications system and its components shall, where applicable, bear the label of a Nationally Recognized Testing Laboratory (NRTL), such as Environmental Technology Laboratory (ETL), and shall be listed by their re-examination service. All work must be completed in strict accordance with all applicable electrical codes, under direction of a qualified and factory-approved contractor, and to the approval of the owner.

1.8 IN-SERVICE TRAINING

- A. The contractor shall provide and implement a complete and comprehensive staff training program for all administrators, facility staff members, and teachers. This mandatory training program will provide school staff a complete understanding of how to utilize and properly operate all functions.
- B. The training program shall be implemented by a staff member/trainer employed by the contractor. The trainer must be factory certified to provide training on their product.
- C. All staff development training is to be coordinated through the owner's designated representative. As training sessions are completed, the trainer will provide the school's administrative staff and school district's staff a document listing all of the staff and faculty members who attended, received, and completed the training program.
- D. The contractor shall provide a minimum of eight hours of in-service training with this system. These sessions shall be broken into segments, which will facilitate the training of individuals in the operation of this system. User Guides shall be provided at the time of this training.

1.9 WIRING

- A. System wiring and equipment installation shall be in accordance with generally-accepted engineering best practices as established by the EIA and the NEC. Wiring shall meet all state and local electrical codes. All wiring shall be tested to be free from grounds and shorts.
- B. All system wiring shall be labeled at both ends of the cable. All labeling shall be based on the room numbers as indicated in the architectural graphics package.
- C. Wiring shall be done per manufacturer's recommendation (Cat 5 or West Penn #357) depending on speaker type. All terminal connections are to be on barrier strips.

1.10 PROTECTION

- A. The contractor shall provide all necessary transient protection on the AC power feed and on all station lines leaving or entering the building.
- B. The contractor shall note on their system drawings, the type and location of these protection devices and all wiring information. Such devices are not to be installed above the ceiling.

1.11 SERVICE AND MAINTENANCE

- A. The contractor shall provide a five-year equipment hardware warranty of the installed system against defects in material and workmanship. All materials shall be provided at no expense to the owner during normal working hours. The warranty period shall begin on 1st of the month following the date of shipment.
- B. The contractor shall, at the owner's request, make available a service contract offering continuing factory authorized service of this system after the initial hardware and software warranty periods.
- C. System shall include software maintenance that includes bug fixes and new feature releases for a period of six years.
- D. The system manufacturer shall maintain engineering and service departments capable of rendering advice regarding installation and final adjustment of the system.

PART 2 - SYSTEM SPECIFICATION

2.1 MANUFACTURERS

- A. Manufacturers, subject to compliance with requirements specifications, provide the following system:
 - 1. Bogen Nyquist E7000 Series Educational System manufactured by Bogen Communications, Inc.
- B. The specifying authority must approve any alternative system 14 days prior to bid day.
- C. The intent is to establish a standard of quality, function, and features. It is the responsibility of the contractor to ensure that the proposed product meets or exceeds every standard set forth in these specifications.
- D. The functions and features specified are vital to the operation of this facility; therefore, inclusion in the list of acceptable manufacturers does not release the contractor from strict compliance with the requirements of this specification.

2.2 EQUIPMENT

- A. Nyquist NQ-E7030 Analog Station Bridge
 - 1. 24 station support
 - 2. 120W of total available power; max. 40W per any individual port
 - 3. 25 Volt Speakers(s)
 - 4. Analog Call Switch(s)
 - 5. Software programmable configuration and operation
 - 6. Rack mounted, wall mounted, or shelf mounted
 - 7. CAN Bus 2.0 interface for future support for NQ-E7020 DCS
- B. Nyquist NQ-P0100 Matrix Mixer Pre-amplifier
 - 1. No less than four Line/Microphone Level Inputs used for:
 - a. CD Player
 - b. AM/FM Tuner
 - c. Push-to-Talk Paging Microphone
 - d. MP3 Player
 - e. Digital AES/EBU (AES3) input
 - 2. Line Level output to drive external amplifier

3. Software programmable configuration and operation
 - a. Push-to-Talk Channel
 - b. Push-to-Talk Type
 - c. Push-to-Talk Zone
 - d. Mixer Channels
 4. Mixer Channels Wall or shelf mounted
- C. Input Devices
1. 1 qty. Astatic 878HL-2 desktop push to talk mic.
 - a. 1 qty. 25' Whirlwind MKQ XLR cable, black.
 2. 1 qty. Tascam CD-400U.
 - a. 1 qty. 32MB SD card, SanDisk or equivalent.
 - b. Provide patch cables required to connect to mixer/pre-amp.
- D. Nyquist NQ-E7010 Input/Output Controller
1. Eight Dry Contact Inputs
 2. Eight Open Collector Outputs
 3. Software programmable configuration and operation including:
 - a. Contact Type
 - b. Extension
 - c. Name
 - d. Close Interval
 - e. Actions including:
 - 1) Audio
 - 2) Alarm
 - 3) Announcement
 - 4) Disable-Audio
 - 5) Other
 - 6) Tone
 - 7) Enable-Audio
 - f. Action ID
 - g. Zones
 - h. Close Extension
 - i. Dashboard Type
 - j. Dashboard Title
 - k. Dashboard Scope
 - l. Dashboard Text
 - m. Dashboard Style
 - n. Email
 4. Wall or shelf mounted
- E. Equipment Rack
1. 1 qty. 44RU x 27" deep equipment rack with rear door.
 - a. Lowell LFR-4427, or equivalent.
 2. 1 qty. vertical power distribution unit.
 - a. Lowell ACS-2012, or equivalent.
 3. UPS
 - a. TrippLite SMART1500RMXL2UA, or equivalent.
- F. Nyquist Station Equipment
1. NQ-T1100 VoIP Admin Phone – Color Touch Display (aka Admin Station)
 - a. Provide 1 qty. Admin phone for each campus to be located in the Reception area.
 2. NQ-T1000 VoIP Staff Phone – LCD Display (aka Staff Station)
 3. NQ-S1810WT VoIP Wall Baffle Speakers with talkback
 4. NQ-S1810CT VoIP Ceiling Speakers with talkback

5. NQ-E7020 Digital Call Switch
6. CSD2X2U Drop-In Ceiling Speaker
7. CA15C or CA21B Analog Call Switch

G. Optional Equipment

1. Telephony interface device(s) for FXO/FXS analog port connectivity

2.3 COMPONENTS AND DESCRIPTIONS

The Nyquist E7000 Series Educational System is a software-based VoIP paging and intercom system.

The Nyquist E7000 Series Educational System must be capable of supporting existing Bogen Multicom 2000 and Bogen Quantum Multicom IP wiring, 25 volt speakers and analog call-switches, and equivalent competitive systems utilizing the existing architectural numbering scheme. The VoIP capabilities of the Nyquist system will enable the support of the features across the various Nyquist appliances within the facility. The following sections define how the system handles each of the features in the system. Systems that do not allow the reuse of existing wiring or numbering scheme shall not be deemed acceptable. Systems that do not allow appliances to be seamlessly integrated via the LAN are not considered equal.

A. Nyquist E7000 Server Software

1. The Nyquist E7000 server software shall be installed on a dedicated dealer or customer supplied server. An unlimited number of facilities can be networked into a Nyquist-based District.
 - a. Minimum Nyquist Server Requirements
 - 1) Debian Linux OS (AMD 64-bit version) release 8.4.x – 8.8.0
 - 2) Quad-core Intel-based processor running at 3.0 GHz or higher
 - 3) 8 GB RAM
 - 4) One 250 GB disk drive
 - a) Redundant Array of Independent Disks (RAID) is recommended for redundancy and high availability.
 - b) Consider using a larger drive if large amounts of audio (for example, voice mail, announcements, recordings, and music) are being stored on the system. Other factors that should be considered are:
 - i. How often will backups be performed?
 - ii. Will the system be backed up locally or remotely on a detachable drive, SAN/NAS, or NFS?
 - iii. How many users will have voicemail ability?
 - iv. How long will voicemail messages be stored?
 - v. Will voicemail messages be part of the local system backups?
 - 5) NIC 10/100/1000 MB Ethernet port
 - 6) One or more PCI/PCI Express (PCIe) slots if telephony network connectivity other than, or in addition to, SIP trunking
 - 7) One or more PCI/PCIe type third-party telephony interface cards (for example, FXO, FXS, etc.) if telephony network connectivity other than, or in addition to, SIP trunking
 2. Audio shall be transmitted between the server and the Nyquist appliances using the customer supplied LAN/WAN using both G.722 and Opus 48k audio encoding and streaming technology to deliver High Definition audio quality. Systems that do not use G.722 and Opus for audio encoding and streaming shall not be deemed equivalent.
 3. The Nyquist server software and Nyquist appliances software shall be upgradeable via the Nyquist Web UI.
 4. It shall be possible for a Nyquist facility to make “station-to-station” calls and “remote facility” All-Call pages to a single facility or to all Nyquist facilities in a district via the

Nyquist Web UI or an Admin Station. Systems that require remote viewing software or other application software to be installed/loaded on to additional servers or PCs to make station-to-station calls and remote facility All-Call or district paging shall not be considered equivalent.

5. The Nyquist server software is designed to handle all facility and district-wide communications, including but not limited to, inter-facility intercom calling and paging, district-wide Emergency All-Call and local facility point-to-point calls. Via the Nyquist Web UI, every facility shall be configured with the IP addresses of all the other remote facilities within the district.
6. Nyquist can support an unlimited number of facilities; however, the maximum number of simultaneous remote facility intercom calls supported is based on the actual performance of the WAN and the Nyquist Server CPU load.
7. The voice quality of the facility calls may vary based on the WAN conditions. The maximum network bandwidth that All-Call and Zone Paging uses is 64 kbps (Multicast G.722), and intercom calls use 128 kbps (unicast, G.722).
8. The system shall facilitate the repetitive playing of Normal or Emergency audio tones or announcements directed to a Paging Zone until stopped by the Nyquist user via the Web UI, an Admin Station, or a dry contact closure connected to the Nyquist I/O Controller NQ-E7010.
9. A built-in Master Clock shall be included to automatically control class change bells or other time-based signals. The Master Clock shall have an unlimited number of Events that may be programmed into any of the unlimited number of Schedules, and unlimited number of Holidays. The schedules shall be nameable for easy selection when assigning schedules to days or overriding a schedule.
10. Network Time Synchronization. The system shall be capable of periodically updating/synchronizing the processor's time with a Network Time Server running Network Time Protocol (NTP) via the school's LAN network. Systems that do not provide Network Time Synchronization will not be deemed equivalent. The Nyquist server can be the NTP server for other devices on the LAN such as IP clocks and other IP devices.

B. Nyquist Server Application

1. The Nyquist software is installed onto the server, and upon boot-up, users can log in to the Nyquist server application via a web browser that supports WebRTC. Systems that require Com Port redirect software, client PC application, software or serial-to-Ethernet adapters for user access are not deemed equal. Communications between the server and the Web UI(s) shall be via secure Hyper Text Transfer Protocol (HTTPS) connections (i.e., https://).
2. The Nyquist Web UI shall be configured with four different default user access levels, based on four unique user roles. Systems that do not provide unlimited access levels and unlimited user roles are not considered equal.
 - a. The four default roles shall be: admin, optech, operator, and user. These roles provide a starting point/example for administrators to create additional roles.
3. Only a user assigned the admin role shall be able to provide access to users, giving them the ability to create, delete, edit, and view system parameters.
4. Only an Administrator shall have the ability to adjust roles and Class of Service (CoS) of users. The roles determine if users can view the definable data objects that can include configuration, alarms, and performance data and if users can perform certain operations based on the user's role and station's CoS. All changes to roles and CoS are effective immediately, without the need to restart the browser or reboot the server.
5. The Nyquist Web UI Dashboard shall provide full administrative capabilities to manage/operate the following system features:
 - a. Calling/Paging – User can initiate a call by accessing the directory or by dial pad and can receive calls, make Zone Page and All-Call Page, make a Prepending Page, Emergency All-Call paging.
 - b. Call Forwarding
 - c. District Calling/Paging – Used for District Facility Page, District All-Call, and District Emergency All-Call.

- d. Tones/Announcements – Used to play Tones, Announcements, and Alarms.
 - e. View This Week’s Schedule – Used to show the current interactive Bell Schedule.
 - f. Audio Distribution – Used for entire facility or Audio Zones
 - g. Enable or Disable Audio – Used to place the Nyquist system into Page Exclusion mode (i.e. "mute" the system) when a contact closure is supplied from the fire alarm panel. Systems that do not provide this capability are deemed not equal.
Systems that require application software to be installed on a PC to manage the above features shall not be considered equivalent.
6. To facilitate installation and configuration of the system, additional Web UI menus are required. The menus shall only be visible to users with the correct roles and CoS. The navigation menus found on the Web UI shall be as follows:
- a. System Parameters – Allow installers to adjust core system parameters.
 - b. Zones – Allow installers to create and modify Paging, Time, and Audio Zones.
 - c. Schedules – Allow installers and administrators to create bell schedules for the facility, predefine alternative schedules to run, prevent the bells from ringing on a holiday, and schedule an announcement to play. The system shall allow an unlimited number of schedules to operate simultaneously within a facility.
 - d. Admin Groups – Allow the installer to create, modify, and delete software groupings of admin phones that can ring when a station calls in with a call switch.
 - e. CoS Configuration – Allow the installer to create, modify, and delete CoS groups that control station access to the following features: Call-in Level, Zone Paging, All-Call Paging, Emergency All-Call, Inter-Facility Call/Page, Audio Distribution, Remote Pickup, Join Conversation, Call Forwarding, Walking Class of Service, External Call Routing, Call Transfer/3-way Calling, Manually Activate Tone Signals, Call Any Station, Manage Recording, Monitor Calls, Monitor Locations, Conference Admin, Conference User, Voicemail, Record Calls, Activate Alarm Signals, Disable Audio, Enable Audio, Allow Callee Auto-answer, District Paging, and Inter-Facility Features.
 - f. Stations – Allow the installer to set up, modify, and delete stations; set up Page Exclusion; view Station Status; and add New Stations.
 - g. Bridge Devices – Allow the installer to configure the Nyquist ASBs.
 - h. Audio – Allow the installer to upload and manage Announcements, Playlists, Songs, and Tones. The system must support the uploading of both MP3 and WAV files and make Audio file management simple for users. Systems that limit the size of Audio files shall not be considered equal.
 - i. Users – Allow the installer to manage users by giving them the proper roles and assign extensions if needed.
 - j. Roles – Allow the installer to grant users rights to Create, Delete, Edit, Restart Server, Sort Menu, Systems Update, Manage, Import/Export, Restore, Settings, or View.
 - k. Facilities – Allow the installer to set up the district wide facilities for remote paging and calling.
 - l. Outside Lines – Allow the installer to set up FXS and FXO ports for inbound and outbound system calling.
 - m. SIP Trunks – Allow the installer to set up SIP trunks into the facility for inbound or outbound calling.
 - n. Call Details – Allow the installer to review the historical system activities that can be used for incident investigation or system troubleshooting.
 - o. System Backup/Restore – Allow the installer to preform system backups or restores and allow the backups to be scheduled to run automatically.
 - p. System Logs – Allow the installer to view and export Server, Nyquist-Intercom, and Web Server logs that can be used for troubleshooting and technical assistance.

- q. Paging Exclusions – Allow the installer to view and edit stations that are excluded from paging.
- r. Firmware – Update firmware for Nyquist speakers and appliances.
- s. Help – Provide information about the system, online help topics, and System Administrator Manual.

Systems that do not provide these menus as a minimum shall not be considered equal.

C. Nyquist NQ-E7030 Analog Station Bridge

- 1. The Nyquist NQ-E7030 ASB allows facilities with existing Multicom or Quantum or compatible intercom systems to upgrade to Nyquist. Each ASB supports up to 24 speakers and call switches with 120 Watts of embedded 25 Volt power. The ASB is designed to drive any combination of 25 Volt speakers and horns. Features Include:
 - a. 10/100 Ethernet
 - b. 24 station interface - Supports connections to as many as 24 individual 25 Volt speakers with one 25 Volt speaker connection per interface
 - c. 24 dry contact closure-type analog Call Switch connections
 - d. Half-duplex talkback using speaker as pickup
 - e. CAN Bus 2.0 Interface for future NQ-E7020 DCS support and other accessory devices
 - f. 120W of available power across all 24 channels; maximum 40W per channel
 - g. 2 x RGB full spectrum LED status indicators
 - h. USB 2.0 host port, type A connector (future use)
 - i. Universal mains supply (100VAC – 240VAC)
- 2. The Nyquist NQ-E7030 ASB shall be rack, wall, or shelf mountable and shall include the required mounting bracket hardware.

D. Nyquist NQ-P0100 Matrix Mixer Pre-Amplifier (MMPA)

- 1. The Nyquist NQ-P0100 MMPA is designed to bring external audio into the Nyquist system. The MMPA interfaces with a local sound system by accepting one or more local audio sources, mixing them, and outputting them to either, a) the network for Audio Distribution, or b) the MMPA's line level output that can then be inserted into an external amplifier to drive local sound system in gyms, cafeterias, auditoriums, etc. The MMPA supports the following:
 - a. Four software selectable MIC or Line Input channels via three XLR connectors and four sets of screw-terminals. Any single input channel shall be capable of being configured to support a Push-to-Talk microphone (for example, Bogen DDU-250). Channel-1 can be configured as a digital AES/EBU (AES3) input. Line/Monitor output – The MMPA becomes a station on the Nyquist system, allowing users to call it directly or to include it in any of the Page, Time, or Audio Zones.
 - b. The MMPA shall support the following features: Line-Level output to drive input on a local amplifier; One USB 2.0 host port (Type-A connector) for future use; 2 x RGB full spectrum LED status indicators.
 - c. The MMPA is powered by Universal mains supply (100VAC – 240VAC).
 - d. The MMPA shall be wall or shelf mountable and shall include the required mounting bracket hardware.
- 2. The dealer shall supply a minimum of one Nyquist MMPA that allows for up to four user-configurable audio inputs. The MMPA shall support Line, MIC, and digital AES/EBU (AES3) input sources. The system shall support an unlimited number of MMPAs.

E. Nyquist NQ-E7010 Input/Output Controller

- 1. The Nyquist NQ-E7010 I/O Controller is designed to accept contact closure inputs and activate open-collector outputs to drive relay coils.
 - a. PoE Class-1; IEEE 802.3af compliant with Optional 48VDC 15W power supply

- b. Eight Dry Contact Closure Inputs that can be used with Fire Alarm Override Relays, external event triggers (for example, Lockdown Buttons, etc.)
 - c. Eight Relay Driver Outputs (Open-Collector) for use with Clock Correction (Sync Pulse), response to contact closure inputs, etc.
 - d. USB 2.0 host port, Type-A connector (future use)
 - e. 2 x RGB full spectrum LED status indicators
 2. The Nyquist NQ-E7010 I/O Controller shall support wall or shelf-mounting options and shall include the required mounting bracket hardware.
 3. The Nyquist NQ-E7010 I/O Controller shall be designed for wall or shelf mounting.
- F. Nyquist VoIP Admin Phone – Color Touch Display (Admin Station)
1. The Nyquist Admin Station shall have the following features:
 - a. 7" 800 x 480-pixel color display with backlight
 - b. Touch screen display for one touch operation
 - c. Full-duplex hands-free speakerphone with AEC
 - d. Call hold, mute
 - e. Redial, call return, auto answer
 - f. PoE (802.3af) Class-3 support
 - g. Headset with EHS support
 - h. Dual Gigabit Ethernet ports
 - i. Desk Mountable
 - j. Optional Wall mount capable
 2. The Nyquist Admin Station display panel shall show the time of day and day of week, the current bell schedule(s), and the station numbers and call-in priority of staff stations that are calling in. Depending upon the system programming, an Admin Station shall display menus to activate Zone Paging, All-Call Paging, Emergency All-Call Paging, District All-Call paging, alarm signals, and external functions.
 3. The Admin Station shall be capable of calling either the loudspeaker or Staff Station at each classroom location.
 - a. The Admin Station shall display the classroom number of any station that calls 911. This allows front-office administrators to direct emergency personnel to the correct physical location in the building when they arrive. If a system is not connected to outside phone lines, then 911 calls can be routed to a designated station within the facility. The system shall automatically record all 911 calls made from any station. The 911 call recording shall begin as soon as 911 is dialed and continue until the call is terminated. Recorded calls shall be maintained on the system for later playback review and/or retrieval by authorized personnel and/or authorities. Systems that do not provide this feature will not be deemed equal.
- G. Nyquist NQ-T1000 Staff VoIP Phone – LCD Display (Staff Station)
1. Nyquist Staff Station shall have the following features:
 - a. 132 x 64-pixel graphical LCD with backlight
 - b. Two-port 10/100M Ethernet Switch
 - c. Full-duplex hands-free speakerphone with AEC
 - d. Call hold, mute
 - e. Redial, call return, auto answer
 - f. PoE (802.3af) Class-3 support
 - g. Dual-color (red or green) illuminated LEDs for line status information
 - h. Two 10/100M Ethernet ports
 - i. Wall or desk mountable
 2. The classroom Staff Station shall be capable of the following features depending on how the station CoS is configured:
 - a. Emergency intercom call – Staff Stations shall be capable of making an Emergency intercom call, which is then routed to the assigned Admin Station. This requires the display of the architectural number and call in level on the Admin Station. Systems that do not provide this feature are not equivalent.

- b. Speed dial
 - c. Toggle audio distribution on and off
 - d. Call Forward activation and deactivation for All-Calls/Busy/No Answer/Busy or No Answer
 - e. Conference Calling
 - f. Transfer Call
 - g. Dial Administrative station– Staff Stations can allow the user to dial the station number to call to the Admin phone or its associated speaker. The call shall be routed to the Admin Station showing the architectural number that is calling.
 - h. Emergency All-Call – An emergency page shall be broadcasted to all the stations in the facility.
 - i. Place Outside Call
 - j. Remote Answer
 - k. Single-Zone/All-Station Page
 - l. Call Waiting Tone for Outside Calls – It shall be possible to feed the call waiting tone to the Administrative Phone during a conversation.
 - m. Transfer call from VoIP speaker in classroom down to an associated Staff Station
 - n. Transfer call from analog speaker in classroom down to an associated Staff Station
 - o. Transfer call from VoIP Staff Station in classroom up to an associated VoIP speaker
 - p. Transfer call from Staff Station in classroom up to an associated analog speaker
- H. Nyquist NQ-S1810CT VoIP Ceiling Speaker with Talkback and NQ-S1810WT VoIP Wall Baffle Speaker with Talkback
- 1. The VoIP speakers shall not require traditional intercom wiring or transformer taps to manually set or adjust volume. Simply connecting them via Cat 5 to a PoE Switch or PoE Injector on the system's network should allow them to be ready to program into the system. Volume is controlled via the Nyquist Web UI. All Nyquist audio appliances shall use a wideband Opus codec for Audio Distribution. Use of the Opus codec, along with G.722, allows for High Definition audio. Nyquist VoIP speakers shall be equipped with a digital MEMS microphone to achieve superior talkback audio. VoIP Speakers that utilize the speaker as the microphone shall not be considered equal.
 - 2. The NQ-S1810WT VoIP Wall Baffle Speaker with Talkback design facilitates mounting the speaker up to four different ways:
 - a. 2x2 Wall Mount
 - b. Box Mount
 - c. Corner Mount
 - d. Tilted Mount
 - 3. The VoIP Speakers provide CAN Bus 2.0 Interface support for the NQ-E7020 DCS.
 - 4. The VoIP Speakers shall be PoE IEEE 802.3af compliant. VoIP speakers may be placed up to 100 meters (328 Feet) from a PoE switch or PoE Injector.
 - 5. Software provides adjustable audio output level.
 - 6. DHCP with Option 66 is supported for easy network deployment.
 - 7. The VoIP Speakers provide VLAN support.
 - 8. The VoIP Speakers are pre-assembled for faster installation.
 - 9. Each VoIP Speaker includes a 10 Watt integrated power amplifier.
 - 10. Each VoIP Speaker has a digital MEMS microphone to support talkback.
- I. Nyquist NQ-E7020 Digital Call Switch
- 1. The Nyquist DCS has been exclusively designed for use with Nyquist appliances equipped with a CAN Bus 2.0 Interface. The CAN Bus 2.0 interface provides power and signal, and multiple DCSs can connect to each CAN Bus 2.0 interface. The DCS fits into a Single Gang/ Low Voltage installation using standard 'decora-plate' covers (supplied).
 - 2. The DCS is a capacitive touch button design, so it doesn't have any moving parts to wear out. The behavior of this switch is software definable. Systems that require

membrane or mechanical rocker style call switches that can wear out over time shall not be acceptable.

3. Normal call initiation involves touching the DCS one time. When a user touches the button on the DCS once, one of the three LED segments will light up green, a normal call will be placed, and the light will start blinking green. This is the indication that the Normal call has been placed to the VoIP Admin Phone or to a group of VoIP Admin Phones and that the phone or phones are ringing.
4. Urgent call initiation involves touching the DCS one time. When a user touches the button on the DCS once, one of the three LED segments will light up yellow, an Urgent call will be placed, and the light will start blinking yellow. This is the indication that the Urgent call has been placed to the VoIP Admin Phone or to a group of VoIP Admin Phones.
5. Emergency call initiation involves touching the DCS one or three times depending on station programming. When a user touches the button on the DCS once or three times within three seconds, all three LED segments will light up red, an Emergency call will be placed, and the light will start blinking red. This is the indication that the Emergency call has been placed to the VoIP Admin Phone or to a group of VoIP Admin Phones.
6. Single Press Emergency Call, if programmed, involves touching the DCS one time. When a user touches the button once, all three LED segments will light up red on the DCS, an Emergency call will be placed, and the light will start blinking red. This is the indication that the Emergency call has been placed to the VoIP Admin Phone or to a group of VoIP Admin Phones.
7. Normal and Urgent calls can easily be upgraded to an Emergency call after the DCS is flashing by touching the button on the DCS one time. The Normal or Urgent call will be canceled and an Emergency call will be placed.
8. Privacy Mode – Pressing and holding the button on the DCS for four seconds will place the speaker into Privacy Mode. As the user continually touches the DCS button, all LED segments will turn purple; when all three LED segments are lit purple, the speaker is in Privacy Mode. If a call comes into the classroom when the station is in Privacy Mode, the microphone will be disabled; the user in the classroom can touch the DCS once and it will allow talkback. Once the call ends, the classroom will need to manually return the speaker into Privacy Mode, if desired. The user can disable Privacy Mode without placing a call by pressing and holding the button on the DCS for four seconds. As the user continually touches the DCS, all LED segments will turn blue. When all three LED segments are lit blue, the speaker is no longer in Privacy Mode. Systems that require mechanical or membrane switches to achieve Privacy Mode shall not be considered equal.
9. The colors specified above are created by three RGB full spectrum LED segments to provide installers and users with visual status and feedback when installing and using the DCS. When the DCS is being installed and the power is connected before the signal, the LED will light red. It will also light red if the speaker in the classroom stops communicating with the Nyquist Server, indicating a problem with the station.
10. In addition to providing visual call status indications, a call confirmation audio file shall be played on the associated loudspeaker when a call is placed via a DCS. The three call-in levels shall have distinct audio confirmation messages:
 - a. Call Placed
 - b. Urgent Call Placed
 - c. Emergency Call Placed
11. Emergency Link Transfer – If an Emergency call is unanswered by the VoIP Admin Phone and the Emergency Link Transfer is active, the Emergency call will be forwarded to the loudspeaker associated with the Emergency Link Station. Any station equipped with a loudspeaker can be programmed as the Emergency Link Station. Systems that do not provide Emergency Link Transfer shall not be considered equal.

J. Bogen Analog Call Switch CA-15C

1. The momentary Call Switch shall be capable of placing a combination of Normal/Urgent/Emergency Calls based on the software configuration of the Call Switch.

INTERCOM AND CLOCK NETWORK

2. Normal/Emergency call configuration: Making a Normal call in this mode involves pressing the button on the Call Switch once. A call is then placed to the designated Admin Station. An Emergency call involves pressing the call switch at least four times. The Emergency call is then routed to the designated Admin Station. In both scenarios, the calling station number and call-in level (Normal or Emergency) are displayed on the Admin Station or on a group of Admin Stations. Additionally, Emergency calls can be routed to an alternative Admin Station or Emergency Link.
 3. Urgent/Emergency call configuration: Making an Urgent call in this mode involves pressing the button on the Call Switch once. A call is then placed to the designated Admin Station. An Emergency call involves pressing the button on the Call Switch at least four times. The Emergency call is then routed to the designated Admin Station. In both scenarios, the calling station number and call-in level (Urgent or Emergency) are displayed on the Admin Station or on a group of Admin Stations. Additionally, Emergency calls can be routed to an alternative Admin Station or Emergency Link.
 - a. Emergency Only call configuration: Making an Emergency call in this mode involves pressing the Emergency call switch with Call Level Emergency one time. The call is then switched to the Admin Station. This requires the display of the station number and call-in level on the Admin Station or on a group of Admin Stations. Additionally, Emergency calls can be routed to any Admin Station, including Emergency Link.
 4. Emergency Link Transfer - If an Emergency call goes unanswered by the Admin Station and the Emergency link transfer is active, the Emergency call will be forwarded to the loudspeaker associated with the Emergency Link Station. Any station equipped with a loudspeaker can be programmed as the Emergency Link Transfer. Systems that do not provide Emergency Link Transfer shall not be considered equal.
 5. In addition to the mechanical click of a Call Switch button press, a call confirmation audio file shall be played on the associated loudspeaker when a call is placed. The three call-in levels shall have distinct audio confirmation messages:
 - a. Call Placed
 - b. Urgent Call Placed
 - c. Emergency Call Placed
- K. Additional Loudspeakers for use with the Nyquist ASB
1. Classroom Speakers shall be Bogen:
 - a. Ceiling Mounted Speakers: CSD2X2U Drop-In Ceiling Speaker
 - b. Ceiling Mounted Speakers: S810T725PG8U Ceiling Speaker
 2. Wall Baffle Speakers: MB8TSQ/SL Metal Box Speaker
 3. Hallway Speakers shall be Bogen:
 - a. Ceiling Mounted Speakers: CSD2X2U Drop-In Ceiling Speaker
 - b. Ceiling Mounted Speakers: S810T725PG8U Ceiling Speaker
 - c. Wall Baffle Speakers: MB8TSQ/SL Metal Box Speaker
 4. Outdoor/Gym/Locker Room Speakers shall be Bogen:
 - a. FMH15T mounted in BBSM6 surface-mounted vandal-resistant enclosure/BBFM6 flush-mounted vandal-resistant enclosure with FMHAR8 adapter ring and SGHD8 heavy duty grille
 - b. KFLDS30T Wide Dispersion Re-entrant Horn Loudspeakers
 5. Common Area, Open to Structure Speakers shall be Bogen:
 - a. OCS1 Orbit Ceiling Speakers
 - b. OPS1 Orbit Pendant Speakers
- L. Secondary Clocks
1. 4-digit digital face wired clock: Bogen #BCBD-31S-404-4R
 2. Mount: Bogen #BCAB-1BD-00S-0

2.4 SYSTEM CAPABILITIES

- A. The communication system shall be a Bogen Nyquist E7000 Series Educational System and shall provide a comprehensive communications network between administrative areas and staff locations throughout the facility.
The system shall provide no less than the following features and functions:
1. Software-based, state-of-the-art, Voice over IP (VoIP) paging and intercom solution.
 2. The system shall provide a Web User Interface (Web UI) shall allow users to configure and control the system, in accordance with their assigned User Role, from any Web browser enabled PC, Mac, Android or iOS tablet or mobile device.
 3. Amplified-voice communication with analog loudspeakers shall use a shielded audio pair when connected to an ASB.
 4. The system shall support any combination of the following VoIP phone station types: NQ-T1100 Administrative VoIP Phone – Color Touch Display (Admin Station) or NQ-T1000 Staff VoIP Phone – LCD Display (Staff Station).
 - a. All VoIP phone station types shall utilize the same type of field wiring.
 - b. There shall be no limit to the number of Admin Stations that can be connected to a facility. Systems that require different head-end equipment to make Admin Stations function, or systems that limit the number of Admin or Staff Stations shall not be deemed acceptable.
 5. Future station alterations shall only require the Station Type to be changed in system programming. Alterations shall not require field wiring or system head-end alterations, unless an analog station device is being replaced by a VoIP station device or vice-versa.
 6. The system shall be a global non-blocking system. The system shall be capable of unlimited amplified intercom paths per facility. Two amplified intercom paths shall be provided with each ASB for its complement of 24 stations. All hardware, etc., required to achieve the necessary number of amplified-voice intercom channels for this system shall be included in this submittal. ASB amplified-voice intercom channels shall provide voice-activated switching. Systems requiring the use of a push-to-talk switch on administrative telephones shall not be acceptable. There shall be an automatic level control for return speech during amplified-voice communications. The intercom amplifier shall also provide control over the voice switching sensitivity and delay times of the VOX circuitry on the ASB.
 7. The system shall provide 911 Dial-Through via outside FXO/FXS lines or SIP trunks to ensure that one or more lines are always available for 911 calls. The 911 Dial-Through is available to any properly configured station (via CoS). When a station dials 911, the 911 call is processed as follows:
 - a. Call routes to an Emergency Group where the call can be answered.
 - b. The 911 CO lines can be pre-configured and reserved. If the 911 reserved lines are busy, the normal CO lines will be connected to route the 911 calls. If all the normal CO lines are busy, then one of the ongoing calls shall be disconnected and the 911 call shall be placed.
 - c. When 911 is dialed from any station, its designated Admin Station or Admin Group will receive a message that the station has dialed 911.
 - d. The system shall automatically record all 911 calls made from any station. The 911 call recording shall begin as soon as 911 is dialed and shall continue until the call is terminated. Recorded calls shall be maintained on the system for later playback review and/or retrieval by authorized personnel and/or authorities.
 8. It is of highest importance that Emergency calls from stations receive prompt attention. Therefore, it is important that there be an alternative destination in case the Emergency call does not get answered at the primary location. Details are as follows:
 - a. Staff-generated Emergency calls shall be treated as the second highest system priority. Therefore, all Emergency calls shall announce at the top of the call queue of their respective Admin Station or Admin Group. Should that Emergency call go unanswered for 15 seconds, the call shall be re-routed to an alternative speaker station. Then, a tone will prompt the caller to make a verbal call for help and announces to the Emergency link station "Emergency." During the transfer, the original administrative telephone shall continue to ring the

- distinctive Emergency Ring. Should the Emergency Transfer-to-Station have an associated Admin Station, it will also ring for the Emergency call.
- b. The Emergency Transfer-to-Station shall be software configurable.
 - c. Systems failing to transfer unanswered Emergency calls or failing to immediately connect to the designated Admin Station shall not be deemed as equal.
9. There shall be a Facility Wide Emergency All-Call feature. The Emergency All-Call shall be accessed from designated Admin Stations or the Nyquist Dashboard or by the activation of an external contact closure that shall give a microphone input Emergency status. The Emergency All-Call function shall have the highest system priority and shall override all other loudspeaker-related functions including Time Tones, Normal All-Call or Zone Pages, or Audio Distribution.
- a. Considering that Emergency calls are to be treated with the highest level of concern, systems that do not regard Emergency All-Call with the highest priority shall not be deemed as equal.
 - b. Upon touching the Directory icon, a menu shall appear on the Admin Station display prompting the user to select the desired menu.
 - c. The Emergency All-Call shall capture the highest-level system priority and shall be transmitted over all speakers in the facility. It shall also be capable of activating an external control output, which can be used to activate external relays to automatically override volume controls, local sound systems, or strobe circuits.
 - d. Systems without Emergency All-Call or systems with All-Call that cannot be activated by external means or that do not capture complete system priority or activate an external relay, shall not be acceptable.
10. There shall be unlimited Alarm Tones (four by default). Each may be accessed by dialing *91 and the two-digit tone number from any Admin Station, SIP Trunk, or FXO/FXS system interface. These Alarm Tones are separate from the Time Tones. Users shall be able to add an unlimited number of Alarm Tones to the system by uploading MP3 or WAV files. Systems that do not allow the user to upload MP3 and WAV files to customize the Alarm Tones or need to use external alarm/tone generators or special software or have less than four Emergency Alarm Tones shall not be acceptable.
11. Upon touching the Directory icon on an Admin Station, a menu shall appear on the display prompting the user to select from the sub-menus. The Alarms sub-menu is the first available. This precludes the user from having to memorize complicated key sequences to access Alarm Tones.
12. There shall be unlimited I/O Controller relay driver outputs accessible and controllable by properly authorized users via an Administrative Web UI. These outputs remain set until accessed and reset. Users shall have the ability to review the status of each relay driver output. Users shall be prompted through fields via a plain English menu, precluding users from having to remember any dialing sequences to control this feature. The system shall support an unlimited number of I/O Controllers, and each I/O Controller shall be able to interact with any and all other I/O Controllers on the system (i.e., an input on one I/O Controller can trigger an output on one or more different I/O Controllers). Systems that require the user to remember complicated dialing schemes or prompt the user via cryptic commands shall not be acceptable.
- a. The I/O Controller can create a contact closure when the following operations are performed in the system:
 - 1) 911 call placed
 - 2) Audio Distributed
 - 3) Alarm is played
 - 4) Announcement is played
 - 5) All-Call performed
 - 6) District All-Call performed
 - 7) District-Emergency-All-Call
 - 8) Emergency-Call

- 9) Emergency-All-Call
 - 10) Audio-Disabled
 - 11) Page
13. The system shall provide software controlled and programmable control outputs for external relay activation for use with strobe lights, magnetic locks, card access systems, motion detectors, cameras, or any low-voltage, dry contact creating device. Systems using dedicated security stations for control of external functions shall not be acceptable.
14. The system shall be capable of interfacing to PSTN/PBX/iPBX via both FXO/FXS line and SIP trunk connectivity.
15. The system shall be capable of providing each facility (i.e., (i.e., Nyquist location) an unlimited number of incoming FXO/FXS or SIP trunk lines that can be designated by the user to ring the designated Day Admin or Night Admin. Where an Admin Station is designated to receive outside line calls, the incoming call's Caller ID information shall appear on the display. The system shall also provide the ability to make outside line calls from Admin Stations. This ability shall be programmable for each Admin Station and there shall be an unlimited number of CoSs available to assign to any station.
16. The system shall be capable of supporting DID, DISA, and Security DISA functions.
- a. The system shall provide a password-protected Security DISA feature that shall only be accessible from authorized Police, Fire, Emergency personnel, or an off-premise security office that monitors the facility's security system. The Security DISA feature shall function as follows: Upon dialing the Security DISA phone number, the caller will receive a dial tone from the system, after which he or she must enter the assigned Security DISA passcode on the dial pad. Upon confirmation, the system will present the dial tone again and will allow the authorized personnel to dial any station/classroom on the system and monitor the activity without any pre-announce tone or privacy beep. This will allow the authorized personnel to audibly assess the situation and determine what actions need to be taken.
 - b. All DISA and Security DISA calls shall be automatically recorded by the system for later playback review and/or retrieval by authorized personnel and/or authorities.
17. The system shall provide for field-programmable three-, four-, five-, or six-digit architectural station numbers.
18. There shall be an automatic level control for return speech during amplified-voice communications.
19. Each station loudspeaker shall be assignable to all or any combination of Paging, Time, and/or Audio Zones. Systems that do not provide unlimited Paging, Time, and/or Audio Zones shall not be acceptable.
20. There shall be unlimited schedules with unlimited programmable events per facility. Each event shall sound one user-selected tone or external audio source. It shall be possible to assign each schedule to a day of the week or to manually change schedules from an authorized user via a web-based UI. Systems that do not provide unlimited schedules, events, and tones, or that require software to be installed on a PC to perform these functions shall not be acceptable.
- a. The system shall provide multiple concurrent schedules per facility/location to accommodate split facilities (for example., combined Elementary and Middle School, combined Middle and High School, etc.).
 - b. The system must be capable of providing Class Change Music to be played from an external audio source or audio files that are stored in playlists on the system during class change periods or whenever a facility wants music to be played in an area (i.e., (i.e., one or more Time Zones) on an automated schedule.
 - c. Each event shall be able to be directed to any one or more of the unlimited Time Zones.
 - d. Each of the unlimited Time Zones shall have a programmable, customizable Preannounce Tone and volume control that is unique unto itself.

- e. Each event shall play any of the Normal tones or external audio. Each event may utilize a different tone. For example, the system shall be capable of sending the gymnasium, shop classes, and pool a separate, unique time tone to indicate "clean up." Minutes later, the entire facility can be sent a different time tone to indicate class change.
 - f. Each of the unlimited Time Tones may be manually activated by selected VoIP Admin Phones or via an authorized user with access to the Web UI. These tones shall remain active as long as the telephone remains off-hook or until canceled from the keypad or the Nyquist Web UI.
 - 1) Systems that do not provide an unlimited number of schedules or do not provide automatic activation of schedules shall not be acceptable.
21. Internal Master Clock shall be included, allowing an unlimited number of events per facility. Systems that do not provide an internal master clock or that must supply an external master clock to meet these specifications shall not be acceptable.
22. The Nyquist E7000 is capable of synchronizing with an NTP server and automatically adjusting the Daylight Savings Time for any time zone in the world. The server that the Nyquist E7000 application is running on can also be used as an NTP server for other systems on the LAN (for example, IP Clocks and control systems).
23. There shall be a Zone Page/All-Call Page feature that is accessible by selected Admin Phones and FXO/FXS or SIP connection to the PSTN or PBX/IPBX.
24. There shall be an option to play a pre-announce tone at any loudspeaker selected for voice paging.
25. There shall be a voice-intercom feature that is accessible by CoS authorized staff phones, all Admin VoIP phones, and Admin Web UIs.
 - a. There shall be a privacy beep played every 15 seconds at any selected loudspeaker to indicate that an intercom call is in progress.
 - b. There shall be a pre-announce tone played at any selected loudspeaker for intercom call communication.
 - c. For special applications, the privacy and pre-announce tone signals shall be capable of being disabled during system initialization.
 - d. There shall be a switch over to private telephone communications should the person at the classroom loudspeaker pick up his or her Staff Station and dial *3 to transfer the call down to the associated classroom Staff Station.
26. There shall be various levels of telephonic communication accessible by all Admin Stations and Staff Stations.
 - a. Staff Stations must be capable of being programmed to ring one Admin Station during day hours and a different Admin Station during night hours. Day and Night start hours shall be configurable. Staff Stations shall be capable of being assigned to any Admin station. Systems that limit the number and assignment of staff call-ins to an Admin Station shall not be acceptable.
27. Each VoIP speaker or ASB speaker equipped with a call switch (analog or digital) shall be configurable as one of three call-in types, as follows:
 - a. Normal/Emergency
 - b. Urgent/Emergency
 - c. Emergency
28. Call buttons programmed for access Normal / Emergency or Urgent / Emergency shall be able to initiate an Emergency call by repeated flashing of the phone's hook switch, or repeated pressing of the DCS or the Call Switch. Systems that require additional switches and/or conductors to initiate an Emergency call, shall not be acceptable.
29. Normal and Urgent calls shall be placed into the queue for the designated Admin Station or Admin Web UI.
30. Each Admin Station call queue shall first be sorted per call priority (for example, Emergency, then Urgent, and then Normal). Calls are sorted within each priority level on a first-in, first-out basis. When a call is answered, it shall automatically be removed from the queue. Systems that do not sort calls per priority and order received shall not be acceptable.

- a. The display shall simultaneously display a minimum of three intercom calls pending.
 - b. Additional calls beyond three shall be indicated by a scrolling option on the right-hand side of the screen thus prompting the user that additional calls are waiting.
31. It shall be possible to answer any incoming call by picking up the handset while it is ringing. It shall not be necessary to press any buttons to answer a call unless the call has dropped into the queue.
32. Staff Stations
- a. Staff Stations shall receive a dial tone upon going off-hook. Outgoing calls are made by dialing the desired station. Incoming calls can be directed to the telephone or to the associated loudspeaker for a hands-free reply. There shall be a switchover from loudspeaker to private telephone communication when a person picks up the handset, dials *3, and presses Enter/OK.
 - b. Staff Stations shall be programmable for any type of system access, provided by or restricted by the following CoS options:
 - 1) Call-in Level
 - 2) Zone Paging
 - 3) All-Call Paging
 - 4) Emergency All-Call
 - 5) Inter-Facility Call/Page
 - 6) Audio Distribution
 - 7) Remote Pickup
 - 8) Join Conversation
 - 9) Call Forwarding
 - 10) Walking Class of Service
 - 11) External Call Routing
 - 12) Call Transfer/3-way Calling
 - 13) Manually Activate Tone Signals
 - 14) Call Any Station
 - 15) Manage Recordings
 - 16) Monitor Calls
 - 17) Monitor Locations
 - 18) Conference Admin
 - 19) Conference User
 - 20) Voicemail
 - 21) Record Calls
 - 22) Activate Alarm Signals
 - 23) Disable Audio
 - 24) Enable Audio
 - 25) Allow Callee Auto-answer
 - 26) District Paging
 - 27) Inter-Facility Features
 - 28) Manage Output Contacts
 - c. Staff Stations shall be able to make a Normal call to any Admin Station by dialing the Admin Station's extension number. Staff Stations shall also be able to initiate an Emergency Call by dialing ****. Emergency Calls shall ring the Designated Day/Night Admin Station. The system shall provide for each station to have a Personal Identification Number (PIN). By dialing the PIN at any system telephone, the administrator shall have access to Emergency paging regardless of the restrictions on the particular phone being used.
33. Admin Stations
- a. Admin Stations shall receive a dial tone upon going off-hook. Outgoing calls are made by dialing the desired stations. Incoming calls can be directed to the telephone or to the associated loudspeaker for a hands-free reply. There shall be an automatic switchover from loudspeaker to private telephone communication should the person pick up his or her handset.

- b. The display shall normally show the time of day and day of week, bell schedule name, and the numbers of a minimum of three stations calling-in, along with the call-in status of each station (Normal, Urgent, Emergency). The Admin Station's display shall indicate the station number being dialed from the Admin Station.
 - c. The display shall also provide user-friendly menu selections to assist the operator when using the Nyquist system. Displays shall be in English for maximum ease-of-use. Systems that require the operator to memorize long lists of operating symbols or control codes shall not be acceptable.
 - d. Admin Stations shall be programmable for any type of system access, providing or restricting the following CoS options:
 - 1) Call-in Level
 - 2) Zone Paging
 - 3) All-Call Paging
 - 4) Emergency All-Call
 - 5) Inter-Facility Call/Page
 - 6) Audio Distribution
 - 7) Remote Pickup
 - 8) Join Conversation
 - 9) Call Forwarding
 - 10) Walking Class of Service
 - 11) External Call Routing
 - 12) Call Transfer/3-way Calling
 - 13) Manually Activate Tone Signals
 - 14) Call Any Station
 - 15) Manage Recordings
 - 16) Monitor Calls
 - 17) Monitor Locations
 - 18) Conference Admin
 - 19) Conference User
 - 20) Voicemail
 - 21) Record Calls
 - 22) Activate Alarm Signals
 - 23) Disable Audio
 - 24) Enable Audio
 - 25) Allow Callee Auto-answer
 - 26) District Paging
 - 27) Inter-Facility Features
 - 28) Manage Output Contacts
 - e. Program selection and its distribution or cancellation shall be accomplished from a designated Admin Station with the assistance of the menu display system. Distribution and cancellation shall be to any one or combination of speakers, any Audio Zone or Audio Zones, or All Zones. It shall be possible to provide an unlimited number of program channels for the user to pick from.
 - f. It shall be possible via an Admin Station to manually initiate any of the unlimited Normal Tones or Emergency Tones. The Tones shall be separate and distinctly different from the Alarm Tones. The Tone selected shall be capable of being played one time, continuously until it is canceled, or until the administrative display phone is placed back on-hook.
 - g. Each Admin Station shall maintain a unique queue of all stations calling that Admin VoIP phone.
34. VoIP Wall Baffle and VoIP Ceiling Speakers shall be configurable as one of two station types: 1) VoIP Speaker Only, or 2) VoIP Speaker with DCS.
- a. The Bogen Nyquist VoIP speakers are powered via PoE. Use an 802.3af compliant PoE network switch port or PoE Injector to power these speakers. One PoE network switch port or PoE Injector is required per VoIP speaker.
 - b. VoIP speakers can be equipped with a DCS that can be programmed as a Normal/Emergency, Urgent/Emergency, or Emergency Only and shall be able to

- initiate an Emergency call by touching the DCS one, two, or three times depending on the CoS and current call state of the DCS. If the station is authorized for Privacy Mode, the users can touch and hold for 4 seconds to enable Privacy Mode or hold for four seconds to disable Privacy Mode. Systems that require mechanical, membrane, or an additional number of switches to initiate an Emergency call, shall not be acceptable.
- c. Emergency Calls from VoIP Speaker with DCS shall have priority over the Normal and Urgent calls in the queue on the Admin Stations and will show up at the top of the list. Systems that do not provide priority for Emergency Call shall not be acceptable.
 - d. Normal and Urgent calls shall be logged into queue for the designated Admin Stations.
 - 1) Admin Stations shall ring for when they receive a call, and then the call will be removed from the queue when the call is answered or when the Admin Queue times out (default is 30 minutes).
 - e. Each queue call shall first be sorted by call priority (Emergency, then Urgent, and then Normal). Calls are sorted within each priority level on a first-in, first-out basis. When a call is answered, it shall automatically be removed from the queue. Systems that do not sort calls by priority and order received, shall not be acceptable. The display shall simultaneously show a minimum of three staff calls pending. Additional staff calls beyond three shall be indicated by an arrow pointing down thus prompting the Admin user that additional calls are waiting.
 - f. It shall be possible to answer any incoming call simply by picking up the handset while it is ringing. It shall not be necessary to hit any buttons to answer a call unless the call has dropped into the queue.
35. System programming shall be from an authorized Nyquist Admin User via any web browser. A valid username and password shall be required to gain access to the following programmable functions:
- a. System Parameters – Allow installers to adjust core system parameters.
 - b. Zones – Allow installers to create and modify Paging, Time, and Audio Zones.
 - c. Schedules – Allow installers and administrators to create Bell Schedules for the facility, predefine alternative schedules to run. Holiday Events prevent the bells from ringing on a school holiday. The system shall allow an unlimited number of schedules to operate simultaneous within a facility.
 - d. Admin Groups – Allow the installer to create, modify, and delete software groupings of admin phones that can ring when a station calls in with a call switch.
 - e. CoS Configuration – Allow the installer to create, modify, and delete CoS groups that can have the following features defined: Call in Level, Zone Paging, All-Call Paging, Emergency All-Call, Inter-Facility Call/Page, Audio Distribution, Remote Pickup, Join Conversation, Call Forwarding, Walking Class of Service, External Call Routing, Call Transfer/3-way Calling, Manually Activate Tone Signals, Call any Station, Manage Recording, Monitor Calls, Monitor Locations, Conference Admin, Conference User, Voicemail, Record Calls, Activate Alarm Signals, Disable Audio, Enable Audio, Allow Callee Auto-answer, District Paging, and Inter-Facility Features.
 - f. Stations – Allow the installer to set up, modify, delete stations, set up Page Exclusion, view stations' status, and add a station.
 - g. Bridge Devices – Allow the installer to install the Nyquist ASBs.
 - h. Audio – Allow the installer to upload and manage Announcements, Playlists, Announcements, Songs, and Tones. The must support the uploading of both MP3 and WAV files making Audio file management simple for users. Systems that limit the size of Audio files shall not be considered equal.
 - i. Users – Allow the installer to manage users by giving them the proper Role and assign an Extension if needed.

- j. Roles – Allow the installer to limit user to the following: create, delete, edit, restart server, sort menu, systems update, manage, import/export, restore, settings, or view.
 - k. Facilities – Allow the installer to set up the district wide facilities for remote paging and calling.
 - l. Outside Line – allow the installer to set up FXS and FXO ports for inbound and outbound system calling.
 - m. SIP Trunks – allow the installer to set up SIP trunks into the facility for inbound or outbound calling.
 - n. Call Details – allow the installer to review the historical system activities that can be used for incident investigation or system troubleshooting.
 - o. System Backup/Restore – allow the installer to preform system backup or restores and allow the backups to be scheduled to run automatically.
 - p. System Logs – allow the installer to view and export Server, Nyquist-Intercom, and Web Server logs that can be used for trouble shooting and technical assistance.
 - q. Paging Exclusions – allow the installer to view and edit station that are excluded from paging.
 - r. Firmware – is used to update Nyquist appliances.
 - s. Help –Provides information about the system, online help topics, and System Administrator Manual.
 - t. Systems not capable of supporting web-based configuration and control, or require plugins or dedicated application software, shall not be deemed as equal.
 - u. Systems that require a Serial-to-Ethernet converter, or require additional application software on a PC for configuration and/or control shall not be deemed as equal.
36. Admin Group
- a. Admin Stations can be placed into Admin Groups, which are used if incoming calls are not answered by the assigned Admin Station or the Day or Night Admin associated with the Admin Station. Admin Groups act as an always answer feature by providing an alternate list of Admin Stations. If an incoming call is not answered by the assigned Admin Station within 30 seconds for normal calls or 15 seconds for emergency calls, all Admin Stations in the Admin Group will ring.
 - b. If Call Forwarding is enabled at the Admin Station, Nyquist tries the forwarded extension. If that station does not answer or is busy, the call timeout is reduced to 15 seconds. After 15 seconds, the call rolls over to the Admin Group.
 - c. If an Emergency level call receives no answer, the Admin Group will ring if the Day Admin or Night Admin does not answer.
 - d. Admin Stations can be assigned to multiple Admin Groups. A Day or Night Admin can also be assigned to one or more Admin Groups.
37. Call Detail Reporting
- a. The Call Details feature allows the viewing and/or printing of detail records of every call in a facility in a call log format. Calls include scheduled announcements, paging, and internally and externally made or received telephone calls.
38. System Backup/Restore
- a. The system backup feature allows users with access to back up the system database, voicemail, and recordings.
 - b. The system restore allows users with access to perform a system restore of previously backed up database, voicemail, and/or recordings.
 - c. The installer also can set up an automatic backup that can be performed daily, weekly, or monthly.
39. System Log Files
- a. A log file records either events or messages that occur when software runs and is used when troubleshooting the system. The following parts of the Nyquist system generate log files:

- 1) Server (This provides access to the Debian Linux OS server log files.)
 - 2) Intercom (This provides access to the Intercom application server log files.)
 - 3) Web Server (This provides access to the web server log files.)
- b. From the web-based UI, system logs can be viewed directly or exported via download to a PC, Mac, or Android device and then copied to removable media or attached to an email to technical support.
40. Paging Exclusions
- a. For school testing and exams, the administrators shall be able to put stations into Page Exclusion mode. During this time, the stations will only receive Emergency All-Call pages – not music, tones, or All-Calls. Emergency pages will still be heard at the station even if that station is set to exclude paging.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with the installer present, for compliance with requirements and other conditions affecting the performance of the Nyquist E7000 Series Educational System.
- B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 EQUIPMENT MANUFACTURER'S REPRESENTATIVE

- A. All work described herein to be done by the manufacturer's authorized representative shall be provided by a documented factory authorized representative of the basic line of equipment to be utilized.
- B. As further qualification for bidding and participating in the work under this specification, the manufacturer's representative shall hold a valid C-10 Contractor's License issued by the Contractor's State License Board of [your state]. The manufacturer's representative shall have completed at least 10 projects of equal scope, giving satisfactory performance, and shall have been in the business of furnishing and installing sound systems of this type for at least five years. The manufacturer's representative shall be capable of being bonded to ensure the owner of performance and satisfactory service during the guarantee period.
- C. The manufacturer's representative shall provide a letter with submittals from the manufacturer of all major equipment stating that the manufacturer's representative is an authorized distributor. This letter shall also state that the manufacturer guarantees service performance for the life of the equipment and that there will always be an authorized distributor assigned to service the area in which the system has been installed.
- D. The contractor shall furnish a letter from the manufacturer of the equipment. This letter shall certify that the equipment has been installed according to factory intended practices, that all the components used in the system are compatible, and that all new portions of the systems are operating satisfactorily. Further, the contractor shall furnish a written unconditional guarantee, guaranteeing all parts and all labor for a period of five years after final acceptance of the project by the owner.

3.3 DIVISION OF WORK

- A. While all work included under this specification is the complete responsibility of the contractor, the following division of actual work listed shall occur:
 1. The conduit, outlets, terminal cabinets, etc., which form part of the rough-in work, shall be furnished and installed completely by the electrical contractor.

2. The balance of the system, including installation of speakers and equipment, making all connections, etc., shall be performed by the manufacturer's authorized representative. The entire responsibility of the system, its operation, function, testing and complete maintenance for one year after final acceptance of the project by the owner, shall also be the responsibility of the manufacturer's authorized representative.

3.4 INSTALLATION

- A. The installation, adjustment, testing, and final connection of all conduit, wiring, boxes, cabinets, etc., shall conform to local electrical requirements and shall be sized and installed in accordance with the manufacturer's approved shop drawings.
- B. Low-voltage wiring may be run exposed above ceiling areas where they are easily accessible.
- C. The contractor shall install the new system at the location shown on the plans.
- D. All Staff Stations and Call Switches shall be wall-mounted:
 1. Mount at 54" AFF.
 2. All wiring should be concealed.
 3. Verify exact location with architect.
 4. Avoid mounting near doors to prevent students from activating and running out of the rooms.
- E. Admin Stations can be desk or wall mounted.
- F. Speaker and telephone lines run above ceiling and not in conduit shall be tie-wrapped to a ceiling joist with a maximum spacing of 8' between supports. No wires shall be laid on top of ceiling tile.
- G. Connect field cable to each Analog Speaker transformer using UL butt splices for #22 AWG wire.
- H. Contractor shall provide a minimum of eight hours of configuration and operational instruction to school personnel.
 1. Bogen Communications, Inc., shall provide online "How To" videos for instructing the teaching staff on how to operate the Teacher Dashboard aspect of the system.
- I. On the first school day following installation of the Nyquist System, the contractor shall provide a technician to stand by and assist in system operation.
- J. Mark and label all demarks IDF and MDF points with destination point numbers. Rooms with more than one outlet shall be marked XXX-1, XXX-2, XXX-3, etc. where XXX is the room number.
- K. No graphic room number shall exceed the sequence from 000001 through 899999.
 1. All outside speakers shall be on a separate Page Zone and Time Zone.
 2. All zones shall be laid out not to exceed 40 Watts (@25V) maximum per zone.
 3. All hallway speakers shall be tapped at 1 Watt (@25V) maximum.
 4. All outside horns shall be tapped at 3.75 Watts (@25V) maximum.
 5. All classroom speakers shall be tapped at ½ Watt (@25V) maximum.
 6. Large rooms, such as cafeterias, shall be tapped at 2 Watts (@25V) maximum.
- L. Plug disconnect: All major equipment components shall be fully pluggable by means of multi-pin receptacles and matching plugs to provide for ease of maintenance and service.
- M. Protection of cables: Cables within terminal cabinets, equipment racks, etc., shall be grouped and bundled (harnessed) as to type and laced with No. 12 cord waxed linen lacing twine or T

and B wire-ties, or hook and loop cable management. Edge protection material shall be installed on edges of holes, lips of ducts, or any other point where cables or harnesses cross a metallic edge.

- N. Cable identification: Cable conductors shall be color-coded and individual cables shall be individually identified. Each cable identification shall have a unique number located approximately 1-1/2" from cable connection at both ends of cable. Numbers shall be approximately 1/4" in height. These unique numbers shall appear on the As-Built Drawings.
- O. Shielding: Cable shielding shall be capable of being connected to common ground at point of lowest audio level and shall be free from ground at any other point. Cable shields shall be terminated in the same manner as conductors.
- P. Provide complete "in service" instructions of system operation to school personnel. Assist in programming of telephone system.

3.5 GROUNDING

- A. The contractor shall provide equipment grounding connections for Integrated Telecommunications/Time/Audio/Media System as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to ensure permanent and effective grounds.
- B. The contractor shall provide ground equipment, conductor, and cable shields to eliminate shock hazard and to minimize the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments.
- C. The contractor shall provide all necessary transient protection on the AC power feed and on all station lines leaving or entering the building.
- D. The contractor shall note on their drawings the type and locations of these protection devices and all wiring information.
- E. The contractor shall furnish and install a dedicated, isolated earth ground from the central equipment rack and bond to the incoming electrical service ground buss bar.

3.6 DOCUMENTATION

Provide the following directly to the Supervisor of Technology Services.

- A. One printed copy of all field programming for all components in system
- B. One copy of all diagnostic software with a copy of field programming data for each unit
- C. One copy of all field wiring runs, location, and end designation of system

END OF SECTION 27 51 23

SECTION 27 51 23.80 – LOCAL SOUND REINFORCING SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Provide all materials, equipment, transportation and labor to achieve complete and fully functional systems as shown or intended on drawings and in bid specifications.
- B. All applicable equipment shall bear the UL label. All work shall be executed in accordance with the National Electric Code (NEC), the Occupational Safety and Health Act (OSHA) and all applicable State and Local codes, ordinances and regulations.
- C. The Contractor's installation team shall have at least one member possessing a NICET Level II, CTS-I or C-EST certification; additionally, at least one audio DSP programmer certified in HiQnet Audio Architect, Symetrix, Biamp Tisera, QSC Q-SYS or Dante.
- D. Contractor shall have been in the commercial AVL (Audio, Video, Lighting) installation industry for at least five years. Contractor shall have installed at least five systems of this type and comparable scale in educational facilities within the State of Texas. Contractor shall provide a list of successfully completed projects including completion dates within the past two years from the bid date of this project.
- E. Should the local sound systems include Crestron or AMX hardware which requires programming, the Contractor shall provide a Certified Crestron Programmer or an AMX Certified Expert (ACE) Programmer to program, upload and debug the third party control systems.
- F. Should the local sound systems include managed network devices, the Contractor shall provide one person on the installation team with valid certification in one of the following: Harman HCNA/P, CompTIA Network+, Cisco CCNA or Cisco CCNP. Provide valid certification credentials in the submittal documentation.
- G. Any discrepancy in quantity or part numbers between the drawings and the bid specifications shall be brought to the attention of the Consultant for clarification during the bidding period. No allowance shall be made to the Contractor by reason of failure to have brought said discrepancies to the attention of the Consultant prior to award of contract. Should discrepancies be discovered, the greater in quality and quantity shown shall be provided.
- H. Systems to be installed in the following areas:
 - 1. As listed below.

1.2 REGULATORY REQUIREMENTS

- A. Standards: All work shall be performed in accordance with the latest revisions of the following standards and codes:
 - 1. Latest Local Codes and Amendments
 - 2. 2015 National Electrical Code
- B. Other References:
 - 1. TIA/EIA-568-A – Commercial Building Telecommunications Wiring Standard
 - 2. EIA/TIA-569 – Commercial Building Standard for Telecommunication Pathways and Spaces.

3. TIA/EIA-606 – The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
4. TIA/EIA-607 – Commercial Building Grounding and Bonding Requirements for Telecommunications.
5. EIA/TIA 455-A – Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices and Other Fiber Optic Components.
6. TIA/EIA TSB 67 – Transmission Performance Specification for Field Testing of Unshielded Twisted-Pair Cabling Systems.
7. TIA/EIA TSB 72 – Centralized Optical Fiber Cabling Guidelines
8. ISO/IEC 1180 – Generic Cabling Standard
9. EN 50173 – Generic Cabling Standards for Customer Premises
10. ANSI/EIA/TIA 526-14 – Optical Power Loss Measurements of Installed Multimode Fiber Cable Plan.

C. Governing Codes and Conflicts:

1. If the requirements of these specifications or the Project Drawings exceed those of the governing codes and regulations, then the requirements of these specifications and the Drawings shall govern. However, nothing in the Drawings or Specifications shall be construed to permit work not conforming to all governing codes and regulations.

1.3 ABBREVIATIONS

- A. The following abbreviations are used in this document:

1.4 SUBMITTAL DOCUMENTATION

- A. Submit shop drawings as specified in pdf format, ARCH E1 (30x42). Contractor shall be responsible for all costs associated with producing and submitting all required documentation.
- B. Submit a room by room list of all equipment to be installed, in pdf format.
- C. Submit Manufacturer's product data for all equipment with a table of contents, in pdf format.
- D. Submit a line item compliance statement indicating that the products being submitted comply with the specified equipment and indicate which products deviate from the specifications.
- E. Submit detailed drawings of all systems, minimum scale 1/8" = 1', in pdf format.
1. Table of Contents.
 2. Rigging details. All hardware must meet or exceed a safety factor of 5:1. Detail the product manufacturer, part numbers and load capacity of all hardware to be used. **Contractor shall employ the services of a professional structural engineer licensed to practice in the State of Texas to verify load ratings of hanging components. Provide attachment details on Shop / Submittal Drawings reviewed by said engineer. Include stamped report of items reviewed by structural engineer with shop drawings submittal. Report shall include an itemization of items reviewed by the structural engineer and confirmation that proposed methods of suseending equipment as shown on the shop drawings conform with required safety factors.**

3. Floor Plans, Reflected Ceiling Plans and Section Elevations displaying loudspeaker locations and orientation, wall plate locations, rack locations, 120vAC receptacle locations and all other related device locations.
4. Comprehensive system schematics displaying detailed connections to all equipment. These shall display wire numbers, terminal block numbers, patch bay assignments and color coding.
5. Proposed construction details for any custom fabricated items; including interface panels, patch panels and wall plates. These shall display dimensions, materials, finishes, I/O connector labels and color selection.
6. Rack elevations displaying the locations of all equipment within each rack.
7. Riser diagrams displaying conduit requirements with pull boxes, outlet boxes, cable layouts, cable type part numbers and quantity of cables with part number in each conduit.
8. Electrical power requirements for the systems. Include diagrams for any remote control of electrical power displaying locations and elevations for all receptacles in detail sufficient to coordinate with the Electrical Contractor.
9. All submittal drawings not meeting the above criteria shall be deemed incomplete, shall not be reviewed and shall be returned for revision.

1.5 OPERATING AND MAINTENANCE MANUALS

- A. Provide Operating and Maintenance Manuals as specified in Division 26 and Division One and deliver to the Owner.
- B. Include:
 1. Product Data.
 - a. Manufacturer's data for each type of product conforming to the submission format specified herein. Include manufacturer's serial numbers within the list of product.
 - b. For custom circuits or modifications, a description of the purpose, capabilities, and operation of each item.
 - c. Each product's Owner Instruction Manual. Provide high quality copies where necessary, with all text legible and illustrations of equal resolution and sharpness as the original manual. Faxed copies or copies with portions of the information missing or smeared are not acceptable.
 - d. Manufacturer's maintenance and care instructions.
 - e. Separately bound list by manufacturer and model or part number of product incorporated within the systems arranged in alphanumeric order.
Manufacturer's warranty statements bound separately where applicable.
 2. A complete as-installed (As Built) equipment list, listed by room, identifying manufacturers' names, model numbers, serial numbers, quantities and locations of each item.
 3. Complete and correct As Built systems schematics, floor plans, reflected ceiling plans, elevations, rack risers and I/O plate details. Include diagrams or charts displaying final settings of all control knobs in the system (mixers, equalizers, audio amplifiers, etc.).
 4. Each individual system's program software / source code (audio, video, lighting and third party control) with final settings and pass codes and As Built AutoCAD files (2013 or newer) shall be saved onto two separate 8GB thumb drives and included in the close-out documentation. All software programs / source codes are the intellectual property of the Owner.
 5. Quick-start Guide for each system written with the assumption that the intended reader is technically inexperienced and unfamiliar with the facility. The Quick-start Guide shall be laminated and affixed to the inside of the front door of the system rack with appropriate mounting hardware. One copy of each individual

system schematics printed in ARCH D (24x36) and laminated shall be delivered to the Owner.

6. Two hard copy, paper sets of the as-installed (As Built) drawings in ARCH E1. Drawing sets shall be individually bound.
7. In addition to the hard copy close-out documentation, all close-out documentation shall be included, in pdf format, on the, 8GB thumb drives.
8. Service & Maintenance Manual:
 - a. Provide an original manufacturer's copy of the service manual on every piece of equipment for which the manufacturer offers a service manual. On equipment where there is no service manual, provide statement from company indicating manual is not available. Arrange manuals in the same order as the operations manual.
 - b. Manufacturer's maintenance and care instructions.
 - c. Maintenance Instructions, including maintenance phone numbers and hours; maintenance schedule; description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products.
9. Organize documents into separate bindings containing data relevant to operation, maintenance and warranty.

1.6 WARRANTY AND SERVICE

- A. The Contractor shall warrant all new equipment to be free of defects in materials and workmanship for not less than one year after the Substantial Completion date.
- B. The systems are to be free of defects and deficiencies and are to conform to the drawings and specifications as to kind, quality, function and characteristics. The Contractor shall repair or replace defects which may occur in labor or materials within the warranty period without charge to the Owner.
- C. Within the warranty period, respond to requests for service within 24 hours. Service calls to perform warranty work shall be made within 72 hours of request by the Owner. Temporary, equivalent replacement equipment shall be provided at no cost to the Owner when immediate on-site repairs cannot be made.
- D. This warranty shall not void or replace individual manufacturer warranties which extend past this warranty period. This warranty shall not void any rights guaranteed the Owner by law.
- E. The Contractor shall include in the close-out documentation a certificate of warranty which includes the start and end dates of the warranty and contact information, including name, telephone number and email, of individuals to perform warranty service.
- F. This warranty shall not apply to existing Owner Furnished Equipment.
- G. Additional warranties may be negotiated between the Contractor and the Owner at the Owner's discretion.

1.7 SUMMARY OF WORK

- A. The installation shall comply with all applicable codes and standards in effect at the job site and as indicated in the Drawings and Specifications.
 1. Reference project drawings for locations, quantities, and coordination with other trades.
- B. All local sound racks shall have cabling installed and routed according to industry standard best practices. Contractor shall employ horizontal lacing rails in the rear of the rack for neat

and orderly cable routing. Use Velcro strips for cable bundling. ZIP TIES ARE NOT ACCEPTABLE.

- C. Contractor shall perform an RF scan and shall provide results in pdf format with the close-out documentation. Contractor shall provide an RF coordination sheet, documenting all RF frequencies in use in each system, including in the High School buildings, to ensure there is no RF interference between systems. Coordinate with General Contractor and for access to High School building systems.
- D. Contractor shall tune each system's DSP to provide a flat frequency response.
 - 1. Tune and set dynamics on all inputs to provide the highest level of gain before feedback while providing intelligibility of all inputs.
 - 2. Contractor shall perform a "rattle test" of all systems: Apply sine wave sweep signal to each loudspeaker system with a two minute sweep from 20Hz to 550Hz, to 10 - 15dB below full system output. Annotate issues discovered during sweep test. Correct issues resulting from the new system equipment and / or rigging hardware.
- E. Contractor shall provide all required equipment and programming to provide a fire alarm override. All audio shall mute in all local sound systems during a fire alarm.
- F. Contractor shall coordinate speaker colors with Architect and District before purchasing.

PART 2 – MATERIALS

- A. All equipment shall be new and unused unless otherwise noted.
- B. Contractor shall provide all necessary patch cables, riser/plenum cabling and connectors interconnecting all equipment to provide for fully functional systems. In addition, all cabling raceway, support systems, sleeves and any other materials required to properly install and support cabling systems.
- C. All equipment quantities shall be as shown on drawings unless otherwise noted.
- D. All materials are to be provided as specified. No substitutions shall be accepted without written request from the Contractor and written consent of the Consultant.

2.1 AUX GYMNASIUM 2 - 4133

- A. DSP, CONTROL, PERIPHERALS & NETWORK DEVICES
 - 1. 1 qty QSC Core 110f V2
 - a. Provide single D1 data in wall behind equipment rack for network connectivity.
 - 2. 1 qty QSC UCI deployment license
 - 3. 1 qty. QSC Scripting license
 - 4. 1 qty. QSC TSC-70-G3 – Touch screen controller panel UCI.
 - a. 1 qty. Honeywell CG512A1009 Large Thermostat Guard
 - b. Provide 5 sets of keys
 - 5. 3 qty. WALL PLATE AUDIO – "AX".
 - a. Provide qty. 1 cat6a data cable from each wall plate to local sound rack.
 - b. QSC UNDX2IO+, Two (2) mic/line inputs, two (2) line outputs.
 - i. ProCo double gang decora wall plate cover.

- a. Label plate Inputs "MIC 1 – MIC 8".
 - b. Label plate Outputs "OUT 1 – OUT 8".
 - c. Cover up manufacturers factory IN/OUT labels.
 - d. Install plates, ascending in mic # from low to high from house left to house right.
 - e. Quantity and locations as shown on drawings.
6. 1 qty. Netgear M4250-26G4XF-PoE+ (GSM4230PX), 24x1G PoE+ 480W 2x1G and 4xSFP+ Managed Switch.
 7. 1 qty. ComScope 760162800 | UNP-6A-DM-1U-24, 24 Port Cat6a Patch Panel.

B. USER CONTROL INTERFACE / TOUCH PANELS

1. Coordinate with Owner and Consultant for final UCI functionality and layout. Coordinate with Owner for Logo to be displayed on all UCI pages. Provide a numeric (0-9) passcode page immediately after the splash page. Provide a simple way for Owner to change and store new password from the UCI.
2. The first page "SYSTEM START UP" shall have the text, "PRESS ANYWHERE TO START SYSTEM". The next page shall display a prompt requesting a passcode. Once the passcode is entered correctly, a System Start Up loading bar shall be visible. After the system has booted, the next page "HOME", shall allow for the selection of auto mode, manual mode, media controls, projection system and system shutdown.
3. The "AUTO MODE" page shall include a system mute button, master output volume control fader with buttons to allow the user to navigate back to the home page or a system shutdown page.
4. The "MANUAL MODE" page shall include a system mute button, channel fader volume controls, preamp controls and mutes for all available inputs with buttons to allow the user to navigate back to the home page or system shutdown page.
5. The "MEDIA CONTROLS" page shall provide transport controls for the CD player.
6. When system shutdown is selected, a prompt shall appear with the text "PLEASE CONFIRM SHUTDOWN". The user will then select a button labeled "Yes" or "No". If no is selected, the "HOME" page shall appear. If yes is selected, a system shutdown loading bar shall appear. All amplifiers and video displays/projectors shall be put in standby mode, and projector screens/lifts raised. Once the system shutdown sequence is complete, the "SYSTEM START UP" page shall be visible

C. AUDIO AMPLIFIERS

1. 1 qty. QSC CX-Q 8K4
 - a. Program amplifier's DSP with data acquired during system tuning.
 - b. Program each output channel with appropriate DSP settings to protect the speaker drivers from being over-driven and damaged.

D. WIRELESS MICROPHONES

1. 1 qty. Shure ULXD4D-G50, DUAL channel digital wireless microphone receiver.
 - a. Installed in local sound rack.
2. 1 qty. Shure ULXD2SM58-G50, wireless microphone handheld transmitter.
3. 1 qty. Shure ULXD1-G50, wireless microphone bodypack transmitter.

4. 1 qty. Shure SBC200, 2 bay charging station for wireless microphone transmitters.
5. 2 qty. Shure SB900B, rechargeable wireless microphone batteries.
6. 1 qty. RF Venue DFINW, diversity remote antenna, white.
 - a. Orient to achieve maximum coverage of Cafeteria.
 - b. Provide 1 qty. AtlasIED GN-13E. Reinforce device to ensure antenna is aimed properly.
 - c. Provide 1 qty. Atlas Sound AD-12BE flange.

E. POWER DISTRIBUTION

1. 1 qty. Middle Atlantic PD-920R-SP, Rackmount Power, 9 Outlet, 20A with Series Surge Protection.
 - a. Installed in local sound rack.

F. LOCAL SOUND EQUIPMENT RACK

1. 1 qty. Middle Atlantic DWR 24-26PD.
2. 1 qty. Middle Atlantic D3 – 3RU Drawer
 - a. 1 qty. Middle Atlantic FI-3
3. 2 qty. Middle Atlantic RSH – Single RU Shelf
4. 1 qty. Middle Atlantic SS – Sliding Shelf.
5. 1 qty. Middle Atlantic UQFP- 4, 2 RU fan panel.
6. Provide 5 extra front door keys to the Owner.
7. Populate all unused rack spaces with blank panels.
8. Install all rack mounted equipment with Middle Atlantic HTX, T20 Star Post, 10-32 security-screws.

G. CD PLAYER

1. 1 qty. Denon DN-700CB.

H. LOCAL SOUND SYSTEM SPEAKERS

1. 5 qty. QSC PL-DC12, WHITE.
 - a. Terminate speakers in full range setting.
 - b. Horizontal orientation.
 - c. Aim speakers for evenly distributed and complete coverage of seating area.
 - d. 2 qty. Speakers per circuit.
2. 1 qty. QSC PL-SUB15, WHITE.
3. Securely attach all speakers to building structure at a 5:1 safety factor.
 - a. Contractor shall employ rigging attachment hardware rated SAE Grade 5 minimum.
 - b. Attach 1 qty. safety cable to each speaker.
 - c. Paint all speakers and rigging hardware to match ceiling color. Coordinate with Architect for paint manufacturer and code.

I. INTERCOM INTERFACE

1. 1 qty. RDL TX-70A Speaker Level Input Interface.
 - a. Local Sound Contractor to provide and install necessary cabling to connect to Intercom system.
 - b. Connect to Audio DSP. Duck Local Sound System during announcements and use local sound speakers to reinforce Intercom System.
 - c. Coordinate with Building Intercom Contractor for integration of systems

J. ASSISTED LISTENING SYSTEM

1. 1 qty. LS-54-216 Assisted Listening System
2. 1 qty. LA-124 antenna. Install at locations shown on drawings.
3. Provide enough LR-4200-216 Receivers to meet TAS and ADA standards as required by law.
4. Provide with each additional LR-4200-216 Receiver:
 - a. 1 qty. LA-401 Ear Speaker.
 - b. 1 qty. LA-430 Earphone/Neck Loop Lanyard
5. Provide 1 qty. LA-124 antenna.
6. Coordinate with Architect for installation location of each LA-304 Signage Kit.

K. PLATES AND PANELS

1. All custom wall plates shall be manufactured by ProCo, RCI or Whirlwind.
 - a. Anodized aluminum, BLACK with white lettering in 1/8" Sans Serif font.

L. OUTLETS / PLATES

1. ANTENNA PLATE, "W".
 - i. ProCo single gang antenna plate with 1 qty. 50 Ohm BNC connector.
 - ii. Provide gooseneck with flange for supporting antenna on plate.
 - iii. Quantity and locations as shown on drawings.
 - iv. Provide wire guard in gymnasiums to protect from flying objects.
2. ASSISTED LISTENING ANTENNA PLATE, "H".
 - i. ProCo single gang antenna plate with 1 qty. 50 Ohm BNC connector.
 - ii. Quantity and locations as shown on drawings.
 - iii. Provide wire guard in gymnasiums to protect from flying objects.

2.2 WEIGHT ROOM- 4146

A. DSP, CONTROL, PERIPHERALS & NETWORK DEVICES

1. 1 qty QSC Core 110f V2
2. 1 qty QSC UCI deployment license
3. 1 qty. QSC Scripting license
4. 1 qty. QSC TSC-70-G3 – Touch screen controller panel UCI.
 - a. 1 qty. Honeywell CG512A1009 Large Thermostat Guard
 - b. Provide 5 sets of keys
 - c. Installed in local sound rack on 4 RU custom cut panel.
5. 1 qty. Netgear M4250-26G4XF-PoE+ (GSM4230PX), 24x1G PoE+ 480W 2x1G and 4xSFP+ Managed Switch.

B. USER CONTROL INTERFACE / TOUCH PANELS

1. Coordinate with Owner and Consultant for final UCI functionality and layout. Coordinate with Owner for Logo to be displayed on all UCI pages. Provide a numeric (0-9) passcode page immediately after the splash page. Provide a simple way for Owner to change and store new password from the UCI.
2. The first page "SYSTEM START UP" shall have the text, "PRESS ANYWHERE TO

START SYSTEM". The next page shall display a prompt requesting a passcode. Once the passcode is entered correctly, a System Start Up loading bar shall be visible. After the system has booted, the next page "HOME", shall allow for the selection of auto mode, manual mode, media controls, projection system and system shutdown.

3. The "AUTO MODE" page shall include a system mute button, master output volume control fader with buttons to allow the user to navigate back to the home page or a system shutdown page.
4. The "MANUAL MODE" page shall include a system mute button, channel fader volume controls, preamp controls and mutes for all available inputs with buttons to allow the user to navigate back to the home page or system shutdown page.
5. The "MEDIA CONTROLS" page shall provide transport controls for the CD player.
6. When system shutdown is selected, a prompt shall appear with the text "PLEASE CONFIRM SHUTDOWN". The user will then select a button labeled "Yes" or "No". If no is selected, the "HOME" page shall appear. If yes is selected, a system shutdown loading bar shall appear. All amplifiers and video displays/projectors shall be put in standby mode, and projector screens/lifts raised. Once the system shutdown sequence is complete, the "SYSTEM START UP" page shall be visible

C. AUDIO AMPLIFIERS

1. 1 qty. QSC CX-Q 2K4
 - a. Program amplifier's DSP with data acquired during system tuning.
 - b. Program each output channel with appropriate DSP settings to protect the speaker drivers from being over-driven and damaged.

D. POWER DISTRIBUTION

1. 1 qty. Middle Atlantic PD-920R-SP, Rackmount Power, 9 Outlet, 20A with Series Surge Protection.
 - a. Installed in local sound rack.

E. LOCAL SOUND EQUIPMENT RACK

1. 1 qty. Middle Atlantic DWR 24-26PD.
2. 1 qty. Middle Atlantic D3 – 3RU Drawer
 - a. 1 qty. Middle Atlantic FI-3
3. 2 qty. Middle Atlantic RSH – Single RU Shelf
4. 1 qty. Middle Atlantic SS – Sliding Shelf.
5. 1 qty. Middle Atlantic UQFP- 4, 2 RU fan panel.
6. Provide 5 extra front door keys to the Owner.
7. Populate all unused rack spaces with blank panels.
8. Install all rack mounted equipment with Middle Atlantic HTX, T20 Star Post, 10-32 security-screws.

F. CD PLAYER

1. 1 qty. Denon DN-700CB.

G. LOCAL SOUND SYSTEM SPEAKERS

1. 5 qty. QSC AD-C821

- a. Tap each speaker at 50 watts.
- b. Insure proper time alignment.
2. 3 qty. QSC AD-C.SUB, WHITE.
 - a. Securely attach all speakers to building structure at a 5:1 safety factor.
 - b. Coordinate with Architect for paint manufacturer and code.

H. INTERCOM INTERFACE

1. 1 qty. RDL TX-70A Speaker Level Input Interface.
 - a. Local Sound Contractor to provide and install necessary cabling to connect to Intercom system.
 - b. Connect to Audio DSP. Duck Local Sound System during announcements and use local sound speakers to reinforce Intercom System.
 - c. Coordinate with Building Intercom Contractor for integration of systems

2.3 FIRE ALARM OVERRIDE

- A. Provide for Fire Alarm Override for each Local Sound system. Contractor shall provide all cabling, relays, mounting hardware and any other devices (Fire Alarm System devices by others) to provide a fully functioning Fire Alarm Override system. When Fire Alarm is active, each Local Sound System shall be muted. When Fire Alarm ceases, each Local Sound System shall automatically revert to normal operation.

2.4 SCHOOL INTERCOM PUBLIC ADDRESS OVERRIDE

- I. Provide for School Intercom Public Address Override for each Local Sound System. Contractor shall provide and install (1) RDL TX-70A, 70v to Line level converter. Contractor shall provide, install and terminate cabling to nearest School Intercom speaker and shall integrate devices into local sound system. Provide DSP programming to duck Local Sound System to give priority to the School Intercom PA System. Coordinate with Building Intercom Contractor for integration of systems

2.5 CABLE ROUTING/PATHWAY

- A. Cable Support System: All audio-video cabling shall be installed and supported using a cable support system at 4'-0" intervals unless installed in conduit. Do not exceed manufacture recommendation for the quantity of cables supported in an individual support.
- B. All cable bundles shall be grouped together using plenum rated Velcro for the entire run above and below the ceilings.

2.6 AUDIO-VIDEO SYSTEM WIRING AND TERMINATING HARDWARE

- A. Cabling:
 1. Provide a complete audio/video cabling solution from back of eah faceplate to device I/O locations as designated on the contract drawings. Each cable provided shall be installed with a minimum of 10' of excess slack above each outlet location. Contractor shall properly support and label all cabling at each outlet.
 2. Contractor shall ensure all cabling requirements are met to provide fully functional A/V systems, specified cabling notwithstanding.

PART 3 – AV SYSTEM SCHEDULING

A. AV SYSTEM SCHEDULING

1. Contractor shall program the QSYS control system to automatically shut down system every day at midnight 12am CST and recall a default configuration. This includes muting audio source inputs and setting to default level (ceiling mic inputs should always be unmuted and set at nominal level), putting all amplifiers in standby, projectors lamped off, lifts, shades and projector screens raised, video walls and displays put into standby.

B. AV SYSTEM ADMINISTRATOR MONITORING AND CONTROL

1. The contractor shall program a password protected UCI for the district systems administrator to access from a district computer with QSYS UCI Viewer.
2. This UCI shall provide all system diagnostics including but not limited to, system wide device health, network audio metering, ptz camera feeds, network video streams per room, display, projector and projector lift status; with the ability to control each rooms UCI remotely, per campus.
3. The contractor shall provide the district with QSYS Reflect Enterprise Manager professional tier services during the warranty period for all systems and peripherals.

C. NETWORK

1. The contractor shall coordinate with the district IT department to provide internet access to each QSC Core 110F dsp ON LAN B port. LAN A reserved for QLAN/Dante.

PART 4 – EXECUTION

4.1 WIRING AND INSTALLATION TECHNIQUES

- A. Coordinate all work with all other trades to avoid causing delays in construction schedule. Contractor shall expedite the delivery of materials and provide additional labor as required to meet construction deadline.
- B. Coordinate final connection of power and ground wiring to equipment racks by electrical contractor. Power and ground wiring shall terminate inside equipment racks on standard duplex outlets. Mount as to not interfere with internal equipment of the rack. Power shall be a dedicated circuit and not share with any other source. Ground per NEC with third wire (green) to panel ground lug at breaker supply panel.
- C. All equipment and enclosures described in this specification section shall be plumb and square. All equipment except portable equipment shall be permanently attached to the structure and held firmly in place. Supports shall be adequate to support their loads with a safety factor of at least five.
- D. Wiring and installation under this contract to meet NFPA, NEC, and local code requirements where applicable.
- E. The process of equalizing and testing the Audio Sound System may necessitate moving and adjusting certain component parts (e.g., loudspeakers). This shall be done without claim for additional payment.

- F. Take such precautions as are necessary to prevent and guard against electromagnetic and electrostatic hum. Separate all low level microphone and auxiliary inputs from speaker output conductors, data or other system wiring.
- G. All wiring shall be labeled using vinyl wire labeling tags. Use Brady™ model BMP21 or equal wire labeling printer. Label input, output and wireless wiring. Label electrical power breaker at electrical panel. Label location of room and power panel/breaker at equipment rack. Protect labels with clear heat shrink.
- H. Label all mixer inputs with their respective input. Example: mixer input 1 – “Mic-1”, etc. Label to reflect name on engraved wall plate.
- I. Solder all microphone connections using rosin core solder. Use temperature controlled soldering equipment. Microphone XLR connectors shall use standard wiring code as follows: pin 1 shield/ground, pin 2 positive, pin 3 negative.
- J. Paint all back boxes and conduit prior to installation of wiring or connectors. Protect and do not paint any wiring or equipment rack cabinets.
- K. Install equipment cabinet in a controlled temperature, dry and accessible area. Provide sufficient space to completely open the front and rear of the cabinet. Equipment not to be in general gym area where it can be damaged.

4.2 CABLING

- A. General: Unless otherwise noted, provide the following cable types (or equivalent) for each application:
 - 1. West Penn 454 #22 AWG twisted pair / shielded for Microphone and Line level signals.
 - 2. West Penn C210 #10 AWG twisted pair for subwoofer / low frequency speakers.
 - 3. West Penn 227 #12 AWG twisted pair for conventional, full range sound reinforcement speakers.
 - 4. West Penn 226 #14 AWG twisted pair for 70v sound reinforcement speakers.
 - 5. West Penn 810 RG-8 coax cable for analog RF signal lines.
 - 6. West Penn 4246 CAT6 cable for Local Sound/Video Network and Dante digital audio devices.
 - 7. West Penn 4246F F/UTP CAT6 for digital audio snake devices.
 - 8. West Penn 4246AF F/UTP CAT6A cable for HDBaseT video devices.
 - 9. Crestron CRESNET.
 - 10. Commscope P-006-DS-5L-FSUAQ multimode fiber optic for drop faceplate connections and network switch interconnections.
 - 11. Provide plenum rated cable where required.

4.3 INSPECTIONS

- A. General: Conformance to the installation practices covered above is to be verified when completed. In some cases, the Owner/ Designer may inspect before acceptance.

- B. Ensure all systems are installed to provide uniform, balanced audio coverage throughout each intended listening area. Ensure there are no rattles, buzzes, hums, RF interference, electro-static interference, feedback or other audible audio anomalies while the systems are in operation.
- C. Contractor shall use white / pink noise generator and audio spectrum analyzer to set overall frequency response and equalization. Ensure gain structure is properly set to prevent clipping on any device and to provide balanced system functionality. Provide proper limiter programming to prevent damage to all audio components. District Maintenance personnel to be on site during process.
- D. Demonstrate the performance of each system and give instructions of proper operation and maintenance to the Owner. Provide a minimum of eight hours of training and basic system operating instructions for each system in not more than four hour sessions. Include a list of system training attendees in the Close-Out Documentation.
 - 1. Contactor shall record each training session with a 720p, minimum, digital video recording device, with audible audio, in .MOV or .MP4 format and compile sessions onto 128MB thumb drives (as many as required) (SanDisk, Kingston or PNY) and provide to Owner. Contractor shall title each video file with the room name of the system and date; e.g., "Dining Commons – August 15, 2019."
 - 2. Contractor shall provide an asbuilt QSYS designer file, Dante Controller preset, Shure wireless work bench inventory/RF coordination report and Netgear switch master configuration file supplied on a usb flash drive. In the event when systems are updated during service calls during the warranty period, the contractor shall furnish updated system files to the district.

END OF SECTION

SECTION 28 05 00 - GENERAL ELECTRONIC SAFETY SYSTEMS REQUIREMENTS

PART 1 – GENERAL

1.1 WORK INCLUDES

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1, apply to this Section.
- B. Furnishing of all required materials, equipment, tools, scaffolding, labor, and transportation necessary for the complete installation of the Electronic Safety Systems as shown on the drawings and as specified herein.
- C. Coordinate wireway, raceway, power, and outlet requirements with the builder and the electrical contractor.
- D. Cable pathways, conduit, boxes and cable support systems shall be complete with bushings, de-burred, cleaned, and secure prior to installation of cable.
- E. The Electronic Safety Systems Contractor shall provide and install prior to cable installation plastic snap in bushings at each box opening, passage through a metal stud, and at the end of all open conduit stubs or sleeves to protect the cabling from damage.
- F. Supply in a timely manner to the electrical contractor special backboxes for installation as required.
- G. It is the intent of these specifications to provide complete installations although every item necessary may not be specifically mentioned or shown.

1.2 WORK TO BE INCLUDED BY THE ELECTRICAL CONTRACTOR IN BASE CONTRACT PROPOSAL

- A. Provide utility services conduit as outlined on drawings as required.
- B. All required conduit for accessibility to attic space.
- C. Furnishing and installation of all required standard back boxes and conduit.
- D. Installation of special back boxes supplied by Division 28 contractor(s).
- E. Furnishing and installation of all floor boxes, surface raceways, and other wireways which are detailed or specified under Division 26.
- F. Provide equipment-mounting boards as outlined on drawings.
- G. Provide equipment grounding system, conductors, and bus bars and as outlined in Division 26.
- H. Provide 120-volt power and hook-up to equipment provided in Division 28.
- I. Coordination of requirements of Division 28 with the Builder.

1.3 WORK NOT INCLUDED

- A. Contractors shall make no agreement that obligates the Owner to pay any company providing communications, monitoring, or other services. Contractors shall not make selection,

purchase, or installation of interconnect instruments/equipment to be used on this project.

1.4 RELATED SECTIONS

- A. The conditions of the Division 0, Division 1, Division 26 requirements, and the contract requirements that include the General Conditions and the Supplementary Conditions apply to work of this division.

1.5 CODES, STANDARDS, AND THEIR ABBREVIATIONS

- A. General:
 - 1. Perform all work in strict accordance with the requirements and recommendations stated in the codes and standards except when requirements are exceeded by the contract documents.
 - 2. In addition to the requirements outlined in other sections of the specifications the following standards are imposed as applicable to the work in each instance:
 - a. OSHA Safety and Health Regulations for Construction.
 - b. NFPA No. 70 National Electrical Code.
 - c. NESC National Electrical Safety Code, ANSI Standard C2.
 - d. NEIS National Electrical Installation Standards.
 - e. Local Codes and Ordinances.
- B. Where local codes or practices exceed or conflict with the NEC, it shall be the Contractor's responsibility to perform the work in accordance with the local code prevailing and local interpretations thereof. Any such additional work shall be performed at no additional cost to the Owner.
- C. Materials and components shall be UL listed and labeled by Underwriters Laboratories, Inc. for the intended use under the latest appropriate testing standard.
- D. The Contractor shall obtain all permits required to commence work. Upon completion of the Work, the Contractor shall obtain and deliver to the Owner's Representative a Certificate of Inspection and Approval from the State Board of Fire Underwriters, and other authorities having jurisdiction. The Contractor shall pay required permit fees.

1.6 LIST OF ASSOCIATIONS AND STANDARDS:

ADA:	Americans with Disabilities Act.
ANSI:	American National Standards Institute, 1430 Broadway; New York, NY 10018.
ASTM:	American Society for Testing and Materials, 1916 Race Street; Philadelphia, PA 19103.
BICSI:	(RCDD5 Standards), 8610 Hidden River Parkway, Tampa, FL 33637
CBM:	Certified Ballast Manufacturers Association, 2116 Keith Building; Cleveland, Ohio 44115.
IEEE:	Institute of Electrical and Electronics Engineers, 345 East 47th Street; New York, NY 10017.
ICEA:	Insulated Cable Engineers Association, P.O. Box P, South Yarmouth, MA 02664.
NEC:	National Electrical Code; NFPA No. 70.
NECA:	National Electrical Contractors Association, Inc., 7315 Wisconsin Ave.; Washington, DC 20014.
NEMA:	National Electrical Manufacturers Association, 155 East 44th Street; New York, NY 10017.
NESC:	National Electrical Safety Code, ANSI Standard C2.
NFPA:	National Fire Protection Association, 60 Batterymarch Street; Boston, MA 02110.
OSHA:	Occupational Safety and Health Administration, US Department of Labor;

Washington, DC 20402.
UL: Underwriters Laboratories, Inc., 333 Pfigsten Road; Northbrook, IL 60062.

- A. Nothing in the Contract Documents shall be construed to permit work not conforming to these codes.
- B. When two or more codes or standards are applicable to the same work, then the stricter code or standard shall govern.
- C. The date of the code or standard is that in effect on the date of issue stated on the contract documents, except when a particular publication date is specified.
- D. The Contractor shall comply with all State, Federal, NFPA, local codes and ordinances that may alter any part of the plans or specifications. The Contractor shall bear all costs for correcting any deficiencies due to non-compliance.
- E. Where local codes and ordinances are not in writing or on record but local precedence have been set, the Owner shall pay for any additional resulting cost.

1.7 DEFINITIONS

- A. Approval: It is understood that approval must be obtained from the Architect in writing before proceeding with the proposed work. Approval by the Architect of any changes, submitted by the Contractor, will be considered as general only to aid the Contractor in expediting his work.
- B. The Builder: The primary contractor engaged to oversee the construction project. They may be technically described as a Construction Manager, General Contractor, Managing Construction Contractor, et cetera.
- C. The Contractor: The Contractor engaged to execute the work included a particular section only, although he may be technically described as a Subcontractor to the Builder. If the Contractor, engaged to execute said work, employs Sub-Contractors to perform various portions of the work included under a particular Section, they shall be held responsible for the execution of this work, in full conformity with Contract Document requirements. The Contractor shall cooperate at all times and shall be responsible for the satisfactory cooperation of his Subcontractors with the other Contractors on the job so that all of the various sections and phases of work may be properly coordinated without unnecessary delays or damage.
- D. The Electrical Contractor: The Electrical Contractor shall be engaged to execute the work included Division 26 only.
- E. PDF file or .pdf: The filename extension associated with "Portable Document Format" files, which are multi-platform computer files in the ISO 32000-1:2008 open standard format developed and licensed by Adobe Systems. These files are a digital electronic representation of text, documents, images, and technical drawings in a font and color-accurate fixed-layout format that is platform and display resolution independent. PDF files can be electronically transmitted, viewed, or printed with various free PDF reader application programs, and may allow markups/comments with various PDF editing application programs.
- F. Provide: Defined as requiring both the furnishing and installation of the item or facility indicated, complete in all respects and ready for operation unless otherwise specifically noted.

1.8 SCHEDULE OF VALUES, APPLICATION FOR PAYMENT

- A. The Contractor shall in accordance with the General Provisions of the Contract, including General and Supplementary Conditions, and Division 1, complete a Schedule of Values and Applications for Payment. When a portion of this work separately funded, including donations or E-Rate, the contractor shall accommodate this in the Schedule of Values and Applications

for Payment. For E-Rate eligible portions of this work, the contractor will be required to participate in the E-Rate program, comply with all E-Rate regulations, and provide billing as needed. The contractor shall coordinate with the Owner to file Form 471 or latter edition and/or other forms as may be required.

1.9 WARRANTY

- A. The Contractor shall warranty his work against defective materials and workmanship for a period of one year from date of acceptance of the job.
- B. Neither the final payment nor any provisions in Contract Documents shall relieve the Contractor of the responsibility for faulty materials or workmanship.
- C. He shall remedy any defects due thereto, and pay for any damage to other work resulting there from, which shall appear within a period of one year from date of substantial completion.
- D. The Owner shall give notice of observed defects with reasonable promptness.
- E. This Warranty shall not be construed to include the normal maintenance of the various components of the system covered by these specifications.

1.10 SITE VISIT

- A. Before submitting a proposal, each proposed contractor shall examine all plans and specifications relating to the work, shall visit the site of the project, and become fully informed of the extent and character of the work required, including all required utilities.
- B. No consideration will be granted for any alleged misunderstanding of the materials to be furnished or the amount of work to be done, it being fully understood that the tender of a proposal carries with it the agreement to all items and conditions referred to herein, or indicated on the accompanying plans or required by nature of the site of which may be fairly implied as essential to the execution and completion of any and all parts of the work.

1.11 SUBMITTALS

- A. Submittal procedures shall be per Division 1 - General Requirements.
- B. Provide a complete submittal for each section as specified.
- C. Submit complete submittal package within 30 calendar days after award of this work for approval. Equipment is not to be ordered without approval. Partial submittals are not acceptable for review. Each submittal shall include a dated transmittal.
- D. A submittal may be electronically transmitted in PDF file format (preferred) or paper copies may be provided in quantities indicated in Division 1. Paper copies shall be organized including index tabs in a 3-ring black binder of sufficient size.
- E. Each Product data submittal shall include:
 - 1. A cover sheet with the name and location of the project, the name, address, and telephone number of the Contractor, and the name, address, and telephone number of the submitting sub-contractor. Include on or after the cover sheet sufficient space for review stamps.
 - 2. An indication of any deviations from Contract Document requirements, including variations and limitations. Show any revisions to equipment layout required by use of selected equipment.
 - 3. A product data index and complete equipment list including for each product submitted for approval the manufactures name and part number, including options and selections.
 - 4. Cut-sheets or catalog data illustrating the physical appearance, size, function,

- compatibility, standards compliance, and other relevant characteristics of each product on the equipment list. Indicate by prominent notation (an arrow, circle, or other means) on each sheet the exact product and options being submitted.
5. Submit design data, when the scope of work requires, including calculations, schematics, risers, sequences, or other data.
 6. When the contract requires extended product warranties, submit a sample of warranty language.
 7. Any resubmittal shall include a complete revised equipment list and any product data that is revised.
- F. Submit shop or coordination drawings, when specified or the required for the scope of work, which include information that will allow to the Contractor to coordinate interdisciplinary work and when necessary guide the manufacturer or fabricator in producing the product. Shop or coordination drawings shall be specifically prepared to illustrate the submitted portion of work, this may require diagrams, schedules, details, and accurate to scale equipment and device layouts prepared using a CAD or BIM engineering drawing program.
- G. The Engineer's review of submittals is only for confirmation of adherence to design of project and does not relieve the Contractor of final responsibility for furnishing all materials required for a complete working system and in complying with the Contract Documents in all respects.

1.12 PROJECT RECORD DOCUMENTS

- A. The Contractor shall keep a set of plans on the job, noting daily all changes made in connection with the final installation including exact dimensioned locations of all new and uncovered existing utility piping outside the building.
- B. Upon submitting his request for final payment, he shall turn over to the Architect/Engineer, for subsequent transmittal to the Owner revised plans showing "as installed" work.
- C. In addition to the above, the Contractor shall accumulate during the jobs progress the following data in PDF file format (preferred) or paper copies to be turned over to the Architect/Engineer for checking and subsequent delivery to the Owner:
 1. All warranties, guarantees, and manufacturer's directions on equipment and material covered by the Contract.
 2. PDF file or paper copies of all Shop Drawing prints and CAD or BIM engineering drawing program files.
 3. Any software programs, data/programming files, passwords, special interface cables, or keys that may be needed to maintain or access equipment.
 4. Set of operating instructions. Operating instructions shall also include recommended maintenance and seasonal changeover procedures.
 5. Any and all other data and/or plans required during construction.
 6. Repair parts lists of all major items and equipment including name, address, and telephone number of local supplier or agent.
 7. The first page, or pages, shall have the names, addresses, and telephone numbers of the following:
 - a. Builder and all Contractors.
 - b. Major Equipment Suppliers
 - c. Submit communication systems warranties.

1.13 TRAINING

- A. Upon completion of the work and at a time designated by the Architect, provide formal training sessions for the Owner's operating personnel to include location, operation, and maintenance of all Electronic Safety Systems equipment and systems.
- B. See other sections for time requirements.

1.14 PLANS AND SPECIFICATIONS

- A. The intent of the project drawings is to establish the types of systems and functions, but not to set forth each item essential to the functioning of the system.
- B. Electrical drawings are generally diagrammatic and show approximate location and extent of work.
- C. Install the work complete including minor details necessary to perform the function indicated. Provide Electronic Safety Systems (including all hook-ups) complete in every respect and ready to operate.
- D. If clarification is needed, consult the Architect/Engineer.
- E. Review pertinent drawings and adjust the work to conditions shown. Where discrepancies occur between drawings, specifications, and actual field conditions, immediately notify the Architect/Engineer for his interpretation.
- F. The Architect/Engineer reserves the right to make any reasonable change in the location of any part of this work without additional cost to the Owner.

1.15 PRODUCT SUBSTITUTIONS:

- A. Descriptions and details, acceptable manufacturers' names listed, and specific manufacturer and model number items indicated in the plans and specifications shall establish a standard of quality, function, and design. Manufacturers and model numbers listed "no exceptions" shall not be substituted without specific notice in an addendum. Otherwise, where a specific manufacturer's product is indicated, products of other manufacturers listed as acceptable may be submitted for approval based on the substitute product being, in the opinion of the Engineer, of equivalent or better quality than that of the product specified.
- B. Proposed contractors wishing to propose systems which differ in manufacturer, features, functions, or operating characteristics from those outlined in these specifications must do so in writing to the specifying authority at least ten (10) days prior to the proposal opening.
- C. For manufacturers equipment or models other than that specified, the proposed contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment. Proposals must include detailed information showing all deviations from the system as specified and include relevant technical and cost data. This shall include a complete description of the proposed substitution, drawings, catalog cuts, performance data, test data, or any other data or information necessary for evaluation.
- D. The Engineer will consider all such submittals and the Architect will issue an addendum listing items that the Engineer considers acceptable. Only such items as specified or approved as acceptable will be installed on this project.
- E. Substitute products for which the proposed contractor does not obtain prior approval will not be considered acceptable for this project. Final approval of the alternate system shall be based on the decision of the Owner and Architect. Prior approval to make a proposal for this project does not automatically ensure the system will be an acceptable equivalent.
- F. The Contractors' proposal represents that the contract proposal price is based solely upon the materials, equipment, and labor described in the Contract Proposal Documents (including addenda, if any) and that he contemplates no substitutions or extras.

- G. The manufacturer of the proposed substitute unit shall provide samples for evaluation, when required, at no charge and non-returnable.
- H. Requests for substitution are understood to mean that the Contractor:
 - 1. Has personally investigated the proposed substitution and determined that it is equivalent or superior in all respects to that specified.
 - 2. Will provide the same guarantee for the substitution that he would for that specified.
 - 3. Will, at no cost to the Owner, replace the substitute item with the specified product if the substitute item fails to perform satisfactorily.
 - 4. After Award of the Contract, substitutions will be considered only under one or more of the following circumstances:
 - a. The substitution is required for compliance with subsequent interpretations of code or insurance requirements.
 - b. The specified product is unavailable through no fault of the Contractor.
 - c. The manufacturer refuses to warranty the specified products as required.
 - d. Subsequent information indicates that the specified product is unable to perform properly or to fit in the designated space.
 - e. In the Engineer's sole judgment, the substitution would be in the Owner's best interest.
 - f. Revisions to the electrical system caused by substitutions shall be under the supervision of the Engineer, at a standard hourly rate charged by the Engineer. Charges from the Engineer, Architect, and Electrical Contractor shall be paid by the Contractor originating the changes.

1.16 FUTURE USE CABLING

- A. When cabling is installed for future use, it shall be identified with a tag of sufficient durability to withstand the environment involved.
- B. Locations and Existing Conditions:
 - 1. Location and condition of any existing equipment or services, when shown, have been obtained from substantially reliable sources, are shown as a general guide only, without guarantees as to accuracy.
 - 2. The Contractor will examine the site, verify all requirements, service points, and availability of all services required to complete this project. No consideration will be granted for any alleged misunderstanding of the materials and labor to be provided as necessitated by nature of the site including those items that may be fairly implied as essential to the execution and completion of any and all parts of this project.

1.17 PROTECTION OF EQUIPMENT AND MATERIALS

- A. The Contractor shall take such precautions as may be necessary to protect his apparatus from damage.
- B. This shall include the creation of all required temporary shelters to protect any apparatus above the floor of the construction and the covering of apparatus in the completed building with tarpaulins or other protective covering.
- C. Failure to comply with the above to the satisfaction of the Owner's inspector will be sufficient cause for the rejection of the equipment in question and its complete replacement by the Contractor.

1.18 FINAL OBSERVATION

- A. It shall be the duty of the Contractor to make a careful observation trip of the entire project, assuring themselves that the work on the project is ready for final acceptance before calling upon the Architect/Engineer to make a final observation.

- B. To avoid delay of final acceptance of the work, the Contractor shall have all necessary bonds, warranties, receipts, affidavits, et cetera, called for in the various articles of these specifications, prepared and signed in advance, together with a letter of transmittal, listing each paper included, and shall deliver the same to the Architect/Engineer at or before the time of said final observation. The Contractor is cautioned to check over each bond, receipt, et cetera, before preparing for submission to verify that the terms check with the requirements of the specifications.
- C. The following and other provision of Division 1 General Conditions will be required at time of final completion:
 - 1. Final clean up completed.
 - 2. All systems are fully operational, all material and devices installed.
 - 3. As built (as installed) drawings and operations manuals.

1.19 PROHIBITED MATERIALS

- A. No new asbestos, lead, or materials containing these substances shall be permitted in this project. The Contractor shall consult the Architect concerning these materials if their presence is suspected. All work in or around existing asbestos or lead materials is at the sole risk of the Contractor and his personnel.

1.20 CUTTING AND PATCHING

- A. Notify the Builder sufficiently ahead of construction of any floors, walls, ceiling, roof, et cetera, of any openings that will be required for his work.
- B. The Contractor shall see that all sleeves required for his work are set at proper times to avoid delay of the job.
- C. All necessary cutting of walls, floors, partitions, ceilings, et cetera, as required for the proper installation of the work under this Contract shall be done at the Subcontractor or at the Subcontractor's expense in a neat and workmanlike manner, and as approved by the Architect/Engineer.
- D. Patching of openings and/or alterations shall be provided by the Electronic Safety Systems Subcontractor or at the Subcontractor's expense in an approved manner.
- E. No joists, beams, girders, or columns shall be cut by any Contractor without first obtaining written permission of the Architect/Engineer.
- F. All openings in firewalls and floors shall be completely sealed after installation for a completely airtight installation. Sealing material shall be non-combustible and UL approved. The installed sealing assembly shall not cause the fire rating of the penetrated structure to be decreased.
- G. All openings in exterior walls shall be sealed watertight.
- H. Seal voids around conduits penetrating fire-rated assemblies and partitions using fire stopping materials and methods in accordance with NFPA and local codes.

1.21 MANUFACTURERS' INSTRUCTIONS

- A. All equipment and devices shall be installed in accordance with the drawings and specifications, manufacturer's instructions, and applicable codes.
- B. Where specifications call for installation of a product to be in accordance with manufacturer's instructions and/or where manufacturer's instructions are required for installation of a product,

it shall be the contractor's responsibility to obtain the necessary applicable manufacturer's instructions and install the product in accordance with the manufacturer's instructions.

- C. It shall be the Contractor's responsibility to install all equipment, materials, and devices shown on the plans and as called out in these specifications even if manufacturer's instructions are absolutely unattainable.

1.22 INSTALLATION

- A. Cooperation with trades of adjacent, related or affected materials or operations, and or trades performing continuations of this work under subsequent contracts are considered a part of this work. In order to effect timely and accurate placing of work and to bring together, in the proper and correct sequence, the work of such trades, including work provided under a Division 1 allowance.
- B. The Electronic Safety Contractor shall coordinate installation of the systems with the Builder, Electrical, Mechanical, and Plumbing Contractors to ensure a complete working system for the Owner.
- C. Where required for accessibility all conduit and boxes for all Electronic Safety Systems shall be provided by the Electrical contractor as specified, including systems in Division 28, any and all allowances shall be included. Normally low voltage wiring shall run open and supported in accessible attic space. All low voltage wiring in exposed areas such as gyms, stages, shops, and field houses shall be enclosed in conduit. Coordinate with, and verify with Division 26 to provide required conduit and boxes at locations and heights as required.
- D. Conduit, innerduct, track, or raceway shall conceal and protect wiring in exposed areas, within walls, through in- accessible areas, floors, chases, under slab, crawlspaces, or underground.
- E. All conduit, duct, track, and raceway runs shall be spaced apart to allow for maintenance, such as the installation of couplings, without disturbing adjacent pathways.
- F. All work must be performed by workers skilled in their trade. The installation must be complete whether the work is concealed or exposed.
- G. Provide stainless screw/bolt hardware wherever stainless devices are used and in potentially wet areas.
- H. Coordinate the actual locations of devices and outlets and equipment with building features and mechanical equipment as indicated on architectural, structural, and mechanical drawings. Review with the Architect any proposed changes in outlet or equipment location. Relocation of devices, before installation, of up to 3 feet from the position indicated, may be directed without additional cost. Remove and relocate outlets placed in an unsuitable location when so requested by the Architect.

1.23 ADDITIONAL MATERIALS: INCLUDE IN THE BASE CONTRACT PROPOSAL

- A. All costs to provide 10 additional fire alarm signals including all cable and devices as directed by the Architect. Conduit and standard back boxes by Division 26 Electrical Contractor.

PART 2 – PRODUCTS

- A. Not Applicable

PART 3 – EXECUTION

A. Not Applicable

END OF SECTION

SECTION 28 05 44 – EMERGENCY RESPONDER RADIO ANTENNA SYSTEM

PART 1 – GENERAL

1.1 SCOPE OF WORK

- A. Design, furnish, install, and test a complete and operating in-building Emergency Responder Radio Antenna System/Distributed Antenna System ['system' or 'DAS'] to provide complete coverage for the public safety agencies as required by the local fire department, other agencies and the authority having jurisdiction [AHJ]. The system will support only Emergency Responder and Public Safety Land Mobile Radios ['LMR']. The system shall not support District Radio, Cellular, and/or Wi-Fi Signals.

1.2 WORK INCLUDES

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions and Division 1 apply to this Section.
- B. Provide all equipment, materials, labor, supervision and services necessary for or incidental to the installation of a complete Emergency Responder Radio Antenna System. The purpose is to extend and amplify the Emergency Responder and Public Safety Land Mobile Radio signals to a strength of 95% in all areas of the facility including elevators, stairwells and all floors.
- C. It shall be the responsibility of the Emergency Responder Radio Antenna System contractor to obtain all required permits, approvals and certifications from the authorities having jurisdiction.
- D. All fees associated with the licensing shall be paid by the Contractor.
- E. Testing of the system shall conform to the testing requirements as described in the International Fire Code [IFC] Section 510.5.3.
- F. All testing must be done on frequencies authorized by the FCC and in use by local agencies as directed by the Authority Having Jurisdiction [AHJ].
- G. Final acceptance and approval shall be required from the local AHJ.
- H. It shall be the responsibility of the Electrical Contractor to provide and install all conduit systems, standard electrical boxes, and operating power for the building access systems as outlined on the project drawings. This Contractor shall coordinate all system requirements with and provide special back boxes to the Electrical Contractor prior to installation of conduit. The BDA head end shall be hardwired to electrical power and on emergency power where possible.
- I. The Electrical Contractor shall provide 120-volt power as required through separate dedicated branch circuits, maximum 20 amperes each. Each such circuit shall be labeled at the power distribution panel as EMERGENCY RESPONDER RADIO SYSTEM. The location of all circuit breakers serving the Emergency Responder Radio Coverage System shall be posted in the control unit cabinets. Each cabinet and all surge protection devices shall be grounded securely to the building grounding system.
- J. Provide all testing, documentation, training, and warranty service contract as outlined in these specifications.

- K. Section shall include:
 - 1. Bi-Directional Amplifiers [BDA's]
 - 2. Distributed Antenna System
 - 3. Coaxial Cables
 - 4. Splitters and Directional Couplers
 - 5. Battery Back-Up System
 - 6. All other equipment and components necessary for a complete and functioning Emergency Responder Radio Antenna System.

- L. Specification Compliance: A letter shall be provided stating, by section and subsection, that the intercom system installer complies with the ENTIRE specification section. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY THE PROJECT'S TECHNOLOGY CONSULTANT.

1.3 SYSTEM PRICING, PHASING AND AWARD

- A. Proposed Contractor shall provide a proposal based on separate pricing for each of the following steps:
 - 1. Outdoor Testing of the Facility – This price shall include verifying the outdoor signal strength at the facility's location.
 - 2. Full Testing, in accordance with IFC Section 510 Grid Testing – This price shall include verification of signal strength throughout the entire facility.
 - 3. Emergency Responder Radio Antenna System Materials and Installation Pricing – This price shall include a full system design and installation, including costs for design, components, materials, labor and testing. This price shall be a "Worst-Case Scenario" situation, as though the entire facility must require coverage.

- B. The project must be budgeted as a complete set of processes, thus the reason for having all pricing, in a "Worst-Case Scenario" prior to performing any work. This pricing will provide a budget before the work begins.

- C. The award of this work will be made in phases, in accordance with the three (3) afore mentioned steps.
 - 1. Phase I award authorizes step #1. Once step one is completed, results are to be provided to the General Contractor, Architect, and Engineer for review. Following this review, step two may be delayed, pending adjustment to the donor signal. If donor signal strength at the facility does not meet IFC Section 510 requirements, the AHJ must be consulted, prior to moving to step two. If the donor signal strength is adequate to meet IFC Section 510 requirements, authorization for step two will be given.
 - 2. The Phase II award authorizes step #2. Testing of the facility to determine signal strength status and to provide a base for a full system design. After testing, a final revised proposal for a full system design, installation and final testing shall be issued to the General Contractor for review. No further work is authorized until award of Phase III is granted.
 - 3. Phase III award authorizes step #3. Design, installation and final testing of the Emergency Responder Radio Antenna System. Provide design and final acceptance testing documents per Section 1.8.

1.4 MANUFACTURERS

- A. Subject to compliance with requirements, available integrators offering products that may be incorporated in the work include, but are not limited to:
 - 1. Commscope

FIRST RESPONDER ANTENNA SYSTEM

2. Farenhyt
3. Axell Wireless
4. Tescoco
5. Times Microwave
6. Gamewell-FCI
7. Notifier
8. SOLID Technologies – Alliance Corporation
9. Simplex
10. Other manufacturers upon approval.

1.5 RELATED SECTIONS

- A. Section 26 05 34 - Provisions for Communication, Security & Safety Systems.
- B. Section 28 05 00 - General Electronic Safety and Security System Requirements.
- C. Section 28 46 21 – Fire Detection and Alarm System

1.6 CODES AND REGULATIONS

- A. Perform all work in strict accordance with the requirements and recommendations stated in the codes and standards except when requirements are exceeded by the contract documents.
- B. The equipment, materials, and installation shall conform to the latest version of all applicable codes, standards and regulations of authorities having jurisdiction including the following:
 1. NFPA 1 – The National Fire Code (including Annex O from 2009)
 2. NFPA 70 – The National Electrical Code
 3. NFPA 72 – National Fire Alarm Code
 4. NFPA 1221 – Standard for the Installation, Maintenance and Use of Emergency Services Communication Systems
 5. UL 2524 - 1st Edition In-building 2-Way Emergency Radio Communication Enhancement Systems
 6. FCC 47 CFR Private Land Mobile Radio
 7. FCC 47 90.219-2007 Services-Use of Signal Boosters
 8. ICC 2009 International Fire Code, Code and Commentary
 9. ADA “Americans with Disabilities Act”
 10. FCC’s OET 65 Standards “Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields”
 11. FCC Rules Part 22, Part 90, and Part 101

1.7 DEFINITIONS

- A. Attenuation: The reduction in signal power, expressed in decibels, as a result of coupling, heat loss, or transmission distance in a cable or in air.
- B. Bi-Directional Amplifier [BDA]: A device used to amplify band-selective or multi-band RF signals in the uplink, to the base station for enhanced signals and improved coverage. Also known as a signal booster.
- C. Coupled Bonding Conductor [CBC]: a bonding conductor placed on the outside of any technology cable. Used to suppress transient noise.
- D. Delivered Audio Quality Definitions [DAQ]: The universal standard often cited in system design, specifications, and testing reports for ERRC and DAS.
 1. DAQ 1: Unusable, speech present but not intelligible.
 2. DAQ 2: Understandable with considerable effort. Frequent repetition required due to

- noise and/or distortion.
3. DAQ 3: Speech understandable with slight effort. Occasional repetition required due to noise and/or distortion.
 4. DAQ 3.5: Speech understandable with repetition only rarely required. Some noise and/or distortion
 5. DAQ 4: Speech easily understood. Occasional noise and/or distortion.
 6. DAQ 4.5: Speech easily understood. Infrequent noise and/or distortion.
 7. Speech easily understood.
- E. Distributed Antenna System [DAS]: A network of service antennas connected at intervals along shielded coaxial transmission lines and all connected to head-end electronics amplifying the signals to be distributed. Often refers to a system that includes both the passive distribution system and the active amplifying electronics.
- F. Directional Coupler: A component which directs a small portion of downstream RF energy to a port which can be connected to an antenna or another branch of distribution cabling, and also serves as a combiner of upstream energy between the tap port and through the connection port.
- G. Donor Antenna: The antenna, usually mounted on the outside of a structure where a DAS is installed, which picks up signals over-the-air from a donor source.
- H. Donor Source: The repeater, transceiver, cell site, or other radio site that produces signals which a DAS will relay and distribute.
- I. Emergency Responder Radio Antenna System [ERRAS]: A two-way radio communication system installed to assure the effective operation and coverage of radio communications systems for fire, emergency medical services, and/or law enforcement agencies within a building or structure. The system is not designed for use with District LMR, Cellular Services, or Wi-Fi Services.
- J. Federal Communications Commission [FCC]: federal agency responsible for implementing and enforcing America's communications laws and regulations.
- K. OET 65 Standards: The FCC's Bulletin that provides Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.
- L. Public Safety and/or First Responder: agencies which are charged with the responsibility of responding to emergency situations. These include, but are not limited to, law enforcement, fire departments, and emergency medical services.
- M. Reflected Power: Power which is reflected back along a transmission line as a result of discontinuities in line impedance caused at connectors or close proximity of metallic objects.
- N. Radio Frequency [RF]: Energy from electromagnetic waves, or alternating currents that produce electromagnetic waves, in the spectrum of radio frequencies (30 kHz to 300GHz)
- O. Signal Booster: See BDA
- P. Splitter: A passive component that has a single input port and two or more output ports, effectively splitting the signal equally amongst the output ports. It also serves to combine upstream signals from the "output" ports into composite signals at the "input" port.

1.8 SUBMITTALS

- A. Submittal procedures: See Section 28 05 00.

FIRST RESPONDER ANTENNA SYSTEM

- B. Submit a complete submittal package within 30 calendar days, for approval, after award of this work. Equipment is not to be ordered without approval. Partial submittals are not acceptable for review. Each submittal shall include a dated transmittal.
- C. Submittal may be electronically transmitted in PDF file format (preferred) or paper copies may be provided in quantities indicated in Division 1. Paper copies shall be organized including index tabs in a 3-ring black binder of sufficient size.
- D. Quality Assurance Submittal:
 - 1. Letter from manufacturer stating that the Contractor is an Authorized Factory Distributor for the area where the project is located.
 - 2. The Contractor and Manufacturer shall supply sufficient information to indicate that the proposed system is based on the latest hardware, software technology and products comply with specified requirements and FCC Regulations.
 - 3. The system described in the submittals shall be certified by an FCC Licensed Designer and installation shall be supervised by an FCC Licensed Project or Installation Manager.
- E. Product Data Submittal including special boxes, cable and other material as requested by the Architect/Engineer including:
 - 1. A cover sheet with the name and location of the project, the name, address and telephone number of the Contractor and the name, address and telephone number of the submitting sub-contractor. Include on or after the cover sheet sufficient space for review stamps.
 - 2. Copies of FCC Licenses for both the Designer and Project or Installation Manger.
 - 3. An indication of any deviations from Contract Document requirements, including variations and limitations. Show any revisions to equipment layout required by use of selected equipment.
 - 4. A product data index and complete equipment list including for each product submitted for approval the manufacturers name and part number including options and selections.
 - 5. Cut-sheets or catalog data illustrating the physical appearance, size, function, compatibility, standards compliance and other relevant characteristics of each product on the equipment list. Indicate by prominent notation (an arrow, circle or other means) on each sheet the exact product and options being submitted for approval.
 - 6. Submit design data when the scope of work requires, including passband curves for both uplink and downlink for all bands, calculations, schematics, risers, sequences or other data.
 - 7. Any resubmittal shall include a complete revised equipment list and any product data that is revised.
 - 8. Any rejected submittals must be corrected and resubmitted to the AHJ and Architect/Engineers within 10 days of receipt of the rejected material.
- F. Submit shop drawings locating all components of the system, indicating circuit routing, cable type, and gauge. Shop or coordination drawings shall include information that will allow to the Contractor to coordinate interdisciplinary work and when necessary guide the manufacturer or fabricator in producing the product. Shop or coordination drawings shall be specifically prepared to illustrate the submitted portion of work, this may require diagrams, schedules, details, risers, floor plans and accurate to scale, (minimum of 1/8" = 1'-0"), equipment and device layouts prepared using a CAD or BIM engineering drawing program.
- G. Testing
 - 1. Submit all field test records of the radio systems. These shall include, but not be limited to:
 - a. Preconstruction Tests – Tests performed with the AHJ prior to construction of the new facility to verify that the municipality has signal coverage in that area.
 - b. Mid-Construction Tests – Tests performed with the AHJ during construction, once walls have been constructed and the exterior roof is installed.

- c. Final Testing – Tests performed in conforming with IFC Section 510.5.3 and Section 510.6. This testing is to be signed off by the AHJ. Engineers shall also be present for the final testing process.
2. All testing records shall be submitted with O&M information and close out documents.
 - a. Provide one (1) digital copy of all close out documents
 - b. Provide three (3) copies of closeout documents bound in a 3-Ring binder with dividers and table of contents.

1.9 QUALIFICATIONS OF A PROPOSED CONTRACTOR

- A. Proposed contractors who do not currently possess the necessary qualifications, trained and experienced personnel, financial capacity, and meet the other requirements herein described will be disqualified.
- B. The proposed contractor, as a business entity, shall be an authorized distributor and designated representative of the emergency responder radio coverage system manufacturer, with full warranty privileges, and shall have been actively engaged in the business of selling, installing, and servicing emergency responder radio coverage systems for a period of at least 5 years.
- C. Recently formed companies are acceptable only if specific pre-approval is requested, and granted by the Architect/ Engineer, based on experience of key personnel, current and completed projects, and all licensing requirements are met 10 working days prior to the contract proposal date.
- D. The Contractor shall employ factory trained technicians capable of supporting the maintenance of the system. No contract employees are allowed unless they have been to the factory service school within the last 18 months. A certificate of this training shall be provided with the Contractors submittal.
- E. The contractor shall employ full time local technicians and installers. The manufacturer shall maintain a full-time factory employed service staff for product support and service.
- F. The proposed Contractor shall have an office within 150-miles of the job site, staffed with trained technicians who are qualified and licensed to supervise the installation, to be responsible that the system is installed as submitted, to conduct system start up and perform a 100 percent operational audit of all installed devices, to instruct the Owners representatives in the proper operation of the system, and to provide service throughout the warranty period.
- G. All testing shall be conducted, documented and signed by a person in possession of an FCC General Radio Telephone Operators License and be a full-time employee of contractor.
- H. The proposed contractor shall be fully experienced in the design and installation of the type of system herein specified and shall furnish with the contract proposal an itemized list of the installations of the type specified herein. The list shall include the name of the project, date of completion, the amount of the contract, the name, and telephone number of a qualified person to contact for reference. This list must contain at least two (2) projects within a 150-mile radius of the school district to allow school administration officials to visit the job site for review of the system installation and service. Each reference project listed must utilize equipment by the same manufacturer as the proposed system.
- I. The Proposed Contractor shall not have any grievances or complaints of record regarding workmanship, code compliance, or service response. A Proposed Contractor that has any prior finding(s) of a code or license violation or has any litigation in process concerning the installation of a system is unacceptable.
- J. The ability of a proposed Contractor to obtain plans and provide a performance bond shall not

be regarded as the sole qualification of the Contractors' competency and responsibility to meet the requirements and obligations of the contract.

- K. The Builder shall be satisfied that a proposed Contractor meets all the requirements expressed herein before including the Contractor's proposal in the project.
- L. The Owner may investigate, as they deem necessary to determine the ability of the proposed Contractor to perform the work. The proposed Contractor shall furnish to the Owner with any information or data requested for this purpose.
- M. The Owner reserves the right to reject any contract proposal if the evidence submitted, or their investigation, fails to indicate that the Contractor is qualified to fulfill of any part of the contract or to complete the work contemplated therein.
- N. The Owner reserves the right to reject the proposal of any Contractor who has previously failed to perform properly, or complete on time, contracts of a similar nature.

PART 2 – PRODUCTS

2.1 GENERAL

- A. The system shall conform to the requirements as identified in IFC Section 510.4 and Section 510.5. Testing records are required to confirm performance of the system.
- B. Compatibility: The equipment, including but not limited to repeaters, transmitters, receivers, signal boosters, cabling, fiber distributed antenna systems, etc., shall not interfere with the existing communication systems utilized by the Public Safety and First Responder agencies.
- C. Power Supplies: At least two (2) independent and reliable power supplies shall be provided: one primary and one secondary. The primary power source shall be supplied from a dedicated 20-ampere branch circuit and comply with 4.4.1.4 of NFPA 72. The secondary power source shall be a dedicated battery back-up, capable of operating the in-building system for at least 24 hours at 100% operation. The battery system shall automatically charge in the presence of external power input. The battery system shall be contained in one NEMA 4 type enclosure. Monitoring the integrity of the power supplies shall be in accordance with 4.4.7.3 of NFPA 72.
- D. Survivability
 - 1. Fire Performance: All main risers or trunks of the antenna system shall be installed with resistance to attack from fire using one of the following methods:
 - a. A 2-hour fire rated cable or cable system
 - b. Routing the cable through a 2-hour fire rated enclosure(s) or shaft(s).
 - 2. Cabinet: The signal booster and all associated equipment shall be housed in a single NEMA 4 certified, painted steel weather tight box. The cabinet shall be large enough to dissipate internal heat without venting from inside of the cabinet to outside atmosphere. Equipment installed on the roof of structures shall be rated for the expected extreme temperature and weather associated with rooftop installation.
 - 3. Rooftop Installations shall require a Pitch Pocket for proper weather-tight roof penetrations.
 - 4. Passive equipment: Passbands shall be VHF, UHF, and 700-900 MHz, IP rating of 2GHz.

2.2 SYSTEM COMPONENTS

- A. Signal Strength
 - 1. Downlink: A minimum signal strength of -95dBm shall be provided throughout the coverage area.
 - 2. Uplink: A minimum signal strength of -95 dBm shall be received at the local municipality

- from the coverage area.
3. A donor antenna must maintain isolation from the distributed antenna system. The donor antenna signal level shall be a minimum of 15 dB above the distributed antenna system under all operating conditions.
- B. Permissible Systems
 1. Buildings and structures shall be equipped with an FCC Certified Class B Bi-Directional VHF, UHF, and 700-900 MHz amplifier(s) as needed.
 2. The distributed antenna system may utilize a radiating cable, fixed antennas, or a combination of both.
 - C. Supported Frequencies: The system shall support VHF, UHF, and 700-900 MHz as required for local public safety and first responder bands as utilized by the local municipality.
 - D. Reject Filters: Notch filter sections shall be incorporated as necessary.
 - E. Band Migration Capability: The signal booster shall include re-tunable or replaceable filters to accommodate rapid and economic passband changes in the event of mandatory FCC changes with the NPSPAC band. The use of non-adjustable and non-replaceable RF input and output filters is prohibited.
 - F. Output Level Control: An automatic output leveling circuit shall be included for both passbands with a minimum dynamic range of 60 dB, less any gain reduction setting, to maintain FCC out of band and spurious emission compliance.
 - G. Degraded Performance in Emergencies: The system shall be designed to allow degraded performance in adverse conditions, such as abnormally high temperatures resulting from nearby fires, extreme voltage fluctuations and/or other abnormal conditions that may occur during an emergency. Circuits that intentionally disable the signal booster in such situations (i.e. under/over voltage, over/under current, over/under temperature, etc.) shall not be implemented as the standard mode for public safety applications.
 - H. Mode of Operation: The system shall be normally powered on and shall continuously provide passing of frequencies within the Public Safety and First Responder bands.
 - I. All in-building radio systems shall be compatible with both analog and digital communications simultaneously at the time of installation.

2.3 SYSTEM MONITORING

- A. The distributed antenna system shall include connections to the fire alarm system to monitor the operational integrity of the signal booster, power supplies and annunciate malfunctions on the fire alarm system. Coordinate and provide this integration, as part of this system, with the fire alarm system contractor that is authorized to service the facility's fire alarm system. The integration of the DAS with the fire alarm system shall comply with Chapter 10 of NFPA 72.
- B. A sign shall be located at the fire alarm panel with the name and telephone number of the local municipality indicating that they shall be notified of any failures that extend past the 2-hour time limit.
- C. A dedicated supervised monitoring panel shall be provided within the emergency command center or other location as designated by AHJ to annunciate the status of all signal booster locations. The monitoring panel shall provide visual and labeled indication of the following for each signal booster:
 1. Normal AC power
 2. Signal booster trouble
 3. Antenna Failure

4. Loss of normal AC power
5. Failure of battery charger
6. Low battery capacity

2.4 CABLE ROUTING, INSTALLATION, AND SUPPORT

- A. System wiring, and equipment installation shall be in accordance with good engineering practices. Wiring shall meet all state and local electrical code requirements.
- B. Wires and cables shall enter each equipment enclosure, console, cabinet or rack in such a manner that all doors or access panels can be opened and closed without removal or disruption of the cables.
- C. Cable pathways, conduit, and cable support systems shall be complete with bushings, deburred, cleaned, and secure prior to installation of cable.
- D. Before energizing the system check all cables for correct connections and test for short circuits, ground faults, continuity, and insulation.
- E. In all exposed areas such as mechanical rooms, parking garages, stairwells, etc., cable shall be fully enclosed in conduit.
- F. Do not attach any supports to joist bridging or other lightweight members. The support system shall provide a protective pathway to eliminate stress that could damage the cabling.
- G. Mount all equipment firmly in place such that vibration or jarring will not interfere with system operation. Route cable in a professional, neat, and orderly installation.
- H. The cable shall not be crushed, deformed, skinned, crimped, twisted, or formed into tight radius bends that could compromise the integrity of the cabling.
- I. Cable must not be fastened to electrical conduits, mechanical ductwork or piping, sprinkler pipes, or routed to obstruct access to hatches, doors, utility access panels, or service work areas. Do not route cables through fire doors, ventilation shafts, grates, or parallel for more than four-feet with line voltage electrical conductors. System cables shall not be run loose on ceiling grid or ceiling tiles.
- J. Provide for adequate ventilation to all equipment housings and take precautions to prevent electromagnetic or electrostatic hum.
- K. All conduit, duct, track, and raceway runs shall be spaced apart to allow for maintenance, such as the installation of couplings, without disturbing adjacent pathways.
- L. Each cable run shall be free of splices. No terminations, splices, or equipment will be installed in or above ceilings.
- M. Do not route any communication cable within two feet of any light fixture, HVAC unit, service access area, electric panel, or any device containing a motor or transformer.
- N. System cable will not be installed in the same conduit, duct, or track with line voltage electrical cable.
- O. Any pulling compounds utilized must be approved by the cable manufacturer and shall not degrade the strength or electrical characteristics of the cable.

PART 3 EXECUTION

3.1 COORDINATION

- A. Contractors shall coordinate with an FCC licensed engineering firm regularly employed in the business of designing and implementing Emergency Responder Radio Antenna Systems for emergency responders.
- B. Electrical Work:
 - a. Proposed Contractor is required to provide for and coordinate with Electrical Contractor for any, and all required electrical work, including but not limited to, circuiting, conduits, back boxes, and more. These expenses will not be included in the electrical contractor primary bid.

3.2 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to job site in OEM's original unopened containers, clearly labeled with the OEM's name and equipment model and serial identification numbers.
- B. Store and protect equipment in a conditioned space until installation.

3.3 SYSTEMS INSTALLATION

- A. Coaxial antenna cabling shall not be installed in the same conduit, raceway, or cable trays used for other systems.
- B. All equipment shall be connected according to the OEM's specifications to insure correct installation and system performance.
- C. Coordinate all roof penetrations with General Contractor and/or Roofing Contractor.

3.4 GROUNDING

- A. Ground cable shields and equipment per Manufacturer's requirements.
- B. Antenna mast shall be grounded per NFPA 70 NEC requirements and antenna manufacturer's requirements. Provide grounding blocks and surge protection for outside coaxial cabling. Bond the antenna mast to the existing lightning protection system.

3.5 TESTING, WARRANTY SERVICE

- A. A factory trained representative of the manufacturer shall supervise the final connections and testing of the system and it shall be subject to the final acceptance of the Architect/Engineer and Owner. All testing shall meet the testing standards set forth in IFC Section 510.
- B. This contractor will thoroughly test all components of the systems and devices proposed herein to assure equipment specifications are met. This contractor will start up, test, and debug systems to ensure that all aspects of the system are working, documented, and reporting properly.
- C. This Contractor shall make a thorough inspection and test of the complete installed Emergency Responder Radio Antenna System including all components and controls to ensure the following:
 - 1. Complete and functional system.
 - 2. Installed in accordance with manufacturer's instructions.
 - 3. Verify proper operation and processing of signals.
 - 4. Verify that units and controls are properly labeled, and interconnecting wires and terminals are identified.
 - 5. Rectify deficiencies indicated by tests and completely re-test work affected by such deficiencies at Contractor's expense.

- D. A final System Acceptance Test shall be performed in the presence of a designated Owner representative and the AHJ. In the event that a system does not pass or only partially passes the Acceptance Test, the Project Manager will file a discrepancy report. Corrected items will be re-tested via a punch list to ensure that they comply with the system requirements.
- E. This Contractor shall provide a warranty of the installed system against defects in material or workmanship for a period of one (1) year from the date of substantial completion. Any equipment, cabling or wiring shown to be defective shall be replaced, repaired, or adjusted free of charge. All labor and materials shall be provided at no expense to the Owner. All equipment will carry a one-year warranty or manufacturer's warranty whichever is greater.
- F. Immediately prior to the end of the warranty period, the system shall be inspected and certified for the following year at no additional cost to the Owner.

3.6 DRAWINGS, MANUALS, AND TRAINING

- A. As-built drawings and operating and maintenance manuals may be electronically transmitted in PDF file format (preferred) or paper copies may be provided in quantities indicated in Division 1. Paper copies shall be organized including index tabs in a 3-ring black binder of sufficient size.
- B. Upon completion of the installation, and prior to final inspection, the Contractor shall furnish as-built drawings.
- C. In addition, the contractor shall furnish complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets. Manuals shall include wiring diagrams to indicate internal wiring for each device and the interconnections between the items of equipment. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system. Provide a parts list with manufacturer and model number for commonly replaced parts. Include complete instructions for the inspection, testing, and maintenance of the system. Include copies of all calculation sheets used to configure the system.
- D. Formal on-site training sessions shall be conducted by the Emergency Responder Radio Antenna System contractor. It shall be the responsibility of the Contractor to coordinate time and location of training sessions with the Owner. Provide documented general instruction as follows:
 - 1. Provide instruction to the maintenance personnel to include the location, inspection, normal maintenance, testing, and operation of all system components. Provide a minimum of four (4) hours—two 2-hour sessions separated by a minimum of two weeks.
 - 2. Provide instruction to designated personnel on the functions and operation of the system provided including capabilities, limitations, and the meaning of status messages. State the proper procedure for testing, routine maintenance, and request for service. Provide detailed instruction on the operation of the system. Provide a minimum of four (4) hours—two 2-hour sessions separated by a minimum of two weeks.

END OF SECTION

SECTION 28 13 00 – ACCESS CONTROL SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1- GENERAL

1.1 RELATED WORK

Division 26 work as applicable
28 05 00 – General Electronic Safety Systems Requirements

1.2 WORK INCLUDED

- A. The Contractor shall furnish and install a complete microprocessor based access control system as specified herein. The system shall include, but not be limited to, all control equipment, power supplies, power circuits, signal initiating and signaling devices, conduit, wire, fittings, and all other accessories required to provide a complete and operable system.
- B. Security system device locations are shown for coordination. The contractor shall coordinate exact location with the Owner and all other required trades prior to installation. The installing contractor shall design and provide a complete system, meeting the requirement of specification. The Contractor shall provide all security system devices required for complete system perimeter coverage acceptable to all governing authorities, Architect and Owner.
- C. The system shall include Security Card reader access interfaces at all locations noted.
 - 1. The Control System shall be the product of a single manufacturer.
 - 2. Tag all conductors or cables at each end.
 - 3. Installation of security panels in the building MDF. Additional panels shall be installed in IDF locations as required.
 - 4. Installation of modules and cards.
 - 5. Interconnection of security panels.
 - 6. Installation of new security devices.
 - 7. Integration with Intrusion Detection and Video Surveillance systems. Primary panel interface shall be the Access Control Panel.
 - 8. Installation of all Card Reader, Door Contact and other field devices.
 - 9. Provide cabling and interconnection of electrified door hardware to the access control system.
 - 10. Provide graphical layout of the floorplan with all systems included for ease of supervision.
 - 11. Preconstruction meeting with Owner's personnel, installing technician and project superintendent.
- D. The contractor shall integrate the system with the video surveillance system and the intrusion detection system for monitoring and direct communication with the District's monitoring company for all intrusion points. All intrusion points shall be included within the Open Options monitoring point group list for the intrusion detection system.
- E. Contractor shall provide all permits, licenses and system certifications as required by Authority Having Jurisdiction.

1.3 CODES AND STANDARDS

The system shall comply with the applicable Codes and Standards as follows:

- A. National Fire Protection Association Standards:

1. NFPA 70 National Electric Code
 2. NFPA 72 National Fire Alarm Code
 3. NFPA 101 Life Safety Code
- B. Local & State Building Codes
- C. Requirements of Local Authorities having Jurisdiction
- D. Underwriters Laboratory Requirements and Listings for use in Security Alarm Systems.
- E. Requirements of American Disabilities Act (Public law 101-336).
- F. Texas Accessibility Standards (T.A.S.)
- G. State Fire Marshall.
- H. Texas Insurance Code.

1.4 QUALITY ASSURANCE

- A. Contractor Qualifications:
1. The installing contractor shall be the authorized representative of the Access Control Manufacturer to sell, install, and service the proposed manufacturer's equipment. The installing contractor shall have represented the security alarm manufacturer's product for at least two years.
 2. Integrated Wiegand Output, Wireless, and IP-Enabled access control products are required to be supplied and installed only through designated ASSA ABLOY "Authorized Channel Partner" (ACP) and "Certified Integrator" (CI) accounts.
 3. Integrated Wiegand Output, Wireless, and IP-Enabled access control products are required to be supplied and installed only through designated ASSA ABLOY "Authorized Channel Partner" (ACP) and "Certified Integrator" (CI) accounts.
 3. The installing contractor shall be licensed by the State of Texas as a security services contractor to design, sell, install, and service security alarm systems.
 4. The installing contractor shall provide 24-hour, 365 day per year emergency service with factory trained service technicians.
 5. The installing contractor shall have personnel on their staff that has been actively engaged in the business of designing, selling, installing, and servicing security alarm systems for at least ten (10) years.
 6. All Contractors must submit to the owner prior to starting any work the factory training certificates for all personnel that will be working on the access control system. No person is allowed to work on the system without proper manufacturer's certification.
 7. **The proposing contractor for this system and the installing contractor of this system shall be of the same organization. Absolutely no subcontracting of any portion of this system by the proposing contractor will be allowed.**
 8. **Contractor must be a current integrator of the specified solution in the closet major metropolitan area marketplace, have a permanent office located within 75 miles of the project, and be able to include information on current support staff to be able to service this client.**

1.5 SUBMITTALS

- A. The installing contractor and/or equipment supplier shall provide complete and detailed shop drawings and include:

1. Control panel wiring and interconnection schematics.
2. Complete point to point wiring diagrams.
3. Riser diagrams.
4. Complete floor plan drawings locating all system devices.
5. Factory data sheets on each piece of equipment proposed.
6. Detailed system operational description. Any specification differences and deviations shall be clearly noted and marked.
7. Complete system bill of material.
8. **Line by line specification review stating compliance or deviation.**

- B. All submittal data will be in bound form with Contractor's name, supplier's name, project name, and state security license number adequately identified.

1.6 ALTERNATE AND ALTERNATIVE PROPOSALS

- A. None.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Genetec Inc.
2280 Alfred-Nobel Blvd. Suite 400
Montreal, Qc, Canada

- B. HID

2.2 GENERAL AND HEADEND EQUIPMENT

- A. General: The ACS is a modular and networked based system providing physical access control security to a Wide Area campus enterprise. The system shall be capable of controlling and integrating multiple security functions including the configuration, management and monitoring of cardholder access, locking hardware units, events, alarms, visitors, and real-time tracking and reporting. The ACS is to be alterable at any time depending on the facility requirements and will allow for easy upgradeability or modification of network processors, controller, interface modules, card data, inputs, outputs, and remote workstations.
- B. Provide and transfer all required licensing to the owner.
- C. Provide local communication port at each panel for local configuration of system with laptop.
- D. Locate all main control panels in MDF room of building or Alternate location provide by the Owner
- E. Connect All Access Control Panels to the Owners Network. All cables shall be terminated on Patch Panel and labeled. All cables installed shall use only products required in the Structured Cabling Specification. If more than one manufacturer is specified the contractor shall only install products that will match the remainder of the project. All cables installed must carry the full manufactures warranty.
- F. Provide and install all power supplies as required. Provide a minimum of (1) Power Supply per panel
- G. Final software configuration / programming of system integration will require owner /

contractor consultation.

- H. Provide and install all connections required to connect the Genetec system to the Bosch intrusion system. The Genetec contractor will be responsible for all integration.

2.3 MAIN ACCESS CONTROL PANEL

- A. The Access Control System (ACS) shall provide controlled access to designated access portal and monitor any exterior portal that are not access controlled.
- B. Standard access control portals shall be:
 - i. Main Entry Portals
 - ii. Secure Vestibule Storefront Portals
 - iii. Kitchen Entrance Portals
 - iv. Main Staff Entrance Portals
 - v. Main Athletic Area Entrance Portals
 - vi. Building Access Portals from Main Playground Areas
- C. Each access-controlled portal shall be equipped with:
 - i. One (1) MultiClass Credential Reader
 - ii. Door Position Sensors – All door contacts must be DPDT.
 - a. Recessed – 1076D-G
 - b. Surface Mount/ Roof Hatch– 2507AD-L
 - c. Roll-up Door – 2315A-L
- D. REX MOTION DEVICES- Should be installed on all double leaf exits, if no micro switch is present, to detect exit on non card reader doors. These should be BOSCH DS150i.
- E. Electrified door hardware to be provided and installed by others. Lock power to door hardware shall be provided by the ACS integrator and centralized at MDFs and IDFs. **ACS Integrator shall provide cabling and connections between the door hardware and the Access Control System.**
- F. Access Control Portals shall not exceed 500' distance from the associated control panel.
- G. Software
 - i. 2-year Genetec Advantage
 - ii. LifeSafety Power Supply Integration
- H. Provide 2 qty. Cisco IP PHONE 8865 with 1 year SMARTnet Service Tool, #CP-8865-K9, #CON-SNT-CP8865KP, and 2 qty. Cisco #CP-BEKEM – Key Expansion Module.
 - a. Confirm Video Phone Model required at front desk and Principal's office prior to purchase.
- I. Include integration between Cisco Call Manager and Genetec Security Center to allow for viewing of video on phone and unlock of associated doors.
- J. Video Intercom
 - i. Provide one (1) Axis 8105-E video intercom at designated locations as shown on drawings.
- K. Door Release Button (quantities based on number of doors and receptionist desk positions)
 - i. Door release buttons should be Schneider Electric Housings, and consist of Schneider Electric Push Button ZB5AA3 and Schneider Electric Contact

block ZBE101.

- L. Emergency Lock-Down Button
Safety Technology International – SS2081EM-EN – Emergency push button, with cover, turn to reset.
- M. Local Alarm
System Sensor – MHW. This device will need to be powered by the centralized lock power supply. Contractor to ensure the power supply is sized appropriately.

2.4 FIELD DEVICES

- A. I/O boards
 - 1. Mercury LP1502 Intelligent Controller – Genetec PN: SY-LP1502
 - 2. Mercury MR-52 Reader Interface – Genetec PN: SY-MR52-S3
 - 3. Mercury MR16-OUT output control interface – Genetec PN: SY-MR16OUT-S3
 - 4. Mercury MR16-IN input control interface – Genetec PN: SY-MR16IN-S3
- B. System Control:
Syngeris Cloud Link with GB of Ram and 16GB flash, Image installed with Synergis access control firmware, Four rs-485 ports and POE. Genetec PN:SY-CLOUDLINK
- C. Door Controllers:
 - 1. Sixteen Reader Kit Prewired – Genetec PN: SY-DV16RD-E8M2-NET-WPA
 - 2. Eight Reader Kit prewired – Genetec PN: SY-DV8RD-E4M-NET-WPA
 - 3. Four Reader Kit prewired - Genetec PN: SY-DV4RD-E2M-NET-WPA
- D. Credential Readers:
 - 1. Wall Mounted Applications:
 - i. HID SIGNO 40 Card Reader – Contactless, SmartCard Reader, black in color.
 - ii. Provide card reader backplate, engraved with district standard naming convention, black Lexan
 - 2. Mullion Mounted Applications:
 - i. HID SIGNO 20 Card Reader – Contactless, SmartCard Reader, black in color.
 - ii. Provide card reader backplate, engraved with district standard naming convention, black Lexan
 - 3. Enrollment Reader:
 - i. RF Ideas PCProx Plus Enrollment reader, black, USB. Programmed to work with district cards
 - 4. Access Credentials:
 - i. Provide two hundred (200) iCLASS® smart card. HID Product 200xiCLAS proximity cards. Card shall be able to print directly on face of card. Cards must be purchased under the HID Corporate 1000 Plan.
 - 5. Wiring:
 - i. All Access control wiring shall be purple in color on the entire project.
 - ii. Wire scheme and conductor quantity shall be as required by the manufacture's specifications. Contractor to provide and install shielded cable as required.
 - 6. Approved Products:
 - i. Access control, plenum, composite cable – 22/6 shielded, 22/4, 22/2, 18/4
 - ii. Access Control, plenum, additional cable 22/6 for additional, single reader, 18/4 for

- door contacts, and 18/2 for the siren
- iii. Tappan No. TAPSEC or approved equivalent
- iv. Windy City Wire or approved equivalent

2.5 Enclosure:

- A. 16-door access control enclosure
 - 1. One (1) 30x36" enclosure
 - 2. One (1) SY-FPO75-BOXED
 - 3. One (1) Synergis Cloudlink
 - 4. One (1) Mercury SY-LP1502 Intelligent Controller
 - 5. Seven (7) Mercury SY-MR52-S3 Reader Interface Boards
 - 6. Sixteen (16) software reader connections
 - 7. Slotted wiring duct
- B. 8-door access control enclosure
 - 1. One (1) 20x24" enclosure
 - 2. One (1) SY-FPO75-BOXED
 - 3. One (1) Synergis Cloudlink
 - 4. Four (4) Mercury SY-MR52-S3 Reader Interface Boards
 - 5. Eight (8) software reader connections
 - 6. Slotted wiring duct
- C. 4-door access control enclosure
 - 1. One (1) 21x23" enclosure
 - 2. One (1) SY-FPO75-BOXED
 - 3. One (1) Synergis Cloudlink
 - 4. Two (2) Mercury SY-MR52-S3 Reader Interface Boards
 - 5. Four (4) software reader connections
 - 6. Slotted wiring duct
- D. Expansion enclosure (to be used after the 8-door and 4-door panels are full and input and output interface modules)
 - 1. One (1) 20x24" enclosure
 - 2. One (1) SY-FPO75
 - 3. Mercury LP1502 Intelligent Controllers, Genetec PN: SY-LP1502 based on additional doors
 - 4. Mercury MR52 Reader Interface Boards, Genetec PN: SY-MR52-S3 based on additional doors
 - 5. Software reader connections, based on additional doors
 - 6. Mercury MR16-IN, Genetec PN: SY-MR16IN-S3 based on additional number of inputs
 - 7. Mercury MR16-OUT, Genetec PN: SY-MR16OUT-S3 based on additional number of outputs
- E. 16-Input monitor interface. Software input and output connections to be included:
 - 1. MR16-IN
- F. 16-output monitor interface. Software input and output connections to be included:
 - 1. SY-MR16OUT-S3
- G. Centralized Lock Power Supply
 - 1. LifeSafety Power Supply – FPO150/150-2C8E2
- H. LSP SDK Connection from Genetec

- I. Enrollment reader: Provide (1) per campus
 - 1. Genetec PN: EL-RFIDEAS-80081AKO
 - 2. To be determined by Conroe ISD Security Dept.

- J. Prox reader:
 - 1. HID SIGNO 40 Card Reader – Genetec PN: SY-40NKS-02-0002BL

- K. SMA
 - 1. SMA for 1 Synergis Enterprise Reader – 5 years – Genetec PN: ADV-RDR-E-5Y
 - 2. SMA for 1 Omnicast Enterprise Camera – 5 years – Genetec PN: ADV-CAM-E5Y

- L. Prox Cards
 - 1. ISOPROX HID Cards/Prepunched HID PN:1386LGGMN
 - 2. All Cards must be registered with the Districts Corporate 1000 account

- M. Licensing – Provide all licenses required for complete and functional system in quantities as required
 - 1. Client Connection Licenses
 - 2. Lock Power supply integration
 - 3. Bosch Integration

- N. Contractor shall provide the following devices for attic stock for the Access Control System that is installed. Contractor shall confirm and Coordinate manufacturer and model number of equipment installed:
 - a. Quantity -1- Genetec Cloud link – Genetec PN: SY-CLOUDLINK
 - b. Quantity – 1- Ditek Surge Protection – DTK-MRJPOES
 - c. Quantity – 1 – Mercury LP1502 Intelligent Controller – Genetec PN: SY-LP1502.
 - d. Quantity – 1 – Mercury MR52 Reader Interface Board – Genetec PN: SY-MR52-S3.
 - e. Quantity -1- Genetec power supply kit for America, with 6A charger and standoff (110 VAC/ 60Hz, 12 DC @ 6A output) – Genetec PN: SY-FPO75-BOXED
 - f. Quantity -2- HID SIGNO 40 Card Reader – Genetec PN: SY-40NKS-02-0002BL
 - g. Quantity -2- HID SIGNO 20 Card Reader – Genetec PN: SY-20NKS-02-0002BL
 - h. Quantity-1- Axis 2N Helios IP Verso, basic unit with Camera- model- 01273-001
 - i. Quantity- 1- Axis Bluetooth & RFID reader (125khz, secured 13.56mhs UID+PACS IS, NFC) -model- 01639-001
 - j. Quantity- 1- Axis Frame for Installation – model- 01289-001
 - k. Quantity -1–Axis Backplate – model- 01294-001
 - l. Quantity -2- Potter Electric holdup switch, 1 button, momentary DPDT, 3amp@28-volt AC/DC – model- 2020130
 - m. Quantity -2- Potter Electric holdup switch, 1 button, momentary DPDT, 3amp@28-volt AC/DC – model- 2020132

- O. Lockdown Button - Should be located in vestibule/administrative offices and should be STI Blue Lockdown button SS2421LD-EN. ***LOCKDOWN MUST KILL POWER TO MAIN EXTERIOR VESTIBULE DOOR WITH AND WITHOUT NETWORK COMMUNICATION***

PART 3- EXECUTION

3.1 INSTALLATION

- A. All wiring shall be in accordance with the National Electrical Code, Local Codes, and article 760 of NFPA Standard 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.
- B. All wire shall be UL Listed CL2 for limited energy (300V) applications and shall be installed in conduit. Limited energy MPP wire may be run open in return air ceiling plenums provided such wire is UL Listed for such applications and is of the low smoke producing fluorocarbon type and complies with NEC Article 760 if so approved by the local authority having jurisdiction.
- C. No AC wiring or any other wiring shall be run in the same conduit as security alarm wiring.
- D. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
- E. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.
- F. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.
- G. All vertical wiring and all main trunk/riser wiring shall be installed in a complete raceway/conduit system. All riser boxes shall be adequately sized for the number of conductors transversing the respective box as well as the number of terminations required.
- H. Network Connection Cable: Provide a 4 pair Category 6 data cable from the Master Control Panel to the MDF network rack. Category 6 cable shall be purple in color.
- I. All plenum wiring is to be installed parallel and perpendicular to the building structure. Install wiring tight up against structure for protection. Cable shall be bundled on a maximum of 2'-6" and secured to the structure at a maximum of 5' on center. Bundling and support shall be with plenum rated cable ties.
- J. Contractor is required to provide all mapping and software configuration required to operate system as per manufacturer's recommendations.
- K. Integrated Wiegand access control products, campus locks, and IP enabled products are required to be installed through current members of the ASSA ABLOY "Certified Integrator" (CI) program.

3.2 CABLE PATHWAYS

- A. Cable Support:
 - 1. All wire not installed inside conduit or a designated cable tray system shall be installed in a dedicated cable support system for the entire run of each cable. Including, but not limited to service loops.
 - a. Approved Cable Support Product:
PANDUIT® Corporation J-MOD™ modular support system (sized appropriately for the number of wires being installed. Reference the manufacturer's specifications for the suggested maximum cables per

- support size.
2. The approved cable support system shall be attached directly to the building steel at a serviceable height. In the event that the building steel is not 5' of the finished ceiling, the contractor shall provide a dedicated threaded rod extending within 5' of the finished ceiling and mount the J-MOD™ support hook to the treaded rod.
 3. J-MOD™ cable support shall be installed at a maximum of 5' on center.
 4. All cable installed shall be attached to the J-MOD™ support system with plenum rated Velcro and a plenum rated Velcro tie shall be installed between each J-MOD™ cable support to keep wires neatly bundled throughout the entire run. Tiewraps will only be allowed to be used inside the control panels as required to manage the wires within each type of panel.
 5. **ABSOLUTELY NO CABLE, NOT INSTALLED IN CONDUIT, WILL BE ALLOWED TO BE ATTACHED DIRECTLY TO THE BUILDING'S STEEL OR SUPPORTED IN ANY OTHER METHOD THAN THAT STATED ABOVE.**
 6. **IT IS THE RESPONSIBILITY OF THE INSTALLING CONTRACTOR TO COORDINATE WITH ALL OTHER TRADES ON THE PROJECT TO INSURE THAT THE PATHWAY OF THIS SYSTEM DOES NOT INTERFERE WITH THE INSTALLATION OF THE OTHER TRADES AND TO PREVENT THE INSTALLED PRODUCT OF OTHER TRADES FROM PUTTING STRAIN ON THE INSTALLED WIRING.**
- B. Conduit / Raceway:
1. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
 2. Conduit and raceway system shall be installed as specified under the general electrical section of the specifications, and per NEC.
 3. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.
 4. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.
 5. All conduit ends shall have a protective bushing to prevent cable damage. **BUSHINGS MUST BE INSTALLED PRIOR TO INSTALLING CABLE. CUTTING BUSHING TO INSTALL AROUND INSTALLED CABLES WILL NOT BE ACCEPTED.**
- C. Wiring:
1. All wiring shall be purple, with direct home runs from power supply located in the MDF/IDF room. All network cables are to be purple in color.

3.3 TESTING

- A. Submit a written test report from an authorized representative of the equipment manufacturer that the system has been 100% tested and approved. Final test shall be witnessed by Owner, Engineer, Electrical Contractor and performed by the equipment supplier. Final test report must be received and acknowledged by the Owner prior to substantial completion.
- B. Provide instruction as to proper use and operation of system, for the Owner's designated personnel.

3.4 WARRANTY

- A. Entire system shall be warranted against defects in materials and workmanship for a period of one (1) year from the date of substantial completion.

3.5 SOFTWARE

- A. Provide two electronic copies of the final programming and program software to the Owner's Security Supervisor after final approval.

END OF SECTION

SECTION 28 16 00 - INTRUSION DETECTION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 RELATED WORK

- 26 05 00 – Grounding and Bonding
- 26 02 00 - Basic Materials and Methods
- 26 05 29 – Electrical Hangers and Supports
- 26 05 33 – Raceway and Boxes
- 28 00 00 – Basic Materials and Methods
- 28 13 00 - Access Control System
- 28 13 53.11 – IP Network Compatible Intercom
- 28 23 00 – IP Video Surveillance System

1.3 SECTION INCLUDES

- A. Integrated Digital Alarm Communicator and Access Control System (DACS), including but not limited to the following:
 - 1. Control panel.
 - 2. Enclosures.
 - 3. Lock and key.
 - 4. Power Supplies.
 - 5. Accessories required to provide a complete DACS.
 - 6. System O and I manual.
 - 7. System programming.
 - 8. Batteries.
 - 9. Wiring.
 - 10. Conduits.
- B. The Contractor shall be responsible for identifying requirements for permits from the local police department for the installation of the alarm system specified herein and shall assist the Owner in obtaining the relevant alarm permits.

1.4 SYSTEM DESCRIPTION

- A. A functionally complete, integrated Digital Alarm Communicator System (DACS) per manufacturer's guidelines, codes and specification requirements.
 - 1. The DACS shall include a Control Panel with built-in Ethernet jack for event communication and remote services.
 - 2. The DACS shall include a Control Panel with an optional, supervised telephone line interface module.
 - 3. The DACS shall include recording and retention of event information in a dedicated event log.
 - 4. The DACS shall incorporate an integral real-time clock, calendar, and a test timer.
 - 5. The DACS shall incorporate battery charging capabilities with supervision of battery voltage and battery leads.
 - 6. The DACS shall accommodate a time / event-based scheduling system.
 - 7. The DACS shall be capable of supervision of peripheral devices and

- communications interfaces.
8. The DACS shall accommodate configuration and operation of separate, independent areas.
 9. The DACS shall accommodate hard-wired or wireless point expansion via eight-point interface modules and RF receivers.
 10. The DACS shall accommodate addressable expansion utilizing a 2-wire bus.
 11. The DACS incorporate removable terminal strips for wiring connection to facilitate simple service and replacement
 12. The DACS shall have electrically supervised detection loops and power supplies with battery(s) maintenance. This supervision shall be programmable for the purposes of reporting this information to the DACR.
 13. The DACS shall be capable of sending (manually or automatically) test and status reports to remote DACRs.
 14. The DACS shall be able to accommodate test, diagnostics, and configuration programming functions locally or remotely via a portable programmer or a computer running the Remote Programming Software (RPS).
 15. The DACS shall annunciate alarm, trouble, service reminders, and other relevant system status messages in custom English, Latin American Spanish, Portuguese and/or French Canadian text at the ACC.
 16. **DO NOT DEVIATE FROM THE FOLLOWING SYSTEM COMPONENTS:**
 - a. Provide one dry contact per partition for lighting controls relay at the main security panel location in the MDF. The Building Management Control System will monitor this contact.
 - b. Include phone line access to remotely turn intrusion alarm "on" and "off."
 - c. Provide motion detectors (mostly in corridors) and keypads in locations as shown on attached floor plan. Use the following motion detector setup reference:
 - Elementary Schools:
 - All exterior doors.
 - Long hallways at intersections.
 - 2 in cafeteria/gymnasiums.
 - 2 in library.
 - Stairwell landings at multi-level buildings.
 - Junior High Schools:
 - All exterior doors.
 - Long hallways at intersections.
 - 2 in cafeteria.
 - 2 in each gymnasium.
 - 2 in library.
 - Stairwell landings at multi-level buildings.
 - High Schools:
 - All exterior doors.
 - Long hallways at intersections.
 - 3 in main cafeteria.
 - 3 in 9th grade cafeteria.
 - 2 in each gymnasium.
 - 3 in library.
 - 4 in natatorium (not including main entrance vestibule).
 - Stairwell landings at multi-level buildings.
 - Attic stock per school:
 - D9127U Pop-it module – 10
 - B308 Octo-output – 2
 - B208 Octo-Input – 2
 - B942 Touch Screen Keypad - 2
 - B9512G Panel – 1

- D1640 Transformer – 1
 - Sounders – 5
 - Strobes – 5
- d. Stand-alone system; not tied to the CCTV system.
 - e. In case of product failure after warranty or the need arises to expand the system in the future, system installed should allow for off the shelf motion detectors and other system components.
 - f. Power supply should not be in a continuous loop, where one failure could affect several intrusion alarm components.
 - g. No Wire Mold or exposed wiring in Public accessible areas.
 - h. Quality of Products (wiring and components) identified in the Specifications
17. The IDS will be integrated / tied to the access control system. Upon a valid read at a credentialing device, the access control system shall send a signal to the IDS to disarm. There shall be a separate “arming” card reader that will allow the system to be armed.

1.5 REFERENCES

- A. National Electric Code, Article 760.
- B. National Fire Alarm Code (NFPA 72).
- C. Administrative Council for Terminal Attachments (ACTA):
 1. ANSI/TIA-968-A-2002 Technical Requirements for Connection of Terminal Equipment to the Telephone Network.
- D. American National Standards Institute (ANSI):
 1. ANSI C63.4 Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
- E. Federal Communications Commission (FCC):
 1. Title 47 C.F.R. Part 15; Class B – Radiated and Conducted Emissions.
 2. Title 47 C.F.R. Part 68; rules governing the connection of Terminal Equipment (TE) to the Public Switched Telephone Network (PSTN).
- F. The National Institute of Standards and Technology of the United States of America (NIST):
 1. Federal Information Processing Standards Publications 197 (FIPS 197) – Advanced Encryption Standard (AES).
- G. International Organization For Standardization (ISO):
 1. 9001 - Quality System.
- H. Underwriters Laboratories, Inc. (UL):
 1. UL 50 - Enclosures for Electrical Equipment.
 2. UL 294 – Access Control System Units.
 3. UL 365 - Police Station Connected Burglar Alarm Units and Systems.
 4. UL 609 - Local Burglar Alarm Units and Systems.
 5. UL864 – Control Units and Accessories for Fire Alarm Systems (Commercial Fire)
 6. UL 1076 – Proprietary Burglar Alarm Units and Systems
 7. UL 1610 - Central Station Burglar-Alarm Units.
 8. UL 60950-1 - Information Technology Equipment - Safety.
 9. UL 636 – Hold up alarms

1.6 SUBMITTALS

- A. Product Data: Manufacturer's data, user and installation manuals for all equipment and software programs including computer equipment and other equipment required for complete Digital Alarm including:
1. Preparation instructions and recommendations.
 2. Storage and handling requirements and recommendations.
 3. Installation methods.
 4. Control panel wiring and interconnection schematics.
 5. Complete point to point wiring diagrams.
 6. Riser diagrams.
 7. Complete floor plan drawings locating all system devices.
 8. Factory data sheets on each piece of equipment proposed.
 9. Detailed system operational description. Any specification differences and deviations shall be clearly noted and marked.
 10. Complete system bill of material.
 11. **Line by line specification review stating compliance or deviation.**
- B. Shop Drawings: Shop drawings shall provide details of proposed system and the work to be provided. Include point-to-point drawings of systems and wiring diagrams of individual devices.
1. Detailed wiring diagrams and system description.
 2. System device locations on architectural floor plans.
 3. Full Schematic of system, including wiring information for all devices.
- C. Documentation to be submitted by the Contractor upon completion of system installation:
1. "As-builts": Upon completion of installation, the Contractor shall prepare "as- built" drawings of the system. These "As-builts" shall be delivered electronically (PDF) and as 30 inches by 42 inches (76 cm by 107 cm) format mylar reproducible drawings of each floor plan indicating exact device locations, panel terminations, cable routes and wire numbers as tagged and color-coded on the cable tag.
 - a. Additionally, final point-to-point wiring diagrams of each type of device (on 30 inches by 42 inches (76 cm by 107 cm) format) shall be included in the "as-builts."
 - b. "As-builts" shall be submitted to the Owner for approval prior to the system acceptance walk-through.
 2. Operation and maintenance manuals: Three sets of operating manuals shall be provided explaining the operation and maintenance of the system.
 3. Parts list.
 4. Maintenance required and maintenance schedule.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualification:
1. The system shall be the standard product of one manufacturer, and the manufacturer shall have been in business manufacturing similar products for at least 5 years.
 2. Manufacturer's Quality System: Registered to ISO 9001:2000 Quality Standard.
- B. Installer Qualification:
1. Minimum of five years' experience installing access control, surveillance and security systems and devices.

2. After-sales support: The Contractor shall be a factory-authorized and trained dealer of the system and shall be factory-trained and certified to maintain/repair the system after system acceptance.
- C. System Requirements:
1. All equipment, systems, and materials furnished and installed under this section shall be installed in accordance with the applicable standards of:
 - a. National Codes: NEC, NFPA, BOCA, SBCCI, IBC, as applicable.
 - b. Approvals and listings: UL, FM, ANSI SIA CP-01, CSFM, as applicable.
 - c. Local Authorities Having Jurisdiction (AHJ).
- D. Mock-Up: provide a mock-up for evaluation of installation techniques and application workmanship.
1. Finish system in areas designated by Architect.
 2. Do not proceed with remaining work until workmanship and aesthetics are approved by Architect.
 3. Remake mock-up area as required to produce acceptable work.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original, unopened, undamaged containers; and unharmed original identification labels.
- B. Store products in manufacturer's unopened packaging until ready for installation.
- C. Protect store materials from environmental and temperature conditions following manufacturer's instructions.
- D. Handle and operate products and systems according to manufacturer's instructions.

1.9 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.10 WARRANTY

- A. All components, parts, and assemblies supplied by the manufacturers and installed by the Contractor shall be warranted against defects in material and workmanship for a period of at least 12 months (parts and labor), commencing upon date of acceptance by Owner. A qualified factory-trained service representative shall provide warranty service.
- B. Service/Maintenance:
 1. System maintenance and repair of system or workmanship defects during the warranty period shall be provided by the Contractor free of charge (parts and labor).
 2. Periodic testing of the system shall be carried out on a monthly or quarterly basis to ensure the integrity of the control panel, the sensing devices, and the telephone lines.
 3. The installer shall correct any system defect within six hours of receipt of call from the Owner.
 4. Extended service/maintenance agreements shall be offered by the Contractor for up to four years after the warranty expires. The agreement shall be renewable monthly, quarterly, or yearly.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Bosch Security Systems, Inc.; 130 Perinton Parkway; Fairport, NY 14450. ASD. Toll Free Tel: 800-289-0096. Tel: 585-223-4060. Email: [request info \(presales.support@us.bosch.com\)](mailto:requestinfo@us.bosch.com). Web: www.boschsecurity.us.
- B. Substitutions: Not permitted.

2.2 GENERAL DESCRIPTION

- A. Control Panel and Features:
 - 1. The DACS control panel shall be Bosch Security Systems, Inc. model B9512G comprising a fully integrated intrusion and residential fire control system. The control panel shall support the following:
 - a. Optional Telephone Line Module, programmable for signaling and supervision.
 - b. Integrated Conettix IP based communication provides high-speed, secure alarm transport and control.
 - c. 32 programmable areas with perimeter and interior partitioning.
 - d. 8 on-board, hardwired points with expansion capability for a total of 599 using a combination of wired or wireless points.
 - e. Compatibility with Color Graphic Touch Screen, 2-line alpha numeric capacitive touch
 - f. Local or remote programming, test, and diagnostic capability via a computer running the Remote Programming Software (RPS).
 - g. The system shall include an integrated USB port for local programming and diagnostics using a computer running Remote Programming Software (RPS) and a male USB2.0 to male USB 2.0 cable with no additional hardware modules required.
 - h. The system shall support the use of an Apple iOS device and/or Android device for control. Functions to include arming, disarming and control of outputs and access door, viewing of connected IP cameras. This application shall connect directly to the DACS using internet, Wi-Fi or cellular communications and shall not require a third party server or network operations center (noc).
 - i. The DACS shall support up to thirty-two (32) custom functions allowing the installer to combine up to 6 functions into one command. These custom functions shall be operated by keypad command, point activation, key fob button, or programmable schedule
 - j. The DACS shall support up to 32 keypad shortcuts which allow the installer to define which commands are available at each keypad.
 - k. The system shall offer multiple language support that can be assigned per keypad. Languages supported must include English, Latin American Spanish, Portuguese and/or Canadian French.
 - l. The DACS shall support flash firmware upgrades of systems firmware for the control panel and peripherals, allowing for future updates.
 - m. Integrated real time clock, calendar, test timer and programmable scheduling capability for relay control and automatic execution of system functions based on a time / event.
 - n. Provide 1.4 amps of power for standby operation and 2.0 amps of alarm power, both rated at 12 VDC.
 - o. 3 configurable form 'C' wet or dry-contact relay outputs with expansion

- capability for up to an additional 472 dry-contact relay outputs.
 - p. Integrated battery charger with reverse hook up protection, battery supervision and battery deep discharge protection.
 - q. Supervision of peripheral devices and communications interface(s).
- B. Point Functionality and Expansion:
1. Each point in the system shall be programmable to provide the following type of response in the system:
 - a. Always on (24 hour response).
 - b. On when the system is Master Armed.
 - c. Only on when the system is Perimeter Armed.
 - d. Displays / Does Not Display at the ACC when the point is activated.
 - e. Provides / Does Not Provide entry warning tone.
 - f. Sounds / Does Not Sound audible alarm indication.
 - g. The Point is bypassable / not bypassable.
 - h. Alarm Verification with programmable verification time.
 - i. Relay activation by Point.
 - j. Provides / Does Not Provide "watch point" capability.
 - k. Provides Swinger Bypass.
 - l. Defers Bypass Report.
 - m. Can return to the system after being force armed and then restoring.
 - n. Can return to the system after being bypassed and then restoring.
 - o. Keyswitch arming (maintained or momentary)
 - p. Activate by Custom Function
 - q. Activate following an output
 2. The system shall support a programmable Monitor delay functionality for supervision of points during disarmed periods. These points may be programmed to ignore status from 1 to 60 minutes and will activate only if the point is off-normal for this time period.
 3. The system shall support a programmable delay response functionality for supervision of points during armed or disarmed periods. These points may be programmed to ignore status from 1 to 60 minutes and will activate only if the point is off-normal for this time period.
 4. The system shall support virtual points and outputs for customized programming of events
 5. The DACS shall be capable of supporting "group zoning." Group zoning refers to the combining of points into a separately identifiable and separately annunciated (programmable text) areas.
 6. The DACS shall be capable of allowing variable point response times via programming. Point response times shall be programmable over a range of 300 milliseconds to 4.5 seconds.
 7. The DACS shall have the capability to expand up to 599 separately identifiable points, of which 8 are on-board and 472 are off-board wired, addressable or wireless points.
 - a. The 8 on-board points shall be able to accommodate powered class B functionality using a powered loop interface module.
 - b. Point Expansion Modules (Wired and Wireless) shall be able to be located remote to the main panel to a maximum distance of 1000 feet.
 - c. Addressable modules shall be able to be located remote to the panel to a maximum of 500 feet.
 8. The DACS shall have the capability to expand up to 99 separately identifiable points, of which 8 are on-board and 91 are off-board addressable points connected to multiplexed backbone trunks via wired modules and/or wireless receivers.
 - a. The 8 on-board points shall be able to accommodate powered class B functionality using a powered loop interface module.

- b. Point Expansion Modules (Wired and Wireless) shall be able to be located remote to the main panel to a maximum distance of 1000 feet.
 - c. Addressable modules shall be able to be located remote to the panel to a maximum of 500 feet.
- C. Areas/Accounts:
 1. The DACS shall support 32 independent areas. Each of the 32 areas shall have custom text associated with the armed state, disarmed state and point-off-normal state.
 2. The DACS shall be capable of assigning 1 to 4 account identifiers to the areas depending on the distribution of areas per account.
 3. The DACS shall be capable of assigning 1 to 2 account identifiers to the areas depending on the distribution of areas per account.
 4. All of the areas must be capable of Master (All) and/or Perimeter (Part) arming (excluding predefined Interior protection).
 5. The DACS shall be capable of logically grouping 1 or more points into an area, or conversely, dividing 2 or more points into two or more areas.
 6. Any area shall be configurable to allow arming by specific users when a programmable number of devices are faulted or bypassed.
 7. Areas shall be independently controlled by their corresponding ACC.
 8. Area(s) shall accommodate assignment of independent account numbers to define annunciation, control, and reporting functions.
 9. The DACS shall be capable of linking multiple areas to a shared area which may be automatically controlled (hallway or lobby).
 10. The DACS shall accommodate conditional area arming dependent on the state of other areas (master or associate). Any area can be configured for perimeter and interior arming, not requiring a separate area for this function.
- D. Output Relay Expansion: The DACS shall provide the capability for output relay expansion using relay expansion modules. Independent control of relay functions by area shall be possible through programming assignments.
 1. The DACS shall be capable of activating 472 additional relay outputs for auxiliary functions based on its classifications (area vs. panel wide). Output Expansion Modules shall be able to be located remote to the main panel to a maximum distance of 1000 feet. 8 relays (Form C) are to be provided per octo-relay module
 2. The DACS shall be capable of controlling relays and automatically executing system functions based on a time / event scheduling program. The program can be hour, day of week or day of month based.
 3. Relays and other outputs may be programmed to follow up to 14 different area conditions or up to 12 panel conditions. Relays may also be programmed to follow individual points or groups of points.
 4. The DACS shall support 5 different types of alarm output selections: Steady, Pulsed, California Standard, Temporal Code 3 and Temporal Code 4.
- E. Scheduling: The DACS shall support scheduling capabilities with the following characteristics:
 1. Arm / Disarm specific area(s) based on open/close windows.
 2. Bypass / Unbypass point(s).
 3. Activate / Deactivate relay(s).
 4. Send test reports.
 5. Up to 4 programmable holiday schedules of 366 days each (includes leap year). Based on the holiday settings, different time windows for open/close and other system functions can be executed.
 6. Automatic adjustment of system clock for daylight savings time.

- F. Alarm Keypads:
1. The DACS shall accommodate connection with up to 32 ACCs, each capable of displaying custom English, Latin American Spanish, Portuguese or Canadian French text on a liquid crystal display.
 2. The Alarm Keypads shall accommodate viewing and configuration of system parameters including:
 - a. Network Parameters:
 - 1) DHCP Enable/Disable for the selected network module.
 - 2) UPnP Enable/Disable for the selected network module.
 - 3) IP Address for the selected network module
 - 4) Subnet Mask for the selected network module.
 - 5) Default Gateway for the selected network module.
 - 6) Port Number for the selected network module - The module's port number shall range from 0 to 65,535.
 - 7) DNS Server Address for the selected module's DNS server IP address
 - 8) DNS Host Name for the selected module. The DNS host name shall contain up to 63 characters.
 - 9) AES Encryption Key Size – Enable/Disable encryption by selecting the AES encryption key size for the selected network module.
 - 10) AES Encryption Key String - The user shall be able to display, add and modify the AES encryption string based upon the key size previously configured for the selected network module.
 - b. Point Parameters:
 - 1) Point Selection between one and the maximum number of points in the control panel.
 - 2) Point Registration to allow system response from a specific physical point on any one of the expansion modules; On-board or Point expansion modules (wired or wireless)
 - 3) Wireless points shall be able to be enrolled in the system via an auto enrollment feature.
 - c. Event Routing Parameters to allow programming of up to 4 report routing groups as well as configuration of primary and secondary paths.
- G. User Passcodes and Authority: Passcodes shall be programmable with authority levels to allow users to operate any or all areas.
1. Up to 2000 different passcodes shall be accommodated
 2. Each passcode shall be 3 to 6 digits (variable) and be assigned a 32-character user name
 3. User access to System features and functions shall be configurable based on 14 individually programmable levels of authority assigned to the user passcode. Additionally, the system shall have the capability to assign to the user passcode, a different authority level in each of the areas. A service passcode can be assigned to the servicing agent allowing the agent limited access to system functions. User-programmable / activated functions include:
 - a. Arming the system: All areas, specific area(s) only, perimeter instant, perimeter delayed, perimeter partial, watch mode, and arming the system with a duress passcode.
 - b. Disarming the system: All areas, specific area(s) only and disarming with a duress passcode.
 - c. Viewing system status: Faulted points, event memory, bypassed points, area status and point status.
 - d. Implementation functions: Bypass a point, un-bypass a point, reset sensors, silence bell, activating relays, initiating the remote Programming function

- locally to allow programming the system from a remote location.
 - e. Testing the system: Local Walk test, Service Walk test, Fire test, send report to remote DACR to check the telephone link, and programming the time and date for the next test report transmission.
 - f. Change system parameters: ACC display brightness, system time and date, and add/delete/change passcodes.
 - g. Extend the closing time of the system.
 - h. Transmitting special alerts and activating audible and visible signals.
 - i. Executing multiple commands / ACC keystrokes from a single Menu / Command List item. This function shall be able to have a 32 character (alphanumeric) title to identify it on the ACC display.
 - j. Editing of time / event based scheduling program from the ACC.
 - k. The DACS shall also provide a "service menu" to implement functions such as viewing and printing the system log, displaying the system firmware revision number, and defaulting (toggling) text displays between custom and default text displays for troubleshooting.
4. The DACS shall allow users to change their own user passcode from the Alarm Keypad (ACC). Managers shall be capable of changing the user passcodes and authority assignments by area of other users from the ACC.
5. The DACS shall incorporate a programmable "Passcode Follows Scope" feature to allow users to arm or disarm only the area they are entering with one simple command or control all areas from one ACC.
- H. Communication: The DACS shall be capable of reporting system events and supervisory reports including alarm, trouble, missing modules, restorals, system status, AC failure, battery status to primary and secondary off-site DACR's. The following features shall be supported.
- 1. The DACS shall be capable of communicating via dial-up analog telephone lines, over a LAN/WAN/Internet using a wired network interface module, or over a cellular network using a CDMA Cellular interface module.
 - a. Bosch B9152G Cell Kit as a secondary backup to access panel.
 - 2. The Bosch Modem4 communications format shall be utilized for optimum system performance. The Modem4 format provides the maximum data information to the receiver for alarms, troubles, restorals, bypasses, relay activation, opening/closings, and card access. The detailed information includes the point numbers with text, peripheral device numbers, user numbers with text, and area information. As an alternative format, Contact ID may be used although it will include less detailed information like point or user text.
 - 3. The DACS shall be capable of sending text (SMS) messages to compatible devices without requiring that these message are sent to a monitoring center
 - 4. The DACS shall have the capability of communicating with up to 8 different DACRs using up to 4 different phone numbers, up to 24-digits in length and/or 4 URL/IP addresses over a network.
 - 5. The DACS shall report to a Commercial Central Station that is using a Bosch D6600 Receiver/Gateway or a Bosch D6100i Receiver using Modem4 as a preferred format or Contact ID as an alternate format.
 - 6. The DACR shall provide the transmission information sent from the DACS that includes alarms, troubles, restorals, bypasses, relay activation, openings/closings, and card access. When using the Modem4 format, the detailed information includes the point numbers with text, peripheral device numbers, user numbers with text, and area information.
 - 7. The DACS reports shall be classified, by event, into eleven subcategories or "report groups." Each group represents similar types of events. Individual events within each group shall be selectively enabled or disabled for transmission. The eleven report groups shall be as follows:

- a. Fire Reports.
 - b. Burglar Reports.
 - c. User Reports.
 - d. Test Reports.
 - e. Diagnostic Reports.
 - f. Relay Reports.
 - g. Auto Function Reports.
 - h. RPS Reports.
 - i. Point Reports.
 - j. User Change Reports.
 - k. Access Reports.
8. The DACS shall have the capability to verify the integrity of the remote communications path and switch to alternate paths when a communications failure occurs.
9. The DACS shall be capable of unattended mode of operation whereby programming and configuration updates are automatically transferred using the Remote Programming Software (RPS). These updates can initiate from either the control panel or the remote computer using RPS.
- I. Network Communication: The DACS shall be capable of network communications over a LAN, WAN, Intranet, or the Internet. The system shall include supervision of the network communication utilizing configurable periodic heartbeats to the Digital Alarm Communications Receiver (DACR). The DACR shall provide notification of the loss of communications from a networked system after a programmable timeframe since the last communication. The notification options shall be programmable and include local annunciation or indication to automation software.
1. The network interface module shall be capable of supporting Dynamic Host Communication Protocol (DHCP) to obtain an IP Address.
 2. The system shall support a method of authentication between the control panel and the receiver to ensure that the control panel has not been compromised or replaced.
 3. The network interface modules shall be capable of supporting encryption using a minimum of 256-bit AES Encryption (Rijndael) certified by NIST (National Institute of Standards and Technology) utilizing the Cipher Block Chaining (CBC) method.
 4. The network interface module shall support a 10/100BaseT connection to an Ethernet network.
 5. The control panel shall be capable of network communication with a programmable poll time to send periodic heartbeats to the receiver, programmable ACK Wait time, and programmable retry time. In the situation where a communication path is unsuccessful, the control panel shall be capable of attempting backup communication through an available communication method to the same receiver or a backup receiver.
 - a. The control panel shall have the ability to automatically adjust the heartbeat rate of a backup path that is using cellular to the heartbeat rate of the primary path in case of a primary path failure. Upon restoral of the primary path, the heartbeat rate of the backup path shall automatically restore to the original rate. This allows a system utilizing cellular communications to keep the wireless charges low.
 - b. The network communication between the control panel and the receiver shall use Modem4 or Contact ID.
 - c. The control panel shall be capable of two-way communication using a wired network interface module with a 10/100BaseT on a LAN/WAN/Internet configuration or with a cellular module on the Internet.

- d. The control panel shall be capable of configuring the destination of the receiver using a URL or static IP Address.
 - e. The control panel shall be capable of using DNS to lookup the IP Address of the receiver when programmed with a URL.
 - f. The control panel shall support UPnP for automated Port Forward configuration in the router where the control panel is installed.
 - g. The control panel shall support AutoIP to enable the RPS software to connect to the control panel locally using an IP Direct connection.
 - h. The control panel shall support configuration of the IP parameters from the keypad eliminating the need for a PC to configure the IP device.
 - i. The control panel shall support network diagnostics from a keypad to allow local testing of network connectivity. The diagnostics should include, Ethernet cable connected, gateway configuration ok, DNS lookup operational, and external network connectivity (such as the Internet) operational.
 - j. The system shall be capable of meeting DCID 6/9 and UL 2050 standards.
- J. Event Log: The DACS shall maintain a log of events indicating time, day, month, year type of event, account number, area number, user ID, point text, user text and primary/secondary event route. The system shall allow the following characteristics:
- 1. The DACS shall be capable of storing up to 10,000 events
 - 2. The DACS shall support viewing of logs locally at the ACC and remotely via an upload to a remote central station computer running the RPS software.
 - 3. The DACS shall provide notification via a report to the DACR when the event log reaches a programmable "percent full capacity". This allows retrieval of stored events via RPS to prevent any loss of event history.
 - 4. Group, signal type and area can route events to specific receivers.
 - 5. Each DACR shall be designated as a primary, backup, or duplicate destination for each report group. Assigning an event to multiple routing groups provides for duplicate destinations for the event. The transmission of grouped events allows the reporting of different types of information to different remote DACRs.
- K. Testing, Diagnostic, and Programming Facilities: The DACS shall be capable of sending (manually or automatically) test and status reports to remote DACRs.
- 1. The DACS shall be capable of sending automatic tests daily, weekly or once every 28 days. Automatic test times shall be programmable to provide an offset of up to 24 hours from the current time.
 - 2. Automatic test reports shall be programmable to be deferred by one test interval if any other report is transmitted in the current interval.
 - 3. Automatic test reports and remote system access for diagnostics shall be supported via a remote central station computer with Remote Programming Software (RPS).
 - 4. The DACS shall be programmable locally or remotely. Programming shall be accomplished via a Keypad or a computer with a remote programmer and diagnostic software package (RPS).
 - 5. The DACS shall allow an on-site user to initiate remote programming while on-line with the servicing location. The remote programming device must provide a compare feature and allow for downloading either the stored program or the (un)modified program copied from the panel.
 - 6. The DACS shall allow the local programming option to be disabled and must provide a method to program a panel while no one is on premises, when the panel shares a line with an answering machine.
 - 7. The DACS shall accommodate IP Diagnostic to verify settings and operation of the network interface modules; Host name, MAC address, IPV4 address assignment.

- The IP Connection test shall include; Link test to verify physical cable integrity, Ping test to verify gateway response, ping test to verify address on the internet.
8. Wireless point diagnostics shall include signal strength and device states of registered wireless points in the system.
 9. The number of system testing and programming sessions shall be restricted via the use of program locking features and passwords. Passcode protection in excess of sixteen million combinations is required.
 10. New modules support enhanced diagnostics through RPS
- L. Miscellaneous Features: Programmable alarm output timer, 4 programmable entry delay times, exit delay programmable by area, individually programmable point of protection text, point bypassing, key switch arming capability with LED outputs, and fire verification.
- M. False Alarm Reduction: The DACS shall comply with all ANSI SIA CP-01 2010 requirements for false alarm reduction
- N. Ambush Detection: The DACS shall include an early ambush feature that requires that the user disarm, and then inspect the facility within a specified time period, before entering their passcode or a different authorized passcode again. If the user does not enter a passcode a second time, a duress event is generated. If the user does enter a passcode within the specified time period, the system disarms.
- O. Two-man rule: The DACS shall include a programmable feature that requires 2 separate passcodes to be entered to disarm the system. After 1 passcode is entered, the system will prompt for a second passcode to be entered on the same ACC. Without the second passcode, the system shall not disarm.
- P. Dual Authentication: The DACS shall support Dual Authentication by area. Areas programmed for Dual Authentication require activate of a card and a passcode to allow access to system functions, arm/disarm, or access control doors.
- Q. Area Re-Arm: The System shall support programmable area re-arm time of 1 minute to 24 hour.
- R. User-Programmable Features: The DACS shall provide a menu driven interface to provide a user-friendly command structure for programming / customizing the system to the operational criteria of the application. The DACS shall be capable of being operated via:
1. The Command Structure.
 2. Menu / Command List.

2.3 SYSTEM INTERFACE REQUIREMENTS

- A. Grounding: The Contractor shall properly earth ground the DACS to prevent electrostatic charges and other transient electrical surges from damaging the DACS panel.
- B. Primary power: The Contractor shall provide a dedicated 120 VAC power circuit to the DACS system. This circuit shall be connected to the emergency power system. The 120 VAC is stepped down to power the DACS panel using a class two, plug-in transformer. This power circuit shall be properly rated to continuously power all points and functions indefinitely in full alarm condition.
- C. Primary power supervision: When the primary power source fails, the system can be configured to report an "AC Fail" message to a commercial central station.
1. The message can also be programmed to "tag-along" with another message

- transmitted to the central station.
2. The system will always display a loss of primary power on the ACC and may be configured to provide additional audible warning.
 3. The transmission delay of this message is programmable from 5 seconds to 86 minutes with an optional 6 to 12 hour transmission delay
- D. Secondary power (standby battery): The Contractor shall provide adequate battery power as defined by the relevant application criteria, (UL 864 and UL 985 for alarm installations or NFPA 72 chapters for fire applications). Appropriate battery chargers shall be provided consistent with the battery back-up capacity. The most current accepted version of NFPA 72 and any applicable local codes or AHJ requirements must be met accordingly.
- E. Secondary power supervision: When the secondary power source experiences a 85 percent depletion of its standby capacity, the system can be configured to report a "Low Battery" message to a commercial central station. The system will always display a low battery condition on the ACC and may be configured to provide additional audible warning.
- F. Telephone interface: The control panel in the DACS shall be equipped with an optional phone line monitor and shall interface with the phone lines via RJ-31X jacks for supervision of the telephone line connection.
1. The telephone line interface shall conform to FCC rules (Title 47 C.F.R. part 68).
 2. When a telephone line is determined to be out of service by the DACS panel, the event will be annunciated locally on the ACC and transmitted to the central station over the alternate communications interface. The transmission delay of this message is programmable from ten to two-hundred forty seconds.
- G. Ethernet Interface: The DACS shall include an integrated Ethernet interface module as the primary, or back-up means of communicating to a DACR.
1. Built-in IP-based alarm transport, programming, and control
 2. The module shall accommodate 128 and 256-bit AES encryption using CBC (Cipher Block Chaining) mode.
 3. 10BASE T or 100BASE T network connection
 4. Full-duplex and half-duplex support
- H. Cellular interface: The DACS may use a cellular radio module as the backup means of communicating to a DACR. Up to 4 IP Addresses shall be available for routing system events. The supervision time shall be programmable with a range of 5 to 65,535 seconds. The module shall accommodate 128 and 256-bit AES encryption using CBC (Cipher Block Chaining) mode.
- I. Auxiliary function control interfaces: The DACS shall accommodate auxiliary functions such as activating bells, strobes, or lights and shall be accomplished using the optional application specific relay modules. These auxiliary interfaces shall be electrically isolated to avoid inter-system interferences or damage to the system.
- J. Wiring: The contractor shall provide cables consistent with the manufacturer's recommendations. The following general guidelines shall be followed for wiring installation:
1. Wiring shall be appropriately color-coded with permanent wire markers. Copper conductors shall be used.
 2. All signal cables provided under this contract shall be Class II, plenum-rated cable where required. Where subject to mechanical damage, wiring shall be enclosed in metal conduits or surface metallic raceway.

3. Data wires shall not be enclosed in conduit or raceways containing AC power wires.
 4. Where EMI may interfere with the proper operation of the DACS circuits, twisted/shielded cable shall be used.
- K. Environmental Conditions: The DACS shall be designed to meet the following environmental conditions:
1. The system shall be designed for a storage temperature of -10° C to 70°C (14° F to 158°F).
 2. The system shall be designed for an operating temperature of 0° C to 50°C (32° F to 120°F).
 3. The system shall be designed for normal operation in an 85% relative humidity environment.
 4. The system shall meet or exceed the requirements of FCC rules Title 47 C.F.R. Part 15, Class B devices, and Part 68, IEC EMC directive

2.4 ACCESSORIES

- A. System Accessories:
1. B520 Auxiliary Power Supply Module, 2A 12V
 2. B208 SDI2 8-Input Expansion Module
 3. B303 SDI2 8-Output Expansion Module
 4. D122L Dual Battery Harness, 35" 12V
 5. D1218 12V 18Ah Battery (minimum of 2)
 6. D137 Accessory Mounting Bracket
 7. D101 Enclosure Lock and Key Set (provide 5 sets of additional keys per enclosure)
 8. D110 Tamper Switch (provide 1 for each security enclosure on the project, including power supplies)
 9. D8108A Attack Resistant Enclosure
 10. D804 Transformer Enclosure Kit (one for each, security associated, wall plug transformer on the entire project)

2.5 FIELD DEVICES

- A. Keypads:
1. Keypad shall feature an illuminated touch screen and graphical interface. Each keypad shall have user adjustable options such as volume and brightness show system messages for all areas.
 2. The touch screen display shall use icons, words, numbers, and symbols to show the status of the security system and for interacting with the security system. When several events occur, the keypad shall show each event in order of priority.
 3. The keypad shall detect when a user approaches and automatically activate the display.
 4. The keypad shall be white in color
 - a. Approved Product
 1. Bosch Product No. B942 Touch Screen Keypad.
- B. Motion Detectors:
1. Detector Requirements
 - a. Detectors shall be a PIR/microwave detector unit incorporating range adaptive Doppler radar and PIR signals into an intelligent algorithm to provide accurate and reliable alarm decisions.
 - b. Detectors shall be built with a sealed optic chamber to provide immunity to drafts, insects, and small animals.
 - c. Detectors shall be designed to provide coverage in the event the microwave

- subsystem fails.
- d. A Multi-Point Anti-mask with Integrated Spray Detection system shall send a supervision trouble signal if a masking material is placed within 30 cm (1 ft.) of the detector.
 - e. Detectors shall contain light emitting diodes (LEDs) that adjust automatically to the surrounding light level. A blue LED indicates dual alarms and activates during a remote walk test. The walk test LED may be enabled or disabled from the control panel or locally at the detector via a DIP switch. A yellow LED shall indicate microwave alarms, and a red LED indicates PIR alarms.
 - f. Detectors shall provide a remote self-test function that initiates when the walk test input switches to its active state. The alarm relay and alarm LED activate for four seconds following a successful test. The trouble relay activates and the alarm LED flashes following a failed test.
 - g. Detectors shall provide input power supervision that activates the trouble relay and causes the LED to flash when the power is lower than 8 volts.
 - h. Each motion detector shall have an individually dedicated POPIT
2. Sensor Technology
- a. The detector shall incorporate sensor data fusion technology that uses an internal microprocessor to gather, analyze, and compare the data from five separate sensors to make the most intelligent alarm decisions. The data processed from the microprocessor shall be from two pyroelectric sensors, a Doppler microwave sensor, a room temperature sensor, and a light level sensor.
 - b. The detector shall also incorporate tri-focus technology that uses three high-quality Fresnel lenses with three specific focal lengths to provide long-range, middle-range, and short-range coverage. The detector shall apply the three focal lengths to 86 detection zones which combine to produce 11 solid curtains of detection. The tri-focal optics technology shall include two pyroelectric sensors which deliver twice the standard optical gain.
 - c. The detector shall provide active white light suppression capable of measuring the light intensity directed at the face of the unit, and use the data gathered by the sensors to eliminate false alarms caused by the bright light source. False alarms shall not be caused from bright light sources up to 10,000 lux.
 - d. The detector shall provide dynamic temperature compensation that adjusts the PIR sensitivity to detect human body heat accurately to avoid false alarms and deliver consistent catch performance at all operating temperatures.
 - e. The detector shall provide multi-point anti-mask with integrated spray detection, utilizing patented prism lenses and active infrared detection to provide industry-leading protection against all known forms of attack.
3. Approved Products
- a. Wall Mount Motion Detector: Bosch Product No. ISC-PDL1-WA18GB
 - b. Wall Mount Curtain Motion Detector: Bosch Product No. ISC-PDL1-WAC30G
 - c. Ceiling Mount Motion Detector: Bosch Product No. DS9370
- C. Magnetic Door/Hatch Contacts:
1. Recessed Steel Door Contacts: Interlogix Product No. 1076D-G Double Pole Double Throw
 2. Surface Mount Contacts (provide and roof hatches, gates, and any location requiring surface mounting): Bosch Product No. 2507AD-L Double Pole Double Throw
 3. Overhead Door Contacts Double Pole Double Throw: Sentrol Product no.

- 2317A or 2327A (coordinate correct contact with door channel)
4. Do not combine multiple doors onto a single POPIT. Each single and double door shall be on an individual POPIT.
- D. Sounder/Strobe Annunciation Devices - Contractor shall add an in ceiling sounder, at each exterior door location and tie back to access control system. System shall be configured to activate sounder after door has been ajar for a given time period, configurable by system settings. Sounder shall silence after door is closed and door contact closure has been initiated. Install sounder in standard electrical back box no higher than 18" above ceiling. Route wiring from sounder back to access control system and required power supplies at headend location.
1. Schneider Electric LED Unit - SQD-XVUC29
 2. Schneider Electric Sounder Unit - SQD-XVUC9S
 3. Schneider Electric Fixing Unit SQD-XVUZ0
- E. Security RF Wireless
1. Provide and install an RF Wireless System as shown on the project drawings. The Integrator shall conduct a wireless survey prior to deployment. The system shall consist of the following Gateways, Repeaters, and transmitters:
 - a. Wireless Serial Receiver Kit consisting of an EN4200 serial receiver and a Bosch B802 interface board: Inovonics Product Number ENKIT- SDI2. Locate receiver at Intrusion Control Panel Location.
 - b. High Power Repeater: Inovonics Product No. EN5040
 - c. Pendant Transmitter: Inovonics Product No. EN1223S (quantity of 10)
- F. Panic/Duress Buttons
1. Wall Mount Buttons: STI Product No. UB-1
 2. Under Counter Buttons: USP Product No. HUB3B
- G. Miscellaneous Devices:
1. POPIT Modules with Tamper: Bosch Product No. D9127T

2.6 WIRING

- A. All wiring shall be by the manufactures specifications. All cable shall be shielded as required.
- B. All 120v Power shall be furnished by the Division 26 contractor.
- C. All Security Conduit as show on the drawings shall be furnished by the division 26 contractor as part of their scope of work.
- D. Coordination with the Division 26 contractor is the responsibility of the Security Contractor to ensure all conduit is in place for a complete installation.
- E. All systems shall be connected to an emergency power source as available.
- F. Color code of all security intrusion detection system and access control wiring shall be purple in color.
Approved Products:
 1. 18/2 unshielded: Belden Product No. 6300UE or equivalent
 2. 18/2 shielded: Belden Product No. 6300FE or equivalent
 3. 18/4 unshielded: Belden Product No. 6302UE or equivalent
 4. 18/4 shielded: Belden Product No. 6302FE or equivalent

PART 3 EXECUTION

3.1 INSTALLATION

- A. All wiring shall be in accordance with the National Electrical Code, Local Codes, and article 760 of NFPA Standard 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings
- B. All wire shall be UL Listed CL2 for limited energy (300V) applications and shall be installed in conduit. Limited energy MPP wire may be run open in return air ceiling plenums provided such wire is UL Listed for such applications and is of the low smoke producing fluorocarbon type and complies with NEC Article 760 if so approved by the local authority having jurisdiction.
- C. No AC wiring or any other wiring shall be run in the same conduit as security alarm wiring.
- D. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" not to exceed 40% per NEC.
- E. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.
- F. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations such as inside walls, all mechanical / electrical rooms, or other areas where wiring might be exposed or subject to Damage.
- G. All vertical wiring and all main trunk / riser wiring shall be installed in a complete raceway / conduit system. All riser boxes shall be adequately sized for the number of conductors transversing the respective box as well as the number of terminations required.
- H. Provide a Green 4 pair Comm scope Category 6a telephone cable from the Master Control Panel to the Telephone Equipment room.
- I. 2 18-4 wires will be run from the panel to the prior designated future portable connection location and labeled in plain English on both ends. These spares are to be left above the ceiling.
- J. Each set of magnetic door contacts or glassbreaks that protect one room are to be connected through one POPIT module for point identification of that room.
- K. Magnetic door contacts protecting separate hallways or entries are to be connected into separate POPIT modules for separate identification.
- L. Provide and install (1) dedicated POPIT for each device installed on the project including but, not limited to glass break detectors.
- M. All POPIT Modules shall be installed inside a 4"x4" junction box with a cover to be mounted on the wall nearest to the device the POPIT Module is associated with. All boxes shall be labeled with the appropriate corresponding point contained within.
- N. Integrate the security system to the remote monitoring station. Provide all hardware and cabling as required. Coordinate with Owner for approved remote monitoring service.
- O. All POPIT modules on project shall be mounted above ceiling in easily accessible area.
- P. All keypads, sirens and POPEX modules shall have dedicated homeruns from each

device to the master control panel. Do not daisy chain keypads or sirens. Chaining of modules is permitted if location serves multiple areas of coverage.

- Q. All POPIT modules and power supplies are required to be located on as-built drawings delivered to owner at substantial completion of project.
- R. Contractor shall install communication wire from freezer/cooler control panels to burglar alarm via POPIT module interface to notify panel should freezer/cooler encounter high temperature condition. Coordinate programming and final terminations with Owner.
- S. All POPEX modules and power supplies shall be installed in IDF closets for that area of coverage with easy accessibility and a dedicated SDI2 homerun to the master control panel not to exceed 500ft.
- T. All device power runs shall be fused and clearly labeled in plain English at each main power source.

3.2 EXAMINATION

- A. Examine areas to receive devices and notify adverse conditions affecting installation or subsequent operation.
- B. Do not begin installation until unacceptable conditions are corrected.
- C. If preparation is the responsibility of another installer, notify architect of unsatisfactory preparation before proceeding.
- D. Ensure selected location is secure and offers protection from accidental damage.
- E. Location shall provide reasonable temperature and humidity conditions, free from sources of electrical and electromagnetic interference.
- F. Ensure power source is protected against accidental shutoff.
- G. Install all equipment and materials in accordance with the "current" recommendations of the manufacturer. The work shall also be in accordance with:
 - 1. Installation criteria defined in these specifications and in the construction documents.
 - 2. Factory Representative can be the Bosch Security Systems Inc. Security Dealer.
 - 3. Approved submittals.
 - 4. Applicable requirements of referenced standards.
- H. The contractor shall provide the following services as part of the contract:
 - 1. Supervision of sub-contractors.
 - 2. Coordination of other contractors for system-related work (electrical contractor, finish hardware contractor, architect, and general contractor).
 - 3. Attending site construction/coordination meetings.
 - 4. Keeping updated construction drawings at the construction site.
 - 5. Meeting construction deadlines per the construction schedule.
- I. Programming of the system shall include the following tasks:
 - 1. Programming system configuration parameters (hardware and software, zone/circuit numbers, communication parameters).
 - 2. Programming operational parameters such as opening/closing reports and windows, system response text (custom English) displays of events, activation of relays that

- drive auxiliary devices, and identifying types of zones/loops.
 3. Programming passcodes according to the authorities and functions defined by the owner.
 4. Other system programming tasks required by the owner. These additional programming requirements shall be coordinated between the owner and the contractor.
 5. Operational Testing: The contractor shall perform thorough operational testing and verify that all system components are fully operational.
 6. Hard-copy System Printout: The contractor shall submit a hard-copy system printout of all components tested and certify 100 percent operation indicating all devices/panels/units have passed the test criteria set forth by the manufacturer.
 7. Acceptance Test Plan Form: An acceptance test plan form shall be prepared/provided by the contractor prior to the acceptance walk-through.
 8. This form shall include separate sections for each device/panel/unit as well as a column indicating the manufacturer's performance allowance/margin, a column indicating the result of the testing performed by the contractor (pass/fail), and an empty column for recording findings during the walk-through.
 9. Fire Alarm Systems shall comply with NFPA 72 Standards for inspection, testing, and maintenance.
- J. The contractor shall certify completion in writing and schedule the commissioning walk-through. The contractor shall provide all the tools and personnel needed to conduct an efficient commissioning process.

3.3 FIELD QUALITY CONTROL

- A. Installation contractor shall submit a written test report that the system has been 100 percent tested and approved. Final test shall be witnessed by the owner, engineer, electrical contractor, chief security officer, and performed by the installation contractor. Final test report shall be received and acknowledged by the owner prior to request for final payment.
- B. Provide instruction to the owner's satisfaction with regard to proper use and operation of the system.
- C. Determine and report all problems to the manufacturer's customer service department.

3.4 ADJUSTING

- A. System maintenance and repair of system or workmanship defects during the warranty period shall be provided by the Contractor free of charge (parts and labor).
- B. Periodic testing of the system shall be carried out on a monthly or quarterly basis to ensure the integrity of the control panel, the sensing devices, and the telephone lines.
- C. The installer shall correct any system defect within six hours of receipt of call from the Owner.

3.5 DEMONSTRATION

- A. Demonstrate at final inspection that surveillance system and devices functions properly.
 1. The Contractor upon completion of installation shall furnish training in the complete operation of the systems.

3.6 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before substantial completion.

END OF SECTION 28 16 00

SECTION 28 23 00 - IP SECURITY CAMERA SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1- GENERAL

1.1 DESCRIPTION OF WORK

- A. Provide all required materials to expand the existing IP based digital video surveillance system. Contractor shall include cameras, cabling, digital image storage, integration and accessibility with Owner's Local/Wide Area Network (LAN/WAN), Internet accessibility thru remote view application software and simultaneous user access capability as required. Provide fully terminated unshielded twisted pair (UTP) cable, UTP terminations, racks, raceways, conduit, and other incidental and miscellaneous premises wiring system hardware as required for a complete and useable system. The installation shall comply with applicable codes and standards in effect at the job site and as indicated in the Specifications and Drawings. Reference technical cabling specifications for cabling requirements.
- B. Provide all electronic hardware and coordinate with the building's LAN/WAN. The contractor shall coordinate with other system vendors, where appropriate, to facilitate equipment installation, scheduling, protection of equipment and access to the project site in order to provide the Owner a substantially complete project in a timely manner.
- C. Contractor must be a current integrator of solution in the nearest, major metropolitan marketplace and be able to include information on current support staff to be able to service this client.
- D. Contractor is responsible for coordinating all electrical work required on this project for connection of servers, cameras, conduit, and power supplies. Contractor shall provide a complete turnkey solution to the owner and be responsible for the complete installation of a security camera system at each campus.
- E. **IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO PROVIDE THE LICENSING AND REGISTRATION FOR ALL EQUIPMENT INSTALLED ON THIS PROJECT.**

1.2 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. The Video Surveillance System Installer shall be licensed and shall meet all applicable regulations. The Contractor shall be a firm normally employed in the low voltage and video cabling industry.
 - 2. The contractor shall be certified by the manufacturing company in all aspects of design, installation and testing of the products described herein. Each contractor shall furnish with their submittal a letter from the manufacture indicating they are a dealer in good standing.
 - 3. The contractor must be certified by the manufacturer of the products, adhere to the engineering, installation and testing procedures and utilize the authorized manufacturer components and distribution channels.
 - 4. The contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size. The contractor shall own and maintain tools and equipment necessary for successful installation and testing of video surveillance distribution systems and have personnel who are adequately trained in the use of such tools and equipment.
 - 5. A resume of qualifications shall be submitted with the Contractor's proposal

IP SECURITY CAMERA SYSTEM

28 23 00 - 1

indicating the following:

- a. A list of five recently completed projects using the product proposed of similar type and size with contact names and telephone numbers for each.
 - b. A list of test equipment proposed for use in verifying the installed integrity of metallic cable systems on this project.
 - c. A technical resume of experience for the contractor's Project Manager and on-site installation supervisor who shall be assigned to this project.
 - d. A list of technical product training attended by the contractor's personnel that shall install the video surveillance system shall be submitted.
 - e. Any subcontractor who shall assist the video surveillance contractor in performance of this work shall have the same training and certification as the video surveillance contractor.
- B. The Owner's representative reserves the right to reject all or a portion of the work performed, either on technical or aesthetic grounds.

1.3 REGULATORY REQUIREMENTS

- A. Standards: All work shall be performed in accordance with the latest revisions of the following standards and codes:
1. Local Building Code
 2. Local Electrical Code
 3. NEC National Electrical Code
- B. Other references:
1. TIA/EIA-568-A - Commercial Building Telecommunications Wiring Standard
 2. EIA/TIA-569 - Commercial Building Standard for Telecommunications Pathways and Spaces.
 3. TIA/EIA-606 - The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
 4. TIA/EIA-607 - Commercial Building Grounding and Bonding Requirements for Telecommunications
 5. TIA/EIA TSB 67 - Transmission Performance Specification for Field Testing of Unshielded Twisted-Pair Cabling Systems.
 6. ISO/IEC 11801 - Generic Cabling Standard
 7. EN 50173 - Generic Cabling Standards for Customer Premises
- C. Governing Codes and Conflicts: If the requirements of these specifications or the Project Drawings exceed those of the governing codes, regulations, and manufacturer installation requirements, then the requirements of these specifications and the drawings shall govern. However, nothing in the drawings or specifications shall be construed to permit work not conforming to all governing codes, regulations, and manufacturer installation requirements.

1.4 SUBMITTALS

- A. The video surveillance system installer shall furnish all CCTV system submittals in a single consolidated submittal
- B. Shop Drawings: Submit the following items, for Owner review and approval:
1. Samples: Complete manufacturer's product literature and samples (if requested) for all pre-approved substitutions to the recommended products made during the course of the Project.

2. Permits: The Contractor shall obtain all required permits and provide copies to the Owner/Architect/Engineer
 3. Product Literature: Complete manufacturer's product literature for all electronics, cable, cable supports, cable labels, outlet devices, and other products to be used in the installation. In addition, whenever substitutions for recommended products are made, samples (when requested by the Owner/Architect/Engineer) and the manufacturer's supporting documentation demonstrating compatibility with other related products shall be included.
 4. Testing: Proposed Contractor test result forms, a list of instrumentation to be used for systems testing.
 5. A complete point-to-point floor plan diagram indicating camera locations and all required cabling to connect systems.
- C. Project Completion: As a condition for project acceptance, the Contractor shall submit the following for review and approval:
1. Inspection and Test Reports: During the course of the Project, the Contractor shall maintain an adequate inspection system to ensure that the materials supplied and the work performed, conform to contract requirements. The Contractor shall provide written documentation that indicates that materials acceptance testing was conducted as specified. The Contractor shall also provide documentation, which indicates that all cable termination testing was completed and that all irregularities were corrected prior to job completion.
 2. Operating and Maintenance Instructions for all devices within the system. These instructions shall reflect any changes made during the course of construction, and shall be provided to the Owner, for their use, in a three-ring binder labeled with the project name and description. (4 copies)
 3. All training sessions with district staff and training media shall be complete.
 4. As-built Drawings shall include cable pathways, camera locations with correct labeling and MDF/IDF locations. The as-built drawings shall be prepared using AutoCad V. 13 or later. Provide the Owner with electronic versions of the as-builts on 2 qty. 8MB thumb drives.

PART 2 PRODUCTS

2.1 VIDEO SERVER SOFTWARE (IP SERVER)

1. IP Server shall be designed to run on a Windows platform, supporting both Desktop and Server class operating systems including Windows 7, 10 (Pro), 2008 R2, 2012, 2016 and 2019.
2. It shall run as a Window's Service. This service shall run as part of the local service account. This service shall be running as long as the system is booted and has started Windows. It shall not require the user to be logged in.
3. It shall store settings in SQL Express and shall not require a full MS-SQL license.
4. It shall have an option for a 32-bit binary and a true 64-bit binary. In a 64-bit OS, it shall run as a native 64-bit application, not merely a 32-bit application.
5. The service shall connect to the camera and handle streaming to the server. It shall not require each client to connect to individual cameras.
6. This service shall allow the cameras to be placed on one network and the clients on a separate network using a different IP range.
7. The software shall support the ONVIF standard.
8. The software shall support Megapixel virtual cameras within a single camera license.
9. IP Server shall record the video streams from different cameras.
 - a. For MPEG-4 based cameras, the video shall be stored in the native codec of the server.

- b. For H.264/H.265 based cameras the video shall be stored in the native codec of the server.
 - c. Each camera will have the option to be able to be stored in different locations
 - d. Streaming from server to client shall support H.264/H.265.
 - e. The server must have Pivot 3 integration.
10. IP Server shall support H.264/H.265, MPEG-4, MJPEG and MXPEG based cameras.
11. IP Server shall support motion detection at the camera and at the software levels.
12. IP Server shall provide graphic examples of what it determines as motion to thick clients if the thick client requests it.
 - a. The software shall display the motion detection as an outline around the area moving.
 - b. The software shall provide a bar showing the total percentage of change. This bar shall have a slider on it to allow the user to quickly set motion detection.
13. IP Server shall allow for multiple zones to be set within an image that support differing motion detection values within a cameras field of view.
 - a. There shall be no limit on the total number of zones allowed, either on a per camera or per server basis.
 - b. Zones should allow the ability to ignore motion within an area.
 - c. The user shall have the ability to move the zones after the fact.
 - d. Motion zones shall be able to be tied into a rules engine to allow the software to use them as triggers for events.
14. IP Server shall support the use of imported maps to show camera placement. The formats for these maps will be JPG, GIF or BMP as determined by the user.
 - a. Hovering over a camera on a map shall cause it to be displayed in a window on the side.
 - b. When the camera is displayed on the side, the option to review recently recorded video will be available to them.
 - c. The user shall be able to embed layouts onto the facility map. Clicking on the layout shall change the display of the client software.
 - d. Alarms from DIOs shall be able to be embedded as well.
 - e. Audio sources shall also be an option.
 - f. Other facility maps shall also be an option to embed. Clicking on a different embedded map shall bring up that map.
 - g. Doors from certain access control systems can be imported and displayed. Hovering over the door shall display the last badge used to badge in, a live view of the camera associated with the door. The user from this pop up shall be able to see badge events and alarm events along with the associated video.
15. IP Server shall not require the administrator to contact the manufacturer to replace a camera.
16. IP Server shall support reporting to a diagnostic tool:
 - a. Number of active cameras.
 - b. Active cameras offline.
 - c. Version of the server.
 - d. Amount of disk space left.
 - e. Recording status of the server.
17. IP Server shall support pre-motion and post motion recording.
18. IP Server shall support various layouts. The layouts will allow for blank spaces within the layout.
19. IP Server shall support an unlimited number of users:
 - a. Users can be drawn from either an Active Directory server, Novell eDirectory, or entered manually.

- b. There will be two different levels of user (Administrator and User).
 - c. Users can be members of a group with settings set for the group. Individual user settings can override the group settings.
 - d. Permissions can be set for live viewing, access to recorded video, control of PTZ cameras, access to audio, the ability to export video, custom layouts, facility maps and rules. Permissions can be defined on a per camera basis.
 - e. It shall support the option of having the users limited to being signed into a single location.
20. IP Server shall include a diagnostic version with limited interface, to allow for testing of the server.
21. It shall support an optional secondary server with failover capacity.
22. A rules engine shall be included to allow the server to handle more complex tasks.
- a. Triggers will include:
 - 1. Dry contacts (DIO).
 - 2. Motion detection of a camera stream.
 - 3. Video Analytics event of a camera stream
 - 4. Scheduled events. Events can be scheduled on daily, weekly, or monthly basis. Individual events can be handled as well.
 - 5. An Alert button for the user interaction in the VI Monitor.
 - 6. Inputs sent programmatically via appropriate APIs.
 - 7. Access control events from supported Access Control Vendors.
 - 8. LPR events.
 - 9. User login events.
 - b. Actions will include:
 - 1. Logging the event.
 - 2. Opening or closing a dry contact.
 - 3. Sending an e-mail with a custom text message tied to the trigger. Multiple texts will be allowed for different triggers.
 - 4. Sending an e-mail with an AVI/MP4 clip from a selected camera.
 - 5. Sending an e-mail with a JPG file of a selected event from a camera.
 - 6. Opening a live window for a user who is viewing.
 - 7. Move a PTZ to a certain preset location.
 - 8. Force recording.
 - 9. Force recording with audio.
 - 10. Instant Replay.
 - 11. Sending video to a Network Decoder.
 - 12. Switching single camera or layout views.
 - 13. Message Instruction.
 - 14. Moving, copying, or deleting of files.
 - 15. Execute a program or batch file.
 - 16. Send an ASCII string to a TCP port.
 - 17. Change the state of the door
 - 18. Send an HTTP command to a specific device.
 - 19. Displays alarm window for client within Workspaces and Message Display
 - 20. Audio alert for a specified Client.
 - 21. Switch viewing field to a specific camera, capable of audio recording.
 - 22. Create time-lapse recordings (very low frame rate).
 - 23. Mask / unmask monitor points
23. IP Server shall support time out functionality.
24. The IP Server software shall support generic RTSP connections
25. PTZ functionality within the camera shall be supported.

26. Dewarping of Panoramic shall be supported for the following manufacturers:
 - a. Advidia
 - b. AMG
 - c. Axis
 - d. Oncam
 - e. Pelco
 - f. Panasonic/ i-PRO
 - g. Sentry 360
 - h. Uniview
 - i. Vivotek
 - j. Dlink
 - k. Dynacolor
 - l. EverForcus
 - m. GridSmart
 - n. IDIS
 - o. ACTi
 - p. GeoVision
 - q. Hanwha
 - r. Samsung
 - s. ImmerVision
27. IP Server shall only stream video to the clients that requested them.
28. If live video is paused, then IP Server shall stop streaming video to the clients to conserve bandwidth.
29. IP Server shall support integration with various access control platforms, including:
 - a. Imron
 - b. MonitorCast v.3 and 4
 - c. AMAG
 - d. Badge Pass
 - e. Blackboard
 - f. Continental
 - g. Infinias
 - h. Isonas
 - i. Lenel
 - j. Paxton
 - k. CCURE
 - l. DSX
 - m. Gallagher
 - n. Maxxess
 - o. RBH
 - p. S2
 - q. Open Options
 - r. Sureview
30. With Isonas, MonitorCast v.4 and Paxton, IP Server shall allow for importing the doors from those systems and respond to events in the VMS software along with basic door control.
31. IP Server shall have support panic button functionality through rules engine.
32. IP Server shall support integration with i-PRO BWC MK3 and BWC4000 Body cameras. The integration must be to automatically retrieve a recorded video in BWC to IP Server.
33. IP Server shall support integration with Halo Smart Sensor which can detect Vape, Temperature and Gunshot etc. The alarm shall be used as Rule Trigger and be able to make a Rule action.

34. IP Server shall support integration with OPTEX Laser sensor which can detect Vape, Temperature and Gunshot etc. The alarm shall be used as Rule Trigger and be able to make a Rule action.
35. IP Server shall support integration with Network speaker.
36. IP Server shall support Shard DB environment and allow user to login to all managed IP Servers by single IP Server credential input.
37. IP Server shall have a capability to store and search User Audit log such as camera control, configuration update (including camera, map, server rule, user and view), force record, Guard Tour, Live Viewing, login/out, export video clip and playback.
38. The User Audit log shall be able to be exported.
39. IP Server shall have an option to allow user to login from only one client.
40. IP Server shall support HTTPS communication including video streaming with camera. And i-PRO camera's pre-installed certificate can be verified.

2.2 WINDOWS CLIENT

1. VI MonitorPlus will be a thick client for viewing live and recorded video, along with handling administrative tasks.
2. The software shall not require a client license to operate.
3. The thick client shall support an encrypted XML file for storing settings. The file can be set up to be shared between many clients, allowing the administrator to update all clients with a single file push.
4. Clients shall be able to use Active Directory to authenticate users.
5. Clients shall be able to use Novell E-directory to authenticate users.
6. VI MonitorPlus shall have a searchable timeline for multiple events:
 - a. Motion.
 - b. Access Control.
 - c. Rules.
 - d. LPR (License Plate Recognition).
 - e. VCA (Video Content Analytic).
7. VI MonitorPlus shall display the servers it is connected to along with the server's cameras in a tree view on the left-hand side:
 - a. The tree view shall allow the user to see the status of the servers that the instance of VI MonitorPlus is aware of.
 - b. The tree view shall also include access to custom layouts, facility maps and action buttons.
 - c. There shall be an option to hide the tree on startup of VI MonitorPlus.
 - d. The user shall be able search for cameras using a searchable box on the left-hand tree.
8. The thick client shall not be limited in the number of servers it can connect to.
9. Live view shall allow views of 1, 2, 4, 8, 9, 10, 13, 16, 18(wide), 19, 24(wide), 25, 36, 48 and 64 cameras. A widescreen option for 18 and 24 cameras shall also be available:
 - a. Layouts shall be selectable via icon.
 - b. Layouts shall not be limited to cameras from a single server.
 - c. Users shall be able to get layouts to cycle in the client's workspaces.
 - d. Layouts shall be able to be put into groups.
10. If motion is detected on a camera, the software shall have the option to indicate it by highlighting the edge of the live window.

11. Live view shall allow cameras to be dragged and dropped onto the live view from the left-hand tree. Cameras can be duplicated in a view.
12. Users shall be able to invoke a digital zoom by drawing a box.
13. After invoking the digital zoom, VI MonitorPlus shall support the use of picture in picture within the zoomed image.
14. Digitally zoomed areas shall be treated as a digital PTZ.
15. PTZ Presets shall be listed in a drop-down menu in the Dynamic Tab.
16. Users shall be able to move the PTZ movements simply by clicking on the image, through onscreen PTZ controls. Zoom functionality can also be controlled via the scroll wheel of the mouse.
17. Live view shall support a full screen mode that hides the UI. User shall be able to start VI MonitorPlus in this full screen mode with a setting.
18. Live view shall allow the user to dewarping the video from panoramic lenses and cameras.
19. Right clicking on a camera in live view shall have the following behaviors:
 - a. Right-clicking on a camera within live view shall allow the user to be able to review the recently recorded video for that camera.
 - b. Right-clicking on a camera within live view shall also allow access to the properties dialog box for that camera.
 - c. Allowing access to recorded video.
 - d. Right-clicking on the Camera tile shall allow the users to send video or messages to other users or Video wall in the form of a popup window.
20. VI MonitorPlus shall have a control panel inside of camera view and allow the below controls:
 - a. Save a still image of the live view.
 - b. PTZ control.
 - c. Display video streaming information on video.
 - d. Force recording.
 - e. Show bounding box of detected objects such like people, vehicle, and face etc. by resulting video analytics.
 - f. Auto focus.
21. Up to 16 Recorded video Synchronized playback shall allow for cameras to simply be dragged and dropped into the player.
22. The exporting of video in VI MonitorPlus shall have Region of Interest capability within a recorded image. This will enable segregation of image for export.
23. VI MonitorPlus shall be able to display logging information such as: changes to the server, lost camera signals, who exported recorded video, when did users log-on/off and other errors. This functionality will be limited to administrative users. The log will be exportable as txt or to the Windows clipboard.
24. VI MonitorPlus shall also provide real time status updates for server status and camera status, including the CPU usage, disk usage, bandwidth usage, licensing and number, motion event, edge storage, and names of users who are logged in.
25. The system shall support an Alarm Log to make it easier to find DIO based events.
26. Facility maps shall be available in the software for viewing:
 - a. When the user hovers over a camera in the facility map it shall display the camera in a window off the side of the map.
 - b. While a camera is displayed it shall allow access to recorded video from that camera as well as the live stream.
 - c. Cameras shall display where they are pointed.
 - d. Embedded layouts shall change the layout of VI MonitorPlus if they are clicked on.

- e. Embedded Facility maps shall cause the current map to change to the embedded map if clicked on.
 - f. The user shall have the option of importing and placing doors from supported access control partners on the map. This shall allow them to see badge events as well as alarm events. It shall also support the ability to lock and unlock doors from the map.
 - g. Integrated Panic button events will be visible on the facility map.
27. VI MonitorPlus will support the DCZ Joystick, i-PRO WV-CU950&WV-CU980, and as well as standard USB joysticks.
28. The software shall support the ability to open a live window that can be moved around. This window will be able to access the view of any camera or layout the user has access to.
29. VI MonitorPlus shall support multiple screen user environments for dynamic user interface.
30. The user shall be able to enable or disable the following settings:
- a. Server name in the live view.
 - b. Camera Name in the live view.
 - c. Audio notification on motion.
 - d. Forcing aspect ratio.
 - e. Use Direct Show for display.
 - f. Double clicking to change the server layout.
 - g. Double clicking expands the camera.
 - h. Allowing multiple live windows.
 - i. Block live windows from popping up.
 - j. Live window always on top.
 - k. The speed in which layouts cycle.
 - l. Hiding left tree on start up.
 - m. Launching Facility maps on start up.
 - n. Auto login.
 - o. Select Startup View.
31. Users with Administrator privileges shall be able to configure the server and camera settings. Users will also be able to test SMTP settings and database settings:
- a. Users shall be able to configure the framerate of the camera, including the option to have the server record continuously from 1 to 3 fps with the option to go to the cameras designated frame rate on motion detection.
 - b. Users shall be able to select various time-lapse options for the camera.
 - c. Users shall be able to select the camera stream type.
 - d. Users shall be able to select camera or server-side motion detection.
32. Users shall be able to access a graphic representation of what the server's motion detection settings are picking up through the timeline. Analytics and bookmark also can be display in a timeline.
33. Users shall be able to configure user settings as well as layout settings from within the thick client.
34. VI MonitorPlus shall allow users to send video to other users who is using VI MonitorPlus, allowing for remote live pop ups of video of important events.
35. VI MonitorPlus shall allow users to send video or video view to Video Wall application.
36. VI MonitorPlus shall support Layout touring. Selecting a layout will cycle through a list of cameras.
37. VI MonitorPlus shall allow Region of Interest searches (a.k.a. Smart Search functionality).

38. VI MonitorPlus shall support quad mode and double panorama mode dewarping for supported 360 degrees cameras. And these dewarping mode shall be changed easily by clicking control icons.
39. VI MonitorPlus shall support 3D dewarping for i-PRO 360 degrees cameras.
40. VI MonitorPlus shall have a capable to playback a video of cameras which are under embedded recorder.
41. VI MonitorPlus shall have a capable to install Plug-in and open the Plug-in form in workspace.
42. VI MonitorPlus shall have a capability to configure AI-VMD analytics setting of i-PRO AI camera. The configuration shall be set via IP Server.

2.3 WEB CLIENT

1. The Web Client shall support Chrome, and Microsoft Edge browsers.
2. The Web Client shall not be limited to only Windows platforms.
3. The Web Client shall not require a license for basic features.
4. The Web Client shall allow user to login single server or multiple servers.
5. The Web Client shall allow to be used by Active Directory users and group users.
6. The Web Client shall be able to display compressed streaming which are MJPEG, H.264 and H.265 without server-side decoding or Active X.
7. The Web Client shall have an option to select the streaming type which are MJPEG and MP4.
8. The Web Client shall have an option to select the video display type which are the maintain aspect ratio, the stretch and the actual size.
9. Web Client users shall be able to select layouts for live viewing, individual cameras, or groups of cameras.
10. Web Client users shall be able to search camera, server, view and map by filling characters.
11. Web Client users shall be able to access recorded video.
12. The Web Client shall be able to highlight days on the calendar if there is a recorded video.
13. Web Client users shall be able to download recorded video from the system.
14. Web Client users shall be able to use the motion log or timeline to find recorded video.
15. The Web Client shall support the use of facility maps and allow to show Live and Playback from a camera icon on the facility map.
16. Web Client users shall be able to see live video in hover when mouse over a camera icon on the facility map.
17. Web Client users shall be able to zoom in and out the facility map.
18. The Web Client shall use IIS as its web server.

2.4 HEALTH MONITOR

1. Health Monitor shall listen for reports given by the VMS server as to its status.
2. If Health Monitor detects anything abnormal, it will give a visual display through a web front end, or by sending out an e-mail to one or more users.
3. The status of VMS servers and cameras shall be summarized in the web front end.
4. The server's up/down status detail shall be displayed with resource status such as CPU usage, memory usage and free storage space.

5. CPU usage, Memory usage and Free disk space shall be able to be confirmed as graphical diagram.
6. The camera's up/down event shall be displayed in the event list. And the detail information of cameras shall be displayed, which are Maker, model, resolution, framerate, bandwidth and last writing/receiving time.
7. It shall be hosted locally or across the internet.
8. The Health Monitor software shall run as a service.
9. Health Monitor shall allow user to reset a password.
10. VMS server shall be enrolled via a web front end.
11. VMS server shall be able to be enrolled by using a bulk import.
12. Current status report shall be exported as CSV/PDF/HTML.
13. Transaction report shall be exported as CSV/PDF/HTML.

2.5 VIDEO WALL

1. Video WallPlus shall support an unlimited number of monitors.
2. Video WallPlus shall support up to four monitors per workstation.
3. Video WallPlus shall support live view (Single/Multi).
4. Video WallPlus shall support cycle view for configured layout.
5. Video WallPlus shall allow to setup display view per monitor.
6. Video WallPlus shall allow to show views of 1, 2, 4, 8, 9, 10, 13, 16, 18(wide), 19, 24(wide), 25, 36, 48 and 64 cameras.
7. The user shall be able to send a camera view to the display of Video WallPlus via the VI MonitorPlus.
8. The user shall be able to control the monitor display and PTZ camera position by i-PRO network Joystick.
9. Video WallPlus shall be able to make direct camera connects.
10. Video WallPlus shall support failover.
11. Video WallPlus shall be able to receive second streaming as low resolution.
12. Video WallPlus shall be able to indicate recording status.
13. Video WallPlus shall have option to select to use hardware decoding.

2.6 IOS MOBILE APPLICATION

1. The iPhone/iPad application shall not require a license to operate.
2. The App shall have access to live and recorded video.
3. PTZ functionality shall be available in the App.
4. Facility map functionality shall be available.
5. Snapshots shall be able to be e-mailed from the App.
6. The app shall provide optional access control functionality.
7. The app shall provide multi-camera views
8. The app shall stream H.264, H.265, and JPEG video.

2.7 ANDROID VI MOBILE PLUS

1. The Android application shall not require a license to operate.
2. The App shall have access to live cameras.
3. PTZ functionality shall be available in the App.
4. The App shall have access to recorded video.

5. Facility map functionality be available.
6. The app shall provide optional access control functionality.
7. The app shall stream H.264 and JPEG video.

2.8 APPLE TV APPLICATION

1. The Apple TV application shall have access to live cameras.
2. The Apple TV application shall have access to recorded video.
3. The app shall require an internet connection.
4. The app shall require a license per server; number of Apple TVs is not limited by license.
5. The app shall make available camera tours.
6. The app shall stream H.264, H.265, and JPEG video.
7. The app shall provide dewarping for fish-eye cameras.
8. The app shall provide multi-camera views.
9. The app shall allow users to create their own multi-camera views and camera tours and store them in their iCloud account.
10. The app shall provide search functionality for cameras, views, and tours.
11. The app shall allow users to select cameras, views, and tours as favorites for quick access.
12. The app shall allow users to select a camera, view, or tour as default start-up content.

2.9 MAC CLIENT

1. The app shall not require a license.
2. The app shall have available live and recorded video.
3. The app shall stream H.264, H.265, and JPEG video.
4. The app shall include PTZ functionality.
5. The app shall create snapshots.
6. The app shall include multi-camera views up to 64 cameras per view.
7. The app shall include access control functionality.
8. The app shall include available facility maps.
9. The app shall include audio support for live and recorded video.
10. The app shall dewarp fish-eye cameras (quad mode, single quadrant mode, single and double panorama modes).
11. The app shall include a timeline.
12. The app shall include video clipping.
13. The app shall include synchronized playback.
14. The app shall allow users to create desktop views and save them as default start-up content.
15. The app shall allow users to create and view bookmarks.

2.10 VIDEO ANALYTICS APPLICATION, MULTI-AI

1. The VMS shall provide a Multi-AI System solution that supports cutting edge intelligent search with the combination of i-PRO camera and deep learning technology.
2. The Multi-AI System shall be structured mainly by the Multi-AI server, the i-PRO camera that has deep learning technology, the Multi-AI Plug-in that can be installed to VI MonitorPlus and IP Server.
3. The Multi-AI System shall not require a license to operate.

4. The Multi-AI server shall be designed to run on a Windows platform, supporting both Desktop and Server class operating systems including Windows 10 (Pro), 2016 and 2019.
5. It shall run as a Window's Service. This service shall be running as long as the system is booted and has started Windows.
6. It shall store settings and detected objects which are best shot images and metadata captured by i-PRO network cameras in SQL Server 2014/2016 Express/Standard Edition.
7. The Multi-AI server shall have the option to be installed with VI IP Server or in dedicated server.
8. The Multi-AI System shall work with the Multi-AI Plug-in software that is installed in VI MonitorPlus..
9. The Multi-AI server shall store face watch list up to 1,000, and person watch list up to 12. These list shall be used to detect a person in Live monitoring.
10. The Multi-AI System shall collate metadata with the watch list registered in the client software and issues an alarm when a match is found.
11. The Multi-AI Plug-in shall be able to search recorded best shot thumbnails with specified conditions by using search filter:
 - a. Face best shot.
Registered face shall be used as filter.
 - b. Person best shot.
Gender, Age, Hair type, Hair color, Top type, Top color, Bottom type, Bottom color, Sunglasses, Beard, Mask and Moving Direction shall be used as filter which is included or excluded. And the threshold shall allow to be changed per search.
 - c. Vehicle best shot.
Car Type, Color and Moving direction shall be used as filter which is included or excluded. And the threshold shall allow to be changed per search.
12. The client software shall monitor live events and search past events with specified conditions by using search filter:
 - a. AI Face Detection, which a registered face is detected.
 - b. AI People Detection, which a registered watch list is detected.
 - c. AI-VMD (Intruder/Loitering/Cross line/Direction).
 - d. AI Sound Classification (Gunshot/Yell/Vehicle horn/Glass break).
13. The Multi-AI Plug-in shall playback a detected object. And the playback shall be continuing or repeating the recorded video.
14. The Multi-AI System shall provide mobile solution (VI Guard) for iOS and Android.
15. The VI Guard shall be able to connect Multi-AI System via Wi-Fi or Cellular network.
16. The VI Guard shall allow users to search an interested person or vehicle by filtering cameras and object appearance.
17. The VI Guard shall receive and display a notification for each alarm.
18. The VI Guard shall allow user to show a camera location on map.
19. The VI Guard shall allow user to show live & playback for camera that had an event.
20. The Multi-AI Plug-in shall be able to send a message with detected object to VI Guard.

2.11 ANALYTICS SYSTEM INTEGRATION

1. The VMS shall be integrated with the below analytics system or application:
 - a. i-PRO FacePro.
 - b. i-PRO Vehicle Search.

- c. BriefCam
- d. ZeroEyes.

2.12 TRANSIT MOBILE SOLUTION

1. Transit mobile solution shall be structured by transit mobile recorder and depot server.
2. Transit mobile solution shall be able to be integrated into a fixed surveillance system. And the client shall manage both transit and fixed surveillance system as one client.
3. Transit mobile recorder shall be able to store a video in local storage and shall be able to transfer a recorded video to a depot server.
4. The client shall have a capability to show a history of the transferred videos.
5. The transferred video shall be able to playback in VI MonitorPlus that connects to a depot server.
6. During transferring a video, the status shall be able to be checked in % per a video file.
7. When a transferred video playback, the video shall be confirmed with Live map so that user can see a location that a video recorded.
8. If transit mobile recorder or connected network has cellular network like LTE, the client shall show the location of the transit mobile recorder in live.
9. And if the mobile recorder is accessible from depot server, the live video shall be able to be displayed in the VI MonitorPlus. As default, the live video shall be low resolution, but can be changed to high resolution as on-demand.
10. The transferred video shall be searched based on location in Live map.
11. The software of the transit mobile recorder shall be able to be updated automatically based on the configuration of depot server.
12. Dashboard shall show the enrolled buses status including Server's CPU usage, memory usage, storage usage and Cameras status.
13. The dashboard information shall be able to be exported. If the transit mobile recorder has i-PRO cameras, the serial number shall be exported.
14. The transit mobile recorder shall have Digital input, and it shall be used for making a recording trigger. And the recorded video by the Digital input trigger shall be able to be transferred to depot server automatically.

2.13 DIGITAL NETWORK VIDEO RECORDERS (NVR)

- A. Standard Hardware Components: With the exception of custom video capture hardware, Image Servers must employ industry standard PC architecture, and must be comprised of replaceable standard parts including:
- B. The contractor shall provide and install Video Insight i-PRO Network Video Recorder (Model # NVR-RL-20TB-V4)
 - a. Typical quantity of NVR per campus type as follows:
 - i. Three (3) per Middle School/Junior High Scholl Campus.
- C. Acceptable Manufacturer for Network Video Recording Units
 - a. Video Insight i-PRO
 - b. **NOTE: It is the Contractor's responsibility to provide additional NVRs as required where the camera view count exceeds 64 per NVR.**

- D. Contractor shall label all NVR units (front and back) as per district naming convention. Coordinate name of NVR units with owner prior to any NVR configuration or installation of equipment.
 - a. Contractor to create and assign pools to for each NVR. Pools drive letters shall be labeled "I".
 - b. Contractor to load and unload ISCSI initiator on NVR and configure the NVR to communicate with the storage array.
- E. Provide all required mounting hardware and adaptors as required to properly install NVRs in the MDF / IDF rack.

2.14 CAMERAS

- A. *Camera Environmental Housing Power Supply:*
 - 1. Provided for powering of camera environmental housings.
 - 2. Power supplies mounted in IDF or MDF.
 - 3. Route cable from camera to nearest power supply unit.
 - 4. PoE customer provided.
 - 5. All gymnasium cameras shall be wall mounted unless otherwise noted. Provide clear, polycarbonate protective cover.
 - 6. All exterior cameras shall be wall mounted unless otherwise noted.

2.15 ACCEPTABLE PRODUCT:

- A. **Approved product: iPRO only.**
 - 1. Provide as shown on drawings.
 - 2. Provide all requisite back boxes, mounting brackets, pendant kits, bracket wall accessories and IP51 rated drop ceiling kits.
 - a. TYPE 1 – iPRO M-87-V
 - b. TYPE 2 – iPRO WV-S8543L
 - c. TYPE 3 – iPRO WV-S8574L
 - d. TYPE 4 – iPRO M-45-FW V2
- B. Model numbers and manufacturers included in this specification are listed to establish a standard of product quality and the desired standards for District facilities. It is the responsibility of the installation contractor to coordinate with telecommunications cabling and district network providers for the correct cabling and hardware requirements of the equipment being provided.

2.16 BUILDING SURVEILLANCE OUTDOOR ENVIRONMENTAL CAMERA HOUSING:

- A. Provide a weather resistant Nema 4X rated enclosure construction of aluminum bracket, acrylic and UV stable plastic.
- B. Internal dimensions: accommodate camera, lens and serving cables.
- C. Provide with thermostatic controlled blower and heater.
- D. Provide UV protection rating UL flame rating of 94V0.
- E. Provide weatherizing mounting as required for network cable entry and connection to maintain network 6 classification,

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Cable Pathway:
 - 1. In suspended ceiling and raised floor areas where duct, cable trays or conduit are not available, the Contractor shall bundle, in bundles of 25 cables or less, with cable ties snug, but not deforming the cable geometry. Cable bundles shall be supported via "J" hooks attached to the existing building structure and framework at a maximum of five (5) foot intervals. Plenum rated cable ties shall be used in all appropriate areas. The Contractor shall adhere to the manufacturer's requirements for bending radius and pulling tension of all cables.
 - 2. Cables shall not be attached to lift out ceiling grid supports or laid directly on the ceiling grid.
 - 3. Cables shall not be attached to or supported by fire sprinkler heads or delivery systems or any environmental sensor located in the ceiling air space.
- B. Fire Wall Penetrations: The Contractor shall avoid penetration of fire rated walls and floors wherever possible. Contractor shall also seal all floor, ceiling and wall penetrations in fire or smoke barriers and in the wiring closet.
- C. Wall Penetrations: Where penetrations are necessary, they shall be sleeved with metallic conduit and resealed with an Underwriter Laboratories (UL) approved sealant.
- D. Provide three sided pre-finished metal hood and seal to wall where conduit penetrates exterior wall.
- E. Install new conduit on portable pipe supports – (low profile type), as manufactured by Portable Pipe Hangers or Advanced Support Products. Provide roof protection pads under each support. Coordinate location and routing with design engineer prior to rough-in or installation of system.
- F. Do not install wall mounted cameras into metal fascia. Ensure they are mounted into brick, and sealed top and sides (not bottom)

3.2 EQUIPMENT RACK CONFIGURATION

Cable Placement: Cable installation in the wiring closet must conform to the Project Drawings. All cabling shall be routed so as to avoid interference with any other service or system, operation, or maintenance location. Avoid crossing areas horizontally just above or below any riser conduit. Lay and dress cables to allow other cables to enter the conduit/riser without difficulty at a later time by maintaining a working distance from these openings.

Cable shall be routed as closely as possible to the ceiling, floor or corners to ensure that adequate wall or backboard space is available for current and future equipment. All cable runs within the wiring closet shall be horizontal or vertical within the constraints of minimum cable bending radii. Minimum bend radius shall be observed. Cables shall not be tie-wrapped to electrical conduit or other equipment.

All incoming cables shall be routed on the cable tray and neatly dressed down to the patch panels.

3.3 WIRING INSTALLATION

- A. General:
 - 1. Cabling between wiring closet and camera locations shall be made as individual home runs. No intermediate splices may be installed or utilized between the wiring closet and the camera location.

2. All cable must be handled with care during installation so as not to change performance specifications.
- B. Exposed Cable: All cabling shall be installed inside walls or ceiling spaces whenever possible. Exposed cable shall only be run where indicated on the Drawings. Additional exposed cable runs shall require Owner approval, and shall only be allowed when no other options exist. Cabling shall be installed concealed at all times, except in unfinished mechanical rooms or wiring closets where cable shall be installed exposed and located to avoid conflicts with pass-through cabling, etc. Tie wraps shall be used to provide a neat appearance. Provide "D" rings or the appropriate cable guides to dress the cable.
- C. Placement: All cabling and associated hardware shall be placed so as to make efficient use of available space. All cabling and associated hardware shall be placed so as not to impair the Owner's efficient use of their full capacity.

Cable Routes: All cabling placed in ceiling areas must be in conduit, cable tray, or J-Hooks. Cable supports shall be permanently anchored to building structure or substrates. Provide attachment hardware and anchors designed for the structure to which attached and that are suitably sized to carry the weight of the cables to be supported. Attaching cable to pipes or other mechanical items is not permitted. Use J-Hooks for up to 15 cables (Caddy CAT 21 or CAT 32 hooks with appropriate brackets). All runs of sixteen (16) or more cables, provide cable individually supported support loops on 5' on center maximum centers to hang cable. Cable shall be routed so as to provide a minimum of 18" spacing from light fixtures, sources of heat, power feeder conduits and EMI sources. Cabling shall not be attached to ceiling grid support wires. Cable runs shall be parallel or perpendicular to building structure. Multiple cables to be banded together every 6 feet.

3.4 DOCUMENTATION

- A. Labels: The Contractor shall label all outlets using permanent machine engraved labels approved by the Owner. Label patch panels in the wiring closet to match those on corresponding camera locations. The font shall be at least one-eighth inch (1/8") in height, block. All labels shall correspond to as-builts and to final test reports.
- A. Contractor shall ensure complete typed labeling of all cameras with numbers that correspond to locations on video server. Labeling system shall correspond to the Owner's labeling system. Verify with Owner. Provide tags (black letters on white labels, plastic coated) on all cables and outlets.
- C. All cables shall be labeled at both ends with a machine label and all terminations shall be stenciled with a typed label for quick circuit identification. Labeling shall conform to TIA/EIA standard 606 and include interconnect cable identification numbers.
- D. A floor plan, clearly labeled with all numbered camera locations, shall be included in the as-built plans.

3.5 CABLE TESTING - BY MANUFACTURER'S REQUIREMENTS

- A. Notification: The Owner/Architect/Engineer shall be notified one week prior to any testing so that the testing may be witnessed.
- B. Final Acceptance: Before requesting a final acceptance, the Contractor shall perform a series of end-to-end installation performance tests. The Contractor shall submit for approval a proposal describing the test procedures, test result forms and time table for all copper and fiber optic cabling.

- C. Procedures: Trained personnel shall perform all testing. Acceptance of the test procedures discussed below is predicated on the Contractor's use of the recommended products and adherence to the inspection requirements and practices set forth. Acceptance of the completed installation shall be evaluated in the context of each of these factors.
- D. Errors: When errors are found, the source of each error shall be determined, corrected and the cable retested. All defective components shall be replaced and retested. Retest results must be entered on the test results form. All corrections shall be made prior to final acceptance test.

3.6 INSPECTION

- A. Conformance to the installation practices covered above are to be verified when completed. In some cases, the Owner/Architect/Engineer may observe before acceptance.

3.7 WARRANTY

- A. Guarantee and warrant all equipment provided for a period of **3 years** following date of substantial completion, or a period equal to the stated guaranty/warranty offered by the product manufacturer, whichever is the longest in duration.
- B. All such warranties shall include all parts (Cameras, encoders, power supplies, housings, etc.).
- C. Labor and all other costs as necessary to maintain the equipment in operating condition as intended by the product manufacturer after a period of 1 year shall be negotiated with the owner upon project completion.

END OF SECTION

SECTION 28 23 16 – AIPHONE ACCESS CONTROL SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1- GENERAL

1.1 RELATED WORK

- A. 26 05 00 – Grounding and Bonding
- B. 26 05 29 – Electrical Hangers and Supports
- C. 26 05 33 – Raceway and Boxes
- D. 28 13 00 – Access Control System
- E. 28 16 00 – Intrusion Detection System

1.2 WORK INCLUDED

- A. Install a new video access/intercom system at the front entrance and controlled at the main office where noted on the Drawings. System shall be based on AIPHONE equipment. The installation contractor shall be licensed by the State of Texas as a security service contractor. The installation contractor shall be a verifiable Bosch/Radionics and AIPHONE Dealer. Technicians shall be Bosch/Radionics and AIPHONE trained and certified in the various applications necessary.

1.3 CODES AND STANDARDS

The system shall comply with the applicable Codes and Standards as follows:

- A. National Electric Code, Article 760.
- B. National Fire Alarm Code (NFPA 72).
- C. Life Safety Code (NFPA 101)
- D. Administrative Council for Terminal Attachments (ACTA):
 - 1. ANSI/TIA-968-A-2002 Technical Requirements for Connection of Terminal Equipment to the Telephone Network.
- E. American National Standards Institute (ANSI):
 - 1. ANSI C63.4 Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
- F. California State Fire Marshal (CSFM):
 - 1. Title 19, California Code of Regulations, Building Material Listing Program (BML).
- G. Federal Communications Commission (FCC):
 - 1. Title 47 C.F.R. Part 15; Class B – Radiated and Conducted Emissions.
 - 2. Title 47 C.F.R. Part 68; rules governing the connection of Terminal Equipment (TE) to the Public Switched Telephone Network (PSTN).
- H. The National Institute of Standards and Technology of the United States of America (NIST):
 - 1. Federal Information Processing Standards Publications 197 (FIPS 197) –Advanced Encryption Standard (AES).
- I. International Organization For Standardization (ISO):
 - 1. 9001 - Quality System.

- J. Underwriters Laboratories, Inc. (UL):
 - 1. UL 50 - Enclosures for Electrical Equipment.
 - 2. UL 294 – Access Control System Units.
 - 3. UL 365 - Police Station Connected Burglar Alarm Units and Systems.
 - 4. UL 609 - Local Burglar Alarm Units and Systems.
 - 5. UL 864 - Control Units System for Fire-Protective Signaling System.
 - 6. UL 985 - Household Fire Warning System Units.
 - 7. UL 1023 - Household Burglar Alarm System Units.
 - 8. UL 1076 – Proprietary Burglar Alarm Units and Systems
 - 9. UL 1610 - Central Station Burglar-Alarm Units.
 - 10. UL 60950-1 - Information Technology Equipment - Safety.
 - 11. UL 636 – Hold up alarms
- K. Local & State Building Codes
- L. Requirements of Local Authorities having Jurisdiction
- M. Requirements of American Disabilities Act (Public law 101-336).
- N. Texas Accessibility Standards (T.A.S.)
- O. State Fire Marshall.
- P. Texas Insurance Code.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND INSTALLERS

- A. Acceptable Manufacturer: AIPHONE

2.2 SYSTEM MODULES / COMPONENTS

- A. AIPHONE Model JF-2MED master monitor with color display with MCW-S/A desk stand.
- B. AIPHONE Model JFS-2AEDV surface mounted, vandal resistant call station with color camera.
- C. AIPHONE PS-1820UL power supply
- D. AIPHONE RY-18L door release relay
- E. Any and all accessories necessary for a complete operable system.
- F. Provide wiring interface between access system and electric locks and panic hardware provided under other Specification Sections.

PART 3- EXECUTION

3.1 INSTALLATION

- A. All wiring shall be in accordance with the National Electrical Code, Local Codes, and article 760 of NFPA Standard 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.
- B. All wire shall be UL listed two conductor, 18 gauge, low capacitance, plenum rated copper wire. Minimum 16gauge wire for power supply. Color code per CFISD Standards.

- C. Door release shall be wired in parallel with card access system door release. Each can release door without interface to the other system.
- D. No AC wiring or any other wiring shall be run in the same conduit as security alarm wiring.
- E. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
- F. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.
- G. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.
- H. All vertical wiring and all main trunk/riser wiring shall be installed in a complete raceway/conduit system. All riser boxes shall be adequately sized for the number of conductors transversing the respective box as well as the number of terminations required.

3.2 CABLE PATHWAYS

- A. Cable Support:
 - 1. All wire not installed inside conduit or a designated cable tray system shall be installed in a dedicated cable support system for the entire run of each cable. Including, but not limited to service loops.
 - a. Approved Cable Support Manufacturer:
Panduit Corporation
Erico/Caddy
B-Line
Supports shall be sized appropriately for the number of wires being supported. Reference the manufacturer's specifications for the suggested maximum cables per support size.
 - 2. The approved cable support system shall be attached directly to the building steel at a serviceable height. In the event that the building steel is not 5' of the finished ceiling, the contractor shall provide a dedicated threaded rod extending within 5' of the finished ceiling and mount the cable support hook to the treaded rod.
 - 3. J-MOD™ cable support shall be installed at a maximum of 5' on center.
 - 4. All cable installed shall be attached to the cable support system with plenum rated Velcro and a plenum rated Velcro tie shall be installed between each cable support, to keep wires neatly bundled throughout the entire run. Tie wraps will only be allowed to be used inside the control panels as required to manage the wires within each type of panel.
 - 5. ABSOLUTELY NO CABLE, NOT INSTALLED IN CONDUIT, WILL BE ALLOWED TO BE ATTACHED DIRECTLY TO THE BUILDING'S STEEL OR SUPPORTED IN ANY OTHER METHOD THAN THAT STATED ABOVE.
 - 6. IT IS THE RESPONSIBILITY OF THE INSTALLING CONTRACTOR TO COORDINATE WITH ALL OTHER TRADES ON THE PROJECT TO INSURE THAT THE PATHWAY OF THIS SYSTEM DOES NOT INTERFERE WITH THE INSTALLATION OF THE OTHER TRADES AND TO PREVENT THE INSTALLED PRODUCT OF OTHER TRADES FROM PUTTING STRAIN ON THE INSTALLED WIRING.
- B. Conduit / Raceway:
 - 1. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
 - 2. Conduit and raceway system shall be installed as specified under the general electrical

section of the specifications, and per NEC.

3. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.
4. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.

3.3 WARRANTY

- A. Entire system shall be warranted against defects in materials and workmanship for a period of one (1) year from the date of substantial completion.

3.4 SHOP DRAWINGS / RECORDS / TESTING

- A. Contractor shall provide shop drawing noting all equipment to be provided. Also provide system wiring diagram showing each device and wiring connection. As built drawings shall be provided after construction with actual locations of devices, cable routing, power supply locations and any other equipment locations. Refer to Division 26 for additional shop drawing requirements.
- B. Upon completion of system testing in order to confirm proper operation, contractor shall demonstrate operation of the system to a AISD representative and perform any test or function requested.

END OF SECTION

SECTION 28 31 00 - FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 SCOPE

- A. The contractor shall furnish and install a complete microprocessor based 24VDC, electrically supervised, analog intelligent fire alarm system as specified herein and indicated on the drawings. The system shall include, but not be limited to, all control equipment, power supplies, signal initiating and signaling devices, conduit, wire, fittings, and all other accessories required to provide a complete and operable system.
- B. The system shall operate as a non-coded, continuous ringing system, which will sound alarm devices until manually silenced, as herein specified.
- C. The system shall be wired as a style B and style 4 supervised system for all circuits.
- D. The drawings show basic device placement to set design criteria. It is the installing contactors responsibility to provide a complete and functional system that meets all applicable codes. The contractor shall include additional devices as required to the design shown to ensure voice evacuation announcement volume levels are met as well as Visual device lumen outputs are reach acceptable levels.

1.2 CODES AND STANDARDS

- A. The system shall comply with the applicable Codes and Standards as follows:
 - 1. National Electrical Code - Article 760.
 - 2. National Fire Protection Association Standards:
 - NFPA 70 NEC
 - NFPA 72 Protective Signaling Systems (current State adopted version)
 - NFPA 90A Air Conditioning
 - NFPA 101 Life Safety Code
 - UL 1971 Visual Devices
 - ANSI 117.1 Visual Devices
 - 3. Local & State Building Codes
 - 4. Requirements of Local Authorities having Jurisdiction. If local authorities design requirements differ substantially from contract drawings, the design engineer shall be notified no less than 10 days prior to bid date, to allow time for addendum to be provided to all contractors. Contractor to provide additional devices as required by local authorities in bid pricing.
 - 5. Underwriters Laboratory Requirements and Listings for use in Fire Protective Signaling Systems as follows:
 - UL 864 Control Panels 9th Edition
 - UL 268 Smoke Detectors - Systems
 - UL 268A Duct Smoke Detectors
 - UL 521 Heat Detectors
 - UL 228 Door Holder-Closers
 - UL 464 Audible Signaling Appliances
 - UL 1971 Visual Signaling Appliances
 - UL 38 Manual Alarm Stations

1.3 ACCEPTABLE MANUFACTURERS

- A. To establish the type, quality, and features of system required, the equipment specified is that of the Silent Knight Company.
- B. All equipment, materials, accessories, devices, etc. covered by the specifications and/or noted on the contract drawings shall be new and unused and be U.L. listed for their intended use.
- C. All references to manufacturer or supplier's model numbers and other pertinent information herein is intended to establish a minimum standard of quality, performance and features required. All equipment proposed as an EQUAL to that specified shall COMPLETELY conform to the specifications herein.
- D. Equipment of other manufacturer's or supplier's may be considered as an equal to that specified provided that completely marked and identified catalog sheets of all proposed equipment is provided to the Owner/ engineer for review ten (10) days prior to the date of bid for evaluation. In addition, a list of the contractor's qualifications and any exceptions to the specifications must be provided for review. Approval for any such substitution of equipment must be obtained in writing from the Owner/engineer five (5) days prior to bid.
- E. Provide one of the following manufacturers:
 - 1. Silent Knight

1.4 GENERAL REQUIREMENTS

- A. Contractor Qualifications:
 - 1. The equipment supplier shall be an authorized and designated representative of the Fire Alarm Manufacturer to sell, install, and service the proposed manufacturer's equipment.
 - 2. The equipment supplier and installing contractor shall be licensed by the State Fire Marshall to sell, install, and service fire alarm systems as required by Article 5.43-2 of the Texas Insurance Code.
 - 3. The installing contractor and/or equipment supplier shall have on his staff a minimum of three (3) installation superintendents who are licensed by the State Fire Marshall's office for such purpose and under whose supervision installation, final connections, and check out will take place as required by the Texas Insurance Code.
 - 4. The installing contractor or equipment supplier shall have on staff a minimum of one (1) certified NICET Level III state licensed fire alarm planner under whose supervision system design shall take place.
 - 5. The installing contractor shall provide 24 hour, 365 days per year emergency service with qualified and state licensed service technicians.
 - 6. The installing contractor shall have been actively engaged in the business of selling, installing, and servicing fire alarm systems for at least ten (10) years.

1.5 SUBMITTALS

- A. The installing contractor and/or equipment manufacturer shall provide complete and detailed shop drawings and include:
 - 1. Control panel configuration including wiring and interconnection schematics.
 - 2. Complete point to point wiring diagram showing terminal connections to all system devices.
 - 3. Riser wiring diagram and associated zoning/addressing configurations with associated conduit sizes.
 - 4. Complete floor plan drawings locating all devices associated with the fire alarm system. Floor plan drawings shall include conduit and wiring routing complete with conduit sizing and number of conductors by type.
 - 5. Factory data sheets on each piece of equipment to be used and so marked as to model,

- dimensions, size, voltage, and configuration.
6. Detailed system description in this specification format describing system functions and operation. All specification variations and deviations shall be clearly noted and marked.
 7. Complete Bill of Material for reference.
 8. Programming matrix defining all input/output functions and zoning.
 9. Power supply and battery calculations.
 10. A letter from the manufacturer stating that the fire alarm system contractor is authorized to sell, service and install the submitted equipment.
 11. Provide letter of specification compliance
 12. Provide current state Fire Alarm license
- B. All submittal data will be in bound form with contractor's name, supplier's name, project name, and state fire alarm license number adequately identified.
- C. Only basic equipment devices have been shown on the contract drawings. Specific wiring between equipment/devices has not been shown. It is the contractor's responsibility to submit for approval the COMPLETE ENGINEERED system configuration and layout showing all devices, wiring, conduit, and locations along with other required information as specified herein.

1.6 COORDINATION

- A. It shall be the responsibility of the installing contractor to coordinate all requirements surrounding installation of the fire alarm system with all trades including, but, not exclusive of: electrical contractor, sprinkler contractor, and HVAC/controls contractor and intercom system. Adequate coordination shall be provided to insure proper installation and interface to all peripheral items required to interact with the fire alarm and communication system to provide a complete and functional life safety system.

PART 2 - PRODUCTS

2.1 SYSTEM FUNCTIONAL OPERATION

- A. Alarm Detection
1. When a fire alarm condition is detected by any of the system alarm initiating devices, the following functions shall occur:
 - a. The system common alarm LED on the CPU Module shall flash. The internal audible trouble device shall sound. Acknowledgement or silencing the alarm condition shall silence the alarm signals and cause flashing alarm LED's to illuminate steady.
 - b. An 160 character back-lit LCD display shall indicate all applicable information associated with the alarm condition including: zone, device type, divide location, and time of alarm. Location and zoning messages shall be custom field programmed to respective premises.
 - c. Any remote or local annunciator LED's associated with the alarm zone shall be illuminated as herein specified.
 - d. A three channel digital alarm communicator shall be integrally provided and transmit trouble and alarm signals to an approved remote station (remote station connection and service provided by Owner).
 - e. All automatic events programmed to the alarm point shall be executed and the associated indicating devices and/or outputs activated. As each indicating circuit or control relay is activated, its associated "ON" LED shall be illuminated.
 - f. Activate all audible/visual alarm devices.
 - g. De-activate HVAC systems over 2000 CFM.
 - h. Display system status changes on the remote annunciator(s).
 - i. Release all smoke doors, fire doors, fire coiling doors, fire smoke dampers and fire

shutters.

- j. Recall elevators to ground floor as specified herein, or to the alternate floor if the alarm condition originates on the ground floor. Each elevator lobby shall be provided with a smoke detector. Activation of this smoke detector shall recall the respective elevator cars to the ground floor. In the event of a fire on the ground floor, the elevator cars shall be recalled to level 2.

B. System Trouble Detection

1. When a trouble condition is detected by the CPU, one of the system initiating, alarm or SLC circuits, the following functions shall immediately occur:
 - a. The system trouble LED on the CPU module shall flash and the internal audible trouble device shall sound. Acknowledgement of the trouble condition shall silence the audible trouble device and cause all trouble LED's to illuminate steady.
 - b. The 160 character alphanumeric LCD annunciator shall display all applicable information via the alphanumeric display associated with the respective trouble condition and its location.

C. Auxiliary Control

1. All designated "non-silenceable" auxiliary control functions shall remain in operation (even upon silencing of audible alarms) until such time as the control panel is cleared and reset manually (i.e. fan control outputs, central station interface, elevator recall interface, etc.).
2. Activation of duct smoke detectors associated fans shall shutdown their respective units immediately in addition to identifying the condition as herein specified.

D. System Supervisory Detection

1. When a supervisory condition is detected by the fire alarm control panel, the following functions shall occur:
 - a. The fire alarm control panel supervisory indicator shall flash and the internal audible device shall sound. Acknowledgment of the supervisory condition shall silence the audible device and cause the supervisory indicator to illuminate steady.
 - b. The 80 character liquid crystal display shall display all applicable information associated with the respective supervisory condition.
 - c. Activate a supervisory contact closure to interface with the owner provided central station monitoring service.
 - d. Display the system changes on the remote annunciators.

E. Fire Drill Control

Provide a fire drill switch located on the Fire Alarm Control Panel. When activated, this switch will activate all horn/strobes and speakers for a fire drill. It shall not release fire shutter, shut down air handling equipment or recall elevators. If a fire alarm condition is detected, the system shall operate as defined in part 2.01A of this section.

2.2 ZONING

- A. The system shall have the inherent capability to employ "Intelligent" smoke detectors and addressable interface devices capable of being recognized and annunciated at the main control panel on an individual basis. All zoning/device location information shall be totally field programmable to exact job requirements as approved by the Owner/Engineer.

2.3 FIRE ALARM CONTROL PANEL

A. Control Panel

The fire alarm control panel (FACP) shall be the Silent Knight IFP-2000ECS analog addressable control panel. The audio amplifiers shall be the Silent Knight ECS-50W, ECS-125W, or ECS-DUAL50W voice evacuation units. The FACP must have a 9 amp power supply and be capable of expansion to a minimum of 54 total amps via bus connected expander modules that supervise low battery, loss of AC and loss of communication.

The system must contain at least one (1) Silent Knight ECS-50W, ECS-125W, or ECS-DUAL-50W watt amplifier and shall be expandable from 50 to 2000 watts utilizing up to 15 additional amplifiers. The ECS-50W and ECS-125W amplifiers shall be capable of adding a 4 zone splitter (Silent Knight ECS-CE4) to distribute the audio information to different locations in the installation. The system shall have the capability of controlling up to 40 notification zones. The amplifiers must contain the capability of being remotely located through a four-wire SBUS communications circuit and a two-wire VBUS voice circuit. The system shall have the capability of adding up to 7 ECS-RCU2000 remote command units.

The voice evacuation system must have the capability of downloading fifteen (15) 60 second messages and utilize DSP technology for higher audio intelligibility.

The voice evacuation system shall be capable of operating at 25vrms or 70.7vrms (ECS-50W and ECS-DUAL50W only) and must be field selectable at the amplifier level. Systems that require additional modules for voltage conversion shall not be accepted.

The FACP must have Day/Night sensitivity capabilities on detectors and be capable of supporting up to 636 analog addressable points. This shall be accomplished via signaling line circuits (SLC) capable of supporting a minimum of 159 detectors and 159 module devices each. The main panel will contain one SLC circuit with the option of utilizing 5815XL expander modules. The communication protocol on the SLC loop must be digital.

The FACP must support a minimum of eight programmable Flexput™ circuits. The panel must have a built in 160 character LCD annunciator with the capability of having an additional supervised remote annunciators connected in the field.

The FACP must have a built in UL approved digital communicator. The communicator must allow local and remote up/downloading of system operating options, event history, and detector sensitivity data.

The FACP must automatically test the smoke detectors in compliance with NFPA standards to ensure that they are within listed sensitivity parameters and be listed with Underwriters Laboratories for this purpose.

The FACP must compensate for the accumulation of contaminants that affect detector sensitivity. The FACP must have day/night sensitivity adjustments, maintenance alert feature (differentiated from trouble condition), detector sensitivity selection, auto-programming mode (Jumpstart) and the ability to upgrade the core programming software on site or over the telephone.

The FACP shall have a Jumpstart feature that can automatically enroll all properly connected accessories into a functional system within 60 seconds of powering up the panel. Panels that do not have these capabilities will not be accepted.

The main communication bus (SBUS RS485) shall be capable of class A or class B configuration with a total SBUS length of 6,000 feet.

B. System Wiring

The Signaling Line Circuit (SLC) and Data Communication Bus (S-BUS) shall be wired with standard NEC 760 compliant wiring, no twisted, shielded or mid capacitance wiring is required for standard installations. All FACP screw terminals shall be capable of accepting 14-18 AWG wire. All system wiring shall be in accordance with the requirements of NFPA 70, the National Electrical Code (NEC) and also comply with article 760 of the NEC.

C. Signaling Line Circuits

Each SLC shall be capable of a wiring distance of 10,000 feet from the SLC driver module (5815XL) and be capable of supporting 99 detectors and 99 addressable module devices. The communication protocol to SLC devices must be digital. Any SLC loop device, which goes into alarm, must interrupt the polling cycle for priority response from the FACP. The FACP must respond consistently to a device that goes into alarm on an SLC in under 3 seconds. The auxiliary 5815XL SLC loop module must be capable of being located up to 6000 feet from the FACP on an RS-485 bus, which is separate from the SLC bus. The SLC shall be capable of functioning in a class A or class B configuration.

D. SLC loop devices

Devices supported must include analog photoelectric, ionization smoke detectors, analog heat detectors, addressable input modules, relay output modules or addressable notification modules. Each SLC loop shall support up to 159 detectors and 159 modules.

E. Analog detector functions

The products of combustion detectors must communicate analog values using a digital protocol to the control panel for the following functions:

Automatic compliance with NFPA 72 standards for detector sensitivity testing

Drift compensation to assure detector is operating correctly

Maintenance alert when a detector nears the trouble condition

Trouble alert when a detector is out of tolerance

F. Sensitivity function

The FACP shall have the ability to set three different sensitivity levels. A zone can be programmed to a day and a night sensitivity value. The day/night schedule shall allow for 16 holiday dates that are user programmable to allow the FACP to respond at the night level on those days.

G. Programmable Flexputs

The FACP shall support six programmable Flexput circuits that are capable of being programmed as supervised reverse polarity notification circuits or supervised auxiliary power circuits that can be programmed as continuous, reset able or door holder power. The circuits shall also be programmable as input circuits in class A or B configurations to support dry contact or compatible two wire smoke detectors.

1. Addressable Notification Module

The contractor shall furnish and install where indicated on the plans, addressable notification modules, Silent Knight Model IDP-Control. The modules shall be U.L. listed compatible with Silent Knight's IFP-2000ECS fire alarm control panel. The notification module must provide one class A (Style Z) or class B (Style Y) notification output with one auxiliary power input. The notification module must be suitable for mounting in a standard 4 square electrical box and must include a plastic cover plate. The notification module must provide an LED that is visible from the outside of the cover plate. The notification module must be fully programmable for such applications as required by the installation. The IDP-Control shall reside on the SLC loop and can be placed up to 10,000 feet from the control or 5815XL SLC loop module.

H. Annunciators

The main control must have a built in annunciator with a 160-character LCD display and feature LED's for Alarm, Supervisory, Trouble, Silenced and Power. When in the normal condition the LCD shall display time and date based on a 200 year clock which is capable of automatic daylight savings time adjustments. All controls and programming keys are silicone mechanical type with tactile and audible feedback. Keys have a travel of .040 in. No membrane style buttons will be permissible. The annunciator must be able to silence and reset alarms through the use of a keypad entered code. The annunciators must have twenty levels of user codes that will allow the limitation of operating system programming to authorized individuals.

I. Remote Annunciators

The fire system shall be capable of supporting remote annunciators. LCD Remote annunciator, Model RA-2000, shall have the same control and display layout so that they match identically the built in annunciator. Remote annunciators shall be available in two colors, red and light gray. Remote annunciators shall have the same functionality and operation as the built-in annunciator. All annunciators must have 160-character LCD displays and must feature five LED's for Alarm, Supervisory, Trouble, Silenced, and Power. All controls and programming keys are silicone mechanical type with tactical and audible feedback. Keys shall have a travel of .040 inches. No membrane style buttons will be permitted.

The annunciator must be able to silence and reset alarms through the use of a code entered on the annunciator keypad. The annunciator must have twenty levels of user codes that will limit the operating system programming to authorized individuals. The control panel must allow all annunciators to accommodate multiple users input simultaneously. Remote annunciators shall be capable of operating at a distance of 6,000 feet from the main control panel on unshielded, non-twisted cable.

J. I/O Module

The fire system shall be able to support I/O modules (SK5880) that shall be used to drive remote LED graphic style displays and accommodate up to eight dry contact type switch inputs, including ECS inputs. The I/O modules shall each drive up to 40 LEDs without requiring external power connections. The I/O module inputs shall be supervised and be suitable for alarm and trouble circuits as well as reset and silence switches. The system shall also support up to 40 LED drivers that reside on the two-wire SLC loop. These driver boards shall contain 80 LED outputs that are powered by an external power source.

K. Serial/Parallel interface

The fire system shall be capable of supporting up to two serial/parallel interfaces (SK5824) that are capable of driving standard computer style printers. The interface shall be programmable for the serial and parallel ports and allow printing of events as they occur.

L. Distributed Power Module

The contractor shall supply power modules, Models RPS-1000 and 5496, compatible with the IFP-2000ECS fire alarm control panel. The RPS-1000 power module must have 6 amps of output power, six Flexput™ circuits rated at 3amps each, and two form C relay circuits rated at 2.5 amps at 24 volts DC. The six Flexput™ circuits shall have the same functionality as the Flexput™ circuits on the main panel. The RPS-1000 shall be capable of being connected via an RS-485 system bus (SBUS) at a maximum distance of 6,000 feet from the main control panel. The RPS-1000 shall contain an additional RS-485 bus that is completely compatible with all IFP-2000ECS add on modules; including 5815XL SLC expanders, RA-2000-SK5865-SK5880 annunciators, 5824 serial/parallel module and addressable devices. The RPS-1000 will also act as a bus repeater so that additional RS-485 (modules) devices can be connected at a maximum distance of 6,000 feet

from the power module.

The 5496 power module must have 6 amps of output power and four circuits rated at 3 amps each. The four circuits can be programmed as notification outputs or auxiliary power outputs of door holder, constant and resettable types.

M. Digital Communicator

The digital communicator must be an integral part of the control panel and be capable of reporting all zones or points of alarm, supervisory, and trouble as well as all system status information such as loss of AC, low battery, ground fault, loss of supervision to any remote devices with individual and distinct messages to a central station or remote station. The communicator must also be capable of up/downloading of all system programming options, event history and detector sensitivity compliance information to a PC on site or at a remote location.

The communicator shall have an answering machine bypass feature that will allow the panel to respond to communication even on phone lines that have other communication equipment present. The communicator must be capable of reporting via SIA and Contact ID formats. The communicator shall have a delayed AC loss report function which will provide a programmable report delay plus a 10-25 min random component to help ease traffic to the central station during a power outage. No controls that use external modems for remote programming and diagnostics shall be accepted.

N. Dry Contacts

The FACP will have three form "C" dry contacts, one will be dedicated to trouble conditions, the other two will be programmable for alarm, trouble, sprinkler supervisory, notification, pre-alarm, waterflow, manual pull, aux. 1 or aux. 2. The trouble contact shall be normal in an electrically energized state so that any total power loss (AC and battery) will cause a trouble condition. In the event that the microprocessor on the FACP fails the trouble contacts shall also indicate a trouble condition.

O. Ground Fault Detection

A ground fault detection circuit shall be used to detect positive and negative grounds on all field wiring. The ground fault detector shall operate the general trouble devices as specified but shall not cause an alarm to be sounded. Ground faults will not interfere with normal operation, such as alarm, or other trouble conditions.

P. Over current Protection

All low voltage circuits will be protected by microprocessor controlled power limiting or have a self restoring polyswitches for the following: smoke detector power, main power supply, indicating appliance circuits, battery standby power and auxiliary output.

Q. Test Functions

A "Lamp Test" mode shall be a standard feature of the fire alarm control panel and shall test all LED's and the LCD display on the main panel and remote annunciators.

A "Walk Test" mode shall be a standard feature of the fire alarm control panel. The walk test feature shall function so that each alarm input tested will operate the associated notification appliance for 6 to 180 seconds. The FACP will then automatically perform a reset and confirm normal device operation. The event memory shall contain the information on the point tested, the zone tripped, the zone restore and the individual points return to normal.

A "Fire Drill" mode shall allow the manual testing of the fire alarm system notification circuits. The fire drill shall be capable of being controlled at the main annunciator, remote annunciators and via a remote contact input.

A "Bypass Mode" shall allow for any point or NAC circuit to be bypassed without effecting the operation of the total fire system.

R. Remote Input Capabilities

The control panel shall have provisions for supervised switch inputs for the purpose of alarm reset and alarm and trouble silence.

S. Notification Appliance Mapping Structure

All notification circuits and modules shall be programmable via a mapping structure that allows for a maximum of 999 output groups. Each of these groups shall have the ability to be triggered by any of the panels 999 zones, panel wide events, or site wide events. Additionally each zone, panel, or site will individually control the cadence pattern of each of the groups that it is mapped to so that devices can indicate a variety of conditions. The zone, panel, or site shall be capable of issuing a different cadence pattern for each of the groups under its control. The mapping structure must also allow a group to be designated to "ignore cadence" for use with strobes and other continuous input devices. Zones shall have ten different output categories; Detector Alarm, Trouble, Supervisory, Pre-alarm, Waterflow, Manual Pull, Zone Auxiliary 1 and Zone Auxiliary 2, CO Alarm and CO Supervisory. Each of the categories shall have the ability to control output groups with a cadence pattern. The patterns are; March code, ANSI 3.41, Single Stroke Bell Temporal, California Code, Zone 1 Coded, Zone 2 Coded, Zone 3 Coded, Zone 4 Coded, Zone 5 Coded, Zone 6 Coded, Zone 7 coded, Zone 8 Coded, Custom Output Pattern 1, Custom Output Pattern 2, Custom Output Pattern 3, Custom Output Pattern 4, Constant, System Sensor Synchronization, Wheelock Synchronization, Gentex Synchronization, Amseco Synchronization, and Faraday Synchronization. This mapping/cadence pattern shall be supported by all system power supplies. 15 recordable one minute messages are available that can be mapped to eight ECS buttons. ECS messages can have priority over fire alarm outputs

T. On board programmer

The FACP shall have an on board programmer which will allow for all system functions and options, except for mapping, to be programmed via the on board annunciator keypad. Any panel that does not have this capability will not be accepted.

U. Downloading Software

The fire alarm control panel must support up/downloading of system programming from a PC. The FACP must also be able to download the detector sensitivity test results and a 1,000 event system event buffer to the PC. Communication shall take place over a direct connection to the PC and/or via the same telephone lines as the built in digital communicator and shall not require an external modem to be connected to the panel. The downloading software shall contain a code that will block unauthorized persons from accessing the panel via direct connection or over the phone lines.

V. Facility Management Software

The FACP must support a facility management software capable of providing off site access to FACP data that is necessary to manage fire system operation. A software package capable of uploading the detector sensitivity test results and the 1000 event system event buffer to the PC

shall be required as part of the bid package. Communication shall take place over a direct connection to the PC and/or via the same telephone lines as the built in digital communicator. The facility management package must be separate from the downloader package and must not be capable of affecting programmed system options.

W. Service reminder

The FACP shall be capable of automatically generating textual service reminder and the main and remote annunciator LCD's to inform the user of required testing or service. The service reminder shall not interfere with the normal operation of the FACP.

X. English language descriptions

The FACP shall provide the ability to have a text description of each system device, input zone and output group on the system. The use of individual lights to provide descriptions will not be acceptable.

2.4 SYSTEM OPERATION

A. Alarm

When a device indicates any alarm condition the control panel must respond within 10 seconds. All programmed audio and visual devices will activate at this time. The Alarm or Supervisory LED on the annunciator(s) should light and the LCD should prompt the user as to the number of current events. The alarm information must be stored in event memory for later review. Event memory must be available at the main and all remote annunciators.

When the alarmed device is restored to normal, the control panel shall be required to be manually reset to clear the alarm condition, except that the alarms may be silenced as programmed.

An alarm shall be silenced at the main or remote annunciators. When silenced, this shall not prevent the resounding of subsequent events if another event should occur (subsequent alarm feature). When alarms are silenced the silenced LED on the control panel, and on any remote annunciators shall remain lit, until the alarmed device is returned to normal.

B. Troubles

When a device indicates a trouble condition, the control panel System Trouble LED should light and the LCD should prompt the user as to the number of current events. The trouble information must be stored in event memory for later review. Event memory must be available at the main and all remote annunciators.

When the device in trouble is restored to normal, the control panel shall be automatically reset. The trouble restore information must be stored in event memory for later review. Event memory must be available at the main and all remote annunciators. A trouble shall be silenced at the main or remote annunciators. When silenced, this shall not prevent the resounding of subsequent events if another event should occur.

C. Supervision methods

Each SLC loop shall be electrically supervised for opens and ground faults in the circuit wiring, and shall be so arranged that a fault condition on any loop will not cause an alarm to sound. Additionally, every addressable device connected to the SLC will be supervised and individually identified if in a fault condition. The occurrence of any fault will light a Trouble LED and sound the

system trouble sounder, but will not interfere with the proper operation of any circuit which does not have a fault condition.

Each indicating appliance circuit shall be electrically supervised for opens, grounds and short circuit faults, on the circuit wiring, and shall be so arranged that a fault condition on any indicating appliance circuit or group of circuits will not cause an alarm to sound. The occurrence of any fault will light the trouble LED and sound the system trouble sounder, but will not interfere with the proper operation of any circuit which does not have a fault condition.

PART 3 - SYSTEM COMPONENTS

3.1 CONTROL UNIT

3.2 System Cabinet

A. Mounting

The system cabinet shall be red and can be either surface or flush mounted. The cabinet door shall be easily removable to facilitate installation and service.

B. Audible System Trouble Sounder

An audible system trouble sounder shall be an integral part of the control unit. Provisions shall also be provided for an optional supervised remote trouble signal.

3.3 Power Supply and Charger:

The entire system shall operate on 24 VDC, filtered switch mode power supply with the rated current available of 9 Amps. The FACP must have a battery charging circuit capable of complying with the following requirements:

Sixty (60) hours of battery standby with five (5) minutes of alarm signaling at the end of this sixty (60) hour period (as required per NFPA 72 remote station signaling requirements) using rechargeable batteries with automatic charger to maintain standby gel-cell batteries in a fully charged condition.

OR

Twenty-four (24) hours of battery standby with five (5) minutes of alarm signaling at the end of this twenty-four (24) hour period (as required per NFPA 72 central station signaling requirements) using rechargeable batteries with automatic charger to maintain gel-cell batteries in a fully charged condition.

The power supply shall comply with U.L. Standard 864 for power limiting.

The FACP will indicate a trouble condition if there is a loss of AC power or if the batteries are missing or of insufficient capacity to support proper system operation in the event of AC failure. A "Battery Test" will be performed automatically every minute to check the integrity of the batteries. The test must disconnect the batteries from the charging circuit and place a load on the battery to verify the battery condition.

In the event that it is necessary to provide additional power one or more of the Model RPS-1000 or 5496 distributed power modules shall be used to accomplish this purpose.

A. Connections and Circuits

Connections to the light and power service shall be on a dedicated branch circuit in accordance with the National Fire Alarm Code NFPA 72, National Electrical Code (NEC) NFPA 70, and the local authority having jurisdiction (AHJ). The circuit and connections shall be mechanically protected.

A circuit disconnecting means shall be accessible only to authorized personnel and shall be clearly marked "FIRE ALARM CIRCUIT CONTROL".

A circuit disconnecting means shall be accessible only to authorized personnel and shall be clearly marked "FIRE ALARM CIRCUIT CONTROL".

PART 4 - ACCESSORY COMPONENTS

4.1 The FACP shall support the following devices on the RS-485 data bus:

ECS-VCM	Voice Control Module
ECS-SW24	Additional 24 Zone Switch Module
ECS-50W	50 Watt Amplifier
ECS-125W	125 Watt Amplifier
ECS-DUAL50W	50/100 Watt Dual Channel Amplifier with 50 Watt Backup
ECS-CE4	4 Zone Splitter
ECS-RCU	Remote Microphone (7 max.)
5815XL	Signaling Line Circuit Expander (SLC) Module
5824	Printer Interface Module
RA-2000	LCD Remote Annunciator
5865-3	LED Remote Annunciator
5865-4	LED Remote Annunciator with reset and silence switches
5880	LED I/O module
RPS-1000	Intelligent Distributed Power Module
5496	Intelligent Distributed Power Module

4.2 The FACP shall support the operation of 159 detectors and 159 addressable module total devices per SLC loop without regard to device type. The following devices shall be supported:

IDP-Photo	Addressable Photoelectric Smoke detector
IDP-Photo-T	Addressable Photoelectric Smoke detector with Thermal
IDP-PhotoR	Addressable Photoelectric Smoke detector with Relay
IDP-Ion	Addressable Ionization Sensor
IDP-Heat	Addressable Heat Sensor
IDP-Heat-ROR	Addressable Heat with Rate of Rise
IDP-Heat-HT	Addressable Heat High temp 190°
IDP-Acclimate	Addressable Multi Criteria Smoke detector with thermal
IDP-6AB	6" detector base
DNR	Addressable Duct Detector Housing
IDP-Relay	Addressable Relay Module
IDP-Relay-6	Addressable Multi Relay Module
IDP-RelayMon-2	Addressable Relay/Input Module
IDP-Monitor	Addressable Input Module (Class A or B)
IDP-Minimon	Mini Input Module
IDP-Monitor-2	Addressable Dual Input Module
IDP-Monitor-10	Addressable Multi Input Module (10)
IDP-Control	Addressable Notification Module
IDP-Control-6	Addressable Notification Multi Module (6)
IDP-Zone	Two Wire Smoke Detector Module
IDP-Zone-6	6 Multi Smoke Detector Module
IDP-Iso	Isolation Module
IDP-Beam	Addressable Beam Detector

IDP-Beam-T	Addressable Beam Detector with Test feature
B224BI	Addressable Isolator base
B224RB	Detector Relay Base
B200SR	Detector Sounder Base
B200S	Intelligent Detector Sounder Base
RTS151KEY	Remote Test Switch for Photoelectric Duct Detector
RTS151	Remote Test Switch for Photoelectric Duct Detector
IDP-Pull-SA	Addressable Single Action Pull Station
IDP-Pull-DA	Addressable Dual Action Pull Station

The FACP shall support these other Silent Knight devices via addressable input, addressable notification, or addressable output modules.

PS-DALOB	Dual Action Manual Pull Outdoor Listed
PS-DAH	Dual Action Manual Pull Hex Key reset
PS-SATK	Single Action Manual Pull Station – Key Reset
PS-DATK	Dual action Manual Pull Station – Key Reset
PS-DASP	Dual action Manual Pull Station “Spanish”- Key reset
SB-I/O	Surface mount back box for outdoor use.

4.3 Furnish and install, where shown on the drawings, the following devices

A. Manual Fire Alarm Stations

Manual fire alarm stations shall be non-coded, break glass, single or double action type, with a key operated test-reset lock in order that they may be tested, and so designed that after actual emergency operation, they cannot be restored to normal except by use of a key. The reset key shall be so designed that it will reset manual station and open FACP without use of another key. An operated station shall automatically condition itself so as to be visually detected, as operated, at a minimum distance of fifty feet, front or side. Manual stations shall be constructed of die cast metal or polycarbonate with clearly visible operating instructions on the front of the stations in raised letters. Stations shall be suitable for surface mounting on matching backbox, or semi-flush mounting on a standard single-gang box, and shall be installed within the limits defined by the Americans with Disabilities Act (ADA) dependent on manual station accessibility or per local requirements. Manual stations shall be installed in conjunction with an addressable input module, IDP-Monitor or IDP-Minimon. Manual stations shall be Silent Knight Underwriters Laboratories listed.

B. Remote Power Supplies

The remote power supplies for notification appliances shall be the Silent Knight Model RPS-1000 or 5496. The Model RPS-1000 intelligent power supply shall wire on the main SBUS and be programmed through the IFP-2000ECS. It will support 6 amps of 24 volt DC power with 6 Flexput™ circuits, rated at 3 amps each. Two additional 5815XL SLC loop expanders shall be capable of be install in the cabinet. The power supply will also regenerate the SBUS for an additional 6000 feet of SBUS capability.

The Silent Knight 5496 intelligent power supply shall wire on the main SBUS and be programmed through the IFP-2000ECS. It will support 6 amps of 24 volt DC power with 4 notification circuits, rated at 3 amps each.

The remote power supply model 5499 or 5495 may also be used on the system. These power supplies are activated by a notification circuit or an IDP-Control module and support 6amps of 24VDC power, with 4 notification circuits, rated at 3amps each.

C. Notification Devices

The visible and audible/visible signal shall be System Sensor series signal devices and be listed by Underwriters Laboratories Inc. per UL 1971 and/or 1638 and UL 464. The notification appliance (combination audible/visible units only) shall produce a peak sound output of 90dba or greater as measured in an anechoic chamber. The signaling appliance shall also have the capability to silence the audible signal while leaving the visible signal energized with the use of a single pair of wires. Additionally, the user shall be able to select either continuous or temporal tone output with the temporal signal having the ability to be synchronized. The visible signaling appliance shall maintain a minimum flash rate of 1Hz or greater regardless of power input voltage. The appliance shall also be capable of meeting the candela requirements of the blueprints presented by the engineer and ADA. The appliance shall be polarized to allow for electrical supervision of the system wiring. The unit shall be provided with terminals with barriers for input/output wiring and be able to mount to a single gang or double gang box or double workbox with the use of an adapter plate. The unit shall have an input voltage range of 20-30 volts with either direct current or full wave rectified power.

D. Smoke Detectors

Smoke detectors shall be Silent Knight Model IDP-Photo ceiling mounted, analog/addressable photoelectric smoke detectors. The combination detector head and twist lock base shall be U.L. listed compatible with the Silent Knight IFP-2000ECS fire alarm control panel. The base shall permit direct interchange with Silent Knight's IDP-Ion, IDP-Acclimate, or the IDP-Heat detectors. The base shall be the appropriate twist lock base B210LP. The smoke detector shall have a flashing status LED for visual supervision. When the detector is actuated, the flashing LED will latch on steady at full brilliance. The detector may be reset by actuating the control panel's reset switch. The sensitivity of the detector shall be capable of being selected and measured by the control panel without the need for external test equipment. The vandal security-locking feature shall be used in those areas as indicated on the drawing. The locking feature shall be field selectable when required. It shall be possible to perform a sensitivity test of the detector without the need of generating smoke. The test method shall simulate the effects of products of combustion in the chamber to ensure testing of the detector circuits. Detectors shall have completely closed back to restrict entry of dust and air turbulence and have a 30 mesh insect screen. Electronics of the unit shall be shielded to protect against false alarms from E.M.I. and R.F.I.

E. Heat Detectors

Furnish and install analog/addressable heat detectors, Silent Knight model IDP-Heat. The combination heat detector and twist lock base shall be U.L. listed compatible with the Silent Knight IFP-2000ECS fire alarm control panel. The base shall permit direct interchange with the Silent Knight IDP-Ion, IDP-Photo, or IDP-Acclimate detectors. The base shall be appropriate twist lock base B210LP. The heat detector shall have a flashing status LED for visual supervision. When the detector is actuated, the flashing LED will latch on steady at full brilliance. The detector may be reset by actuating the control panel's reset switch. The vandal security-locking feature shall be used in those areas as indicated on the drawings. Electronics of the unit shall be shielded to protect against false alarms from E.M.I. and R.F.I.

F. Duct Detectors

Duct Detector shall be Silent Knight Model DNR Duct Detector Housing. A separate IDP-Photo or IDP-PhotoR is required. The duct detector housing shall be capable of housing the IDP-Relay module for optional output devices.

PART 5 - WIRING

5.1 Installer's Responsibilities

The installer shall coordinate the installation of the fire alarm equipment. All conductors and wiring shall be installed according to the manufacturer's recommendations.

It shall be the installer's responsibility to coordinate with the supplier, regarding the correct wiring procedures before installing any conduits or conductors.

5.2 Installation of System Components

System components shall be installed in accordance with the latest revisions of the appropriate NFPA pamphlets, the requirements contained herein, National Electrical Code, local and state regulations, the requirements of the fire department and other applicable authorities having jurisdiction (AHJ).

All wire used on the fire alarm system shall be U.L. Listed as fire alarm protection signaling circuit cable per National Electrical Code, Articles 760.

PART 6 - WARRANTY AND FINAL TEST

6.1 General

The contractor shall warrant all equipment and wiring free from inherent mechanical and electrical defects for one year (365 days) from the date of final acceptance.

6.2 Final Test

Before the installation shall be considered completed and acceptable by the awarding authority, a test of the system shall be performed as follows:

- The contractor's job foreman, a representative of the owner, and the fire department shall operate every building fire alarm device to ensure proper operation and correct annunciation at the control panel.
- At least one half of all tests shall be performed on battery standby power.
- Where application of heat would destroy any detector, it may be manually activated.
- The communication loops and the indicating appliance circuits shall be opened in at least two (2) locations per circuit to check for the presence of correct supervision circuitry.

When the testing has been completed to the satisfaction of both the contractor's job foreman and owner, a notarized letter cosigned by each attesting to the satisfactory completion of said testing shall be forwarded to the owner and the fire department.

The contractor shall leave the fire alarm system in proper working order, and, without additional expense to the owner, shall replace any defective materials or equipment provided by him under this contract within one year (365 days) from the date of final acceptance by the awarding authority.

Prior to final test the fire department must be notified in accordance with local requirements.

6.3 As Built Drawings, Testing, and Maintenance Instructions

A. As Built Drawings

A complete set of reproducible "as-built" drawings showing installed wiring, color coding, and wire tag notations for exact locations of all installed equipment, specific interconnections between all equipment, and internal wiring of the equipment shall be delivered to the owner upon completion of system.

B. Operating and Instruction Manuals

Operating and instruction manuals shall be submitted prior to testing of the system. Three (3) complete sets of operating and instruction manuals shall be delivered to the owner upon completion. User operating instructions shall be provided prominently displayed on a separate sheet located next to the control unit in accordance with U.L. Standard 864.

END OF SECTION

SECTION 31 13 13.13 - WASTE MATERIAL DISPOSAL

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

- A. Waste material disposal consists of disposal of trees, brush, vegetation, rubbish and other objectionable matter from operations such as clearing and grubbing, demolition, excavation, concrete placement and grading. Unless otherwise specified, the Contractor is responsible for removal and disposal of waste material.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Specific products are not required. Use equipment and materials necessary to properly complete disposal of waste materials.

PART 3 - EXECUTION

3.1 DISPOSAL AREA

- A. Items noted on plans to be "removed" or "disposed" will be taken completely off the site.
- B. Concrete wash-out will become property of Contractor to be disposed of with other waste materials.

3.2 COMPACTION AND GRADING

- A. Level off waste material to an elevation 12 inches below final grade. Place excess topsoil on waste material in a layer not less than 12 inches thick and compact to the density of the surrounding area.

END OF SECTION 31 13 13.13

SECTION 31 20 00 – EARTHWORK (UNDER PAVING AND SITE APPURTENANCES)

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

- A. This section includes the furnishing of all plant, labor, equipment, materials and the performance of all operations required to complete the Earthwork indicated on the Drawings and specified herein, including the following: Clearing and Grubbing, Stripping, Excavation, Embankment, Borrow, Subgrade Preparation, Compaction and Finish Grading.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

3.1 CLEARING & GRUBBING

- A. This item shall consist of clearing the ground of all trees, brush, rubbish, and of grubbing the roadway, pavement areas, roadside ditches and/or outfall ditch right-of-way or other easements as designated within the limits of the project. The designated areas shall be cleared of stumps, brush, logs, rubbish, trees and shrubs, except such trees and shrubs and certain areas designated by the Engineer for preservation shall be carefully protected from abuse, marring or damage during construction operations. Continual parking and/or servicing of equipment under the branches of trees designated for preservation will not be permitted. Trees and shrubs designated for preservation, that must be pruned, shall be trimmed as directed by the Engineer and all exposed cuts over two (2) inches in diameter shall be treated with an approved material.
- B. On areas required for paving, channel, or structural excavation, all stumps, roots, etc., shall be removed to a depth of approximately 2-feet below the lower elevation of the excavation. On areas required for embankment construction, all stumps, roots, etc., shall be removed to a depth of approximately 2-feet below the existing ground surface. All holes remaining after clearing and grubbing shall be backfilled and compacted to ninety percent of Standard Proctor Density (ASTM Method D698) at a moisture content of between optimum and plus 3 percent of optimum as directed by the Engineer and the entire area bladed to prevent ponding of water and to provide drainage; except in areas to be immediately excavated, the Engineer may direct that the holes not be backfilled. On areas required for borrow sites and material sources, stumps, roots, etc., shall be removed to the complete extent necessary to prevent such objectionable matter becoming mixed with the material to be used in construction.
- C. All cleared and grubbed materials shall be disposed of off site. Contractor shall be responsible for obtaining any necessary disposal permits. The Contractor shall not bury any refuse on site. No burning shall be permitted unless specifically noted and permitted by local jurisdictions.
- D. No separate measurement or payment will be made for furnishing all labor, materials, permits, supervision, equipment and supplies required to complete all items of work specified for clearing and grubbing.

3.2 STRIPPING

- A. Within the limits indicated, or in areas where existing grade is to be altered either by excavation or embankment, the Contractor shall strip existing topsoil to approximately 3-inches in depth, except that areas beneath foundations or structures shall be stripped to a minimum depth of 6-inches, and

may be stockpiled for future use or disposed of at the Contractor's expense. Stripping shall include the removal and disposal of scrap iron, rubbish, logs, abandoned utilities, signs, and any and all other debris, if within the project site or right-of-way, whether above or below existing grade. Stripping and excavation can take place in the same operation, provided the topmost material is suitable for use in future construction and provided it is not to be set aside for backfill or topsoil. The upper topsoil and debris to be stripped as noted above, shall be removed regardless of whether the site is to be excavated or receive embankment. Surface soil, not suitable for use in the future construction and any other unsatisfactory material shall be excavated, removed off the site and placed in designated spoil banks or shall otherwise be disposed of as directed by the Engineer in such a manner as not to create an unsightly or objectionable condition.

- B. Stripping will not be paid for directly. Payment for stripping shall be subsidiary to excavation, borrow or embankment.

3.3 EXCAVATION

- A. Excavation shall consist of the required excavation within the project limits, the removal and proper utilization or disposal of all excavated materials; and the constructing, shaping and finishing of all earthwork on the entire project site, in conformity with the required lines, grades and typical cross sections, and in accordance with the specification requirements herein outlined. All suitable excavated materials shall be utilized, insofar as practicable, in grading the site, uniformly widening embankment, flattening slopes, etc., or as directed by the Engineer. The Engineer will define suitable materials. Unsuitable excavation in excess of that needed for construction shall be known as waste and shall become the property of the Contractor to be disposed of by the Contractor outside the limits of the site. Unsuitable material encountered below subgrade elevation, shall be replaced with material from the excavation, or with other suitable material.
- B. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price, including preparing ditches, trimming of slopes, disposal of surplus materials (wastage), preparation and completion of subgrade, shoulders, roadway, any necessary hauling and the furnishing of all labor, tools, equipment and incidentals necessary to complete the work.

3.4 EMBANKMENT

- A. This item shall govern for the placement and compaction of all materials obtained from the site, borrow, channels, structural and sewer excavation, including all underground utility excavation, used in the construction of project fill and/or embankment. Prior to placing any embankment, all stripping and/or clearing and grubbing operations shall have been completed on the excavation sources and areas over which the embankment is to be placed. Stump holes or other small excavations in the limits of the embankments shall be backfilled with suitable material and thoroughly compacted by approved methods before commencing embankment construction.
- B. Unless otherwise indicated on the plans, the surface of the ground of all unpaved areas, which are to receive embankment, shall be loosened by scarifying or plowing to a depth of not less than 4-inches. The loosened material shall be recompacted with the new embankment as hereinafter specified and shall not exceed 8-inches in total depth. Where indicated on the plans or as directed by the Engineer, the surface of a hillside to receive embankment shall be loosened by scarifying or plowing to a depth of not less than 4 inches, or cut into steps, benched or notched before embankment materials are placed. The embankment shall then be placed in layers, not to exceed 8-inches, as hereinafter specified, beginning at the low side in part width layers and increasing the widths as the embankment is raised. The material, which has been loosened, shall be recompacted simultaneously with the embankment material placed at the same elevation. Where embankments are to be placed adjacent to or over existing roadbeds, the roadbed slopes shall be plowed or scarified to a depth of not less than 4-inches and the embankment built up in successive layers, as hereinafter specified to the level of the old roadbed before its height is increased. The top of the

old roadbed shall be scarified and recompacted with the next layer of the new embankment. The total depth of the scarified and added material shall not exceed the permissible depth of layer.

- C. Trees, stumps, roots, vegetation or other unsuitable materials shall not be placed in the embankment.
- D. Except as otherwise required by the plans, all embankment shall be constructed in layers approximately parallel to the finished grade of the site or paving. Embankments shall be constructed to the grade established by the Engineer and completed embankments shall correspond to the general shape of the typical sections shown on the plans and each section of the embankment shall correspond to the detailed section or slopes established by the Engineer. After completion, the site shall be continuously maintained to its finished section and grade until the project is completed.
- E. No material placed in the embankment by dumping in a pile or windrow shall be incorporated in a layer in that position, but all such piles or windrows shall be moved by blading or similar methods. Clods or lumps of material shall be broken, and the embankment material mixed by blading, harrowing, discing, or similar methods to the end that a uniform material is secured in each layer. Water required for sprinkling to bring the material to the moisture content necessary for maximum compaction shall be evenly applied and it shall be the responsibility of the Contractor to secure uniform moisture content throughout the layer by such methods as may be necessary.
- F. After each layer of embankment or select material is complete, the Engineer will make tests as necessary. If the material fails to meet the density specified, the course shall be reworked, as necessary, to obtain the specified compaction. Should the subgrade, due to any reason or cause, lose the required stability, density or finish before the pavement is placed, it shall be recompacted and refinished at the sole expense of the Contractor. Excessive loss of moisture in the subgrade shall be prevented by sprinkling, sealing or covering with a subsequent layer of asphaltic or other approved material. Embankment shall not be paid for directly, but shall be incidental to site excavation, channel excavation, construction of underground utilities, including all sewers, or borrow.

3.5 BORROW

- A. Borrow shall consist of the required excavation, removal and proper utilization of materials secured from sources obtained by the Contractor and approved by the Engineer. Borrow shall be used only when shown on the bid form or directed by the Engineer and then only from approved sources. Borrow material shall come only from sources approved by the Engineer. The Engineer shall provide samples of the fill material for testing and approval. In the event the material is not acceptable, as determined by the Engineer, the Contractor shall find other sources. All fill material shall be free from organic matter and deleterious material.
- B. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price. All work performed as required herein shall be full compensation for furnishing all labor, for all materials, for all royalties and freight involved, for all hauling, delivery, spreading and compacting complete and in place and for all tools, equipment and incidentals necessary to complete the work.

3.6 SUBGRADE

- A. The subgrade shall be brought to the lines, grades and typical cross section shown on the plans and in accordance with these specifications. Whenever unsuitable natural material is encountered and cannot be handled by the excavation or embankment requirements, then the following requirements shall apply. The unsuitable material shall be excavated to a depth deemed sufficient by the Engineer and the excavated material shall be disposed of off the jobsite at the expense of the Contractor. The excavated area shall be filled to its original level with suitable material meeting

the requirements of borrow. This imported material shall be compacted to 95-percent of standard proctor density, (ASTM Method D698) using a moisture content ranging from optimum to plus 3-percent above optimum. Soils shall not be compacted at less than the optimum moisture content.

- B. After all holes and depressions are filled with approved material, the subgrade shall be brought up to the lines and grades required and if it is not to be stabilized, it shall be compacted to 95-percent of standard proctor density, (ASTM Method D698), using a moisture content ranging from optimum to plus 3-percent above optimum. The subgrade, without stabilization, shall be compacted to a depth of 9-inches. The subgrade shall be kept free from all ruts and weak spots. Any ruts and weak spots that develop under traffic shall be repaired with suitable material as they develop.

3.7 COMPACTION

- A. All fill material shall be placed in uniform layers, dried or moistened as required to obtain approximate optimum moisture content and rolled to a density of at least 95 percent of maximum density at optimum moisture as determined by ASTM D-698. Compaction equipment shall be as hereinafter specified. The maximum thickness of uniform layers (loose measurements) shall be as follows:
 - 1. If the Contractor elects to use a pneumatic tired roller, the thickness of each uniform layer shall not exceed six (6) inches.
 - 2. If the Contractor elects to use sheepsfoot rollers, the thickness of each uniform layer shall not exceed eight (8) inches.
 - 3. In locations where it is impractical to use the roller equipment, mechanical hand tampers will be used, and the thickness of each uniform layer shall not exceed four (4) inches. The method used to secure the optimum moisture content will be the Contractor's responsibility. The compacting equipment and the method of compaction shall be such that a uniform density will be obtained over the entire area and depth of material being compacted. All fill material deposited in place by means of scrapers, dump trucks, draglines or other similar equipment shall be thoroughly broken up before being spread into the uniform layers. Rolling shall start longitudinally at the sides and proceed toward the center of the crowned sections or start longitudinally at the low side and proceed toward the high side of sloped areas, overlapping on successive trips by at least one-half (1/2) the width of the roller unit. Alternate trips of the roller shall be slightly different in length.
- B. Excess loss of moisture shall be construed to exist when the soil moisture content is three (3) percent less than optimum moisture.
- C. An independent qualified Testing Laboratory either selected by or approved by the Owner or Engineer, for every 500 square yards of the compacted subgrade shall take density tests. The Testing Laboratory will furnish written reports covering results of all tests and inspections made. Reports will be made promptly to the Engineer, Contractor and Owner.

3.8 FINISH GRADING

- A. Uniformly smooth grade all areas indicated on the drawings to be graded. The finish surface shall be not more than 0.05 feet above or below the established grade or approved cross section. All ditches and swales shall be properly graded so as to drain readily. Where existing grade is disturbed by the Contractor in areas not marked to be graded, the Contractor will regrade the disturbed area to its original grade at no additional expense to the Owner.

END OF SECTION 31 20 00

SECTION 31 23 00 - CONSTRUCTION OF UNDERGROUND UTILITIES

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section shall govern for all excavation required for the construction of sewers, sewer structures, pipe culverts, appurtenances and connections and for the backfilling around completed sewers to the level of the original ground, all in conformity with the locations, lines and grades shown on the plans or as given by the Engineer and in accordance with these specifications. This Section shall also govern for any necessary pumping or bailing and drainage and all sheathing and bracing of trench walls. Also governed by this Section are the cutting and restoration of pavement and base courses, the furnishing and placing of cement stabilized backfill, the hauling and disposing of surplus materials and the bridging of trenches and other provisions for maintenance of traffic or access as provided herein.

1.2 QUALITY ASSURANCE

- A. The Testing Laboratory's representative will determine the moisture density relationship in accordance with ASTM D698 on material secured from the trench excavation. Samples secured from the cement stabilized sand supplier shall be blended with Portland cement in accordance with Section 31 23 23.16 - Cement Stabilized Sand Bedding and Backfill, and the moisture density relationship will be determined in accordance with ASTM D558.
- B. The Testing Laboratory's representative will determine the in-place density in accordance with ASTM Methods D2922 or D1556. The minimum level of testing will consist of at least one test for each 200 linear feet of trench per lift of backfill.
- C. At the completion of the project, all on site storm and sanitary sewer lines shall be cleaned out using a hydraulic jet machine in the presence of the owner and engineer. After hydro-jetting storm and sanitary sewer lines, all segments shall be video tape recorded and tapes shall be furnished to the owner.

1.3 REQUIRED INSPECTIONS

- A. The contractor is solely responsible for meeting with all inspecting authorities having jurisdiction over the project (to include, but not limited to: Water District, City, County, State and Federal) prior to construction. All required inspections shall be coordinated by the contractor prior to installation of the WORK. All WORK found to be deficient by the inspector(s) and WORK installed prior to notification of inspector(s) shall be removed and replaced at the contractor's sole expense.

PART 2 – PRODUCTS

2.1 CONNECTIONS TO BUILDING GRAVITY SEWERS

- A. Connections to building gravity sewers, to include roof drains and sanitary sewer connections shall be made with SCH 40 X SDR adapter couplings.
- B. Fernco couplers are not allowed.

PART 3 – EXECUTION

3.1 EXCAVATION & TRENCH PREPARATION

- A. Excavate trench to the alignment and depth required. Brace the trench and drain, as required, so that the work may be accomplished safely and efficiently. If necessary, install a dewatering system to provide a dry trench bottom. Pumps shall discharge into natural drainage channels or to drains. Shoring for excavations and trenches shall meet the requirements of the latest edition of OSHA Regulation 1926, Subpart P.
- B. For pipes less than 30 inches in diameter, the minimum width of the trench shall be the width of the outside barrel of the pipe plus 24 inches, the maximum width of the trench shall be the width of the outside barrel of the pipe plus 36 inches. For pipe 30 inches and larger, the minimum trench width shall be the width of the outside barrel of the pipe plus 32 inches, and the maximum width of the trench shall be the width of the outside barrel of the pipe plus 36 inches.
- C. Side sloping or benching of the trench, where permitted, will begin at one foot above the top of the pipe and will not encroach upon private property or endanger existing or future structures or underground utilities. Depth of trench, without sheathing or bracing shall comply with OSHA Regulation 1926.650.
- D. The full width of the trench shall be excavated to a depth below the invert elevation of the pipe so as to permit placing the bedding material specified on the attached drawings below the outside bottom of the pipe. Any additional depth excavated by the Contractor shall be replaced with an equal depth of cement-stabilized sand. The cost of this additional material, in place shall be at the expense of the Contractor.
- E. Where necessary, excavations shall have sheathing and bracing to prevent caving. At these locations, increase the trench width as required and leave the sheathing in place until the pipe has been laid and the backfill compacted to a depth of 2 feet over the pipe. All sheathing and bracing shall be designed to the requirements of OSHA Standard 1926, Subpart P (latest edition).
- F. Sewers shall not be constructed, or sewer pipe laid in the presence of water. All water shall be removed from the excavation sufficiently prior to the sewer placing operation to ensure a dry, firm bed on which to place the sewer and shall be maintained in such unwatered condition until all concrete and mortar is set. Removal of water may be accomplished by bailing, pumping or by a well-point system as conditions warrant. There will be no separate pay for well pointing without the prior approval of the Engineer. Contractor shall include in base proposal all costs associated with de-watering, well pointing, stabilizing, etc. necessary to install all underground utilities.
- G. In the event that the excavation cannot be dewatered to the point where the pipe subgrade is free of mud, excessive wet soil, sand silt or clay with water, a seal slab shall be used in the bottom of the excavation. Such seal slab shall consist of a lean concrete mixture. The seal slab shall be a Class "D", 5 sacks of cement per cubic yard with a minimum compressive strength of 1,750 P.S.I. at 7 days and 2,500 P.S.I. at 28 days. A precast seal slab may be used, provided that the joints of the seal slab do not occur at the joint of the pipe. Contractor shall have an option of using a three-day cylinder break test at no expense to the Owner.
- H. For unstable conditions requiring outside forms, seals, sheathing, and bracing, or where groundwater is encountered, any additional excavation in width and backfill required shall be done at the Contractor's expense. Portable trench boxes may be used in lieu of sheathing upon approval in writing by the Engineer. The trench box must be in accordance with OSHA Regulation 1926.650 (latest edition).

- I. Use of the trench box does not relieve the Contractor of any liability for damages to person or property. When a trench box is moved, the jointed pipe or in-place backfill shall not be disturbed.
- J. All materials from excavation operations not required for backfilling, if considered suitable shall be placed in embankments or wasted, in accordance with Section 31 20 00 - Earthwork. All material not suitable for use in embankments will be declared surplus by the Engineer and shall become the responsibility of the Contractor to dispose of as he wishes. Such surplus material shall be promptly removed from the work following the completion of the portion of the sewer involved. No separate payment shall be made for disposal of this surplus material.
- K. Unless otherwise specifically approved, Contractor shall use ladder or wheel-type trench-digging machinery, except where hand methods must be employed to avoid damage to existing structures above or below ground, or where hand excavation is indicated.
- L. Engineer may limit the amount of trench opened or partially opened at any time in advance of the completed pipe laying operation and the amount of trench left unfilled. Open no more than 500 feet of trench at any one time.

3.2 PIPE LAYING

- A. No pipe shall be laid in water or when the trench conditions or weather is unsuitable for such work, unless specifically approved by the Engineer.
- B. Non-pressure concrete pipe shall be laid with the ends abutting and true to line and grade. Fit and lay the pipe to form a smooth and uniform invert. Laying of pipe shall commence at the lowest point, so that the spigot ends point in the direction of flow. Lay cast iron pipe on firm earthen foundation with bell ends facing the direction of laying.
- C. All other types of pipe shall be laid in accordance with the applicable provisions of this specification, in accordance with the Special Provisions preceding this Subsection, or with the manufacturer's recommendations.
- D. Cut cast iron pipe with wheel-type cutters or cold chisel. Flame cutting of cast iron pipe is not allowed. Make cuts in a neat and workmanlike manner without damage to pipe and so as to leave a smooth end at right angles to axis of pipe. Field cutting of Polyvinyl Chloride shall be in accordance with the pipe manufacturer's recommendations.
- E. Minor deflections may be obtained in pipe joints. Contractor must obtain approval when the degree of deflection is necessary to deflect from a straight line. Where necessary to make major deflections in concrete pipe, use sections of pipe with beveled ends for deflections not greater than five degrees. For deflections greater than five degrees, use fabricated fittings for concrete pressure pipe and use cast iron fittings for cast iron pipe.
- F. When the pipe laying operation is halted, seal the open end of the pipe with a temporary plug. Plug is to remain in place until the pipe laying operation re-commences. Standard plugs shall be inserted into bells of all dead-end pipe.
- G. All underground pipe shall have a 12-gauge metallic tracer wire running the full length of the pipe. Tracer wire shall be taped to the pipe at intervals not to exceed 15-feet using duct tape and terminate at each end above ground in a 2" PVC riser.
- H. Pipe shall be installed with the labels facing upward.
- I. At the completion of the project, all on site storm and sanitary sewer lines shall be cleaned out using a hydraulic jet machine in the presence of the owner and engineer. After hydro-jetting storm

and sanitary sewer lines, contractor shall run video-camera through pipes and video-record each line segment in order to document proper installation.

3.3 BACKFILLING

- A. As soon as practicable after completion of laying and jointing of pipe, backfill the trench. Not more than 200 feet of the trench shall be left open after laying the pipe.
- B. Trenches shall be backfilled in accordance with drawing details and notes. Backfill material selected from sewer trench excavation, or obtained from other sources, shall be free from stones, which will interfere with compaction and free of large lumps, which will not break down readily under compaction. Do not use material excavated in large lumps which will not break down or which cannot be spread in loose layers. Material excavated by trenching machine will generally be suitable for use as backfill. Cement stabilized sand shall be in accordance with Section 31 23 23.16 - Cement Stabilized Sand Bedding and Backfill.
- C. When placing backfill in the trench simultaneously on both sides of the pipe for the full width of the trench, moisten if necessary and tamp in approximately 6-inch layers, thoroughly compacting under and on each side of the pipe to provide solid backing against the external surface of the pipe. Walking or working on the completed pipeline, except as necessary in tamping or backfilling shall not be permitted until the trench has been backfilled to at least 12-inches over the top of the pipe.

3.4 RESTORATION OF SURFACES

- A. Replace or repair sidewalks, driveway culverts, inlets, curbing, gutters, shrubbery, trees, fences, sod and other like obstructions removed or disturbed, to the condition equivalent to that existing prior to commencement of this work. Use concrete having a compressive strength of not less than 3,000 psi in 28 days for the replacement of curbing, gutters, inlets and sidewalks.
- B. Use reasonable care in the removal and replacement of shrubbery and trees designated to be replaced at original locations. Where at all possible, ditch alignment will be such as to minimize this work. The restoration of asphalt-topped flexible base and concrete streets shall be as specified under other items of the specifications.

3.5 CLEAN-UP

- A. The Contractor shall remove from the site of the work and from public and private property temporary structures, rubbish, and waste materials, including excess excavated materials. The Contractor is responsible for disposing of all surplus earth. The pipe laying operation shall be temporarily suspended if the clean-up is falling behind as determined by the Engineer or Owner.

3.6 MEASUREMENT & PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

END OF SECTION 31 23 00

SECTION 31 23 23.13 - BANK SAND BACKFILL

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section shall consist of the furnishing, placing, manipulation, compacting and completing in-place, Bank Sand as a bedding and backfill material for water and sewer lines, as construction fill for certain excavation areas, as construction fill for ruts, holes and other similar conditions; as a fill material for project clean-up and as directed by the Engineer. Bank sand shall be in accordance with these specifications and in conformity with the lines, grades and cross-sections shown on the plans and as directed by the Engineer.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Bank sand is to be free of organic matter, foreign material, clay balls, sticks, foreign objects and other objectionable material. Bank sand shall have a plasticity index less than three (3) and shall meet the following gradation: 100 percent passing a 3/8-inch sieve, 5 to 30 percent passing a No. 200 sieve. Prior to use, Contractor shall identify the source of the proposed bank sand for testing.

PART 3 - EXECUTION

3.1 CONSTRUCTION

- A. After the water line, sewer line or other similar construction item, such as a trench, has been excavated and brought to grade, bank sand shall be furnished, placed, compacted complete in-place, either as bedding or backfill material, as shown on the plans, described in these specifications or as directed by the Engineer. After the trench or excavation has been brought to grade, the bank sand shall be placed and compacted as a bedding material, the construction item shall be placed and joined properly around and over that construction item as required and as shown on the plans, described in the specifications or directed by the Engineer. Bank sand shall be placed in layers not exceeding 8-inches. It shall be compacted with mechanical vibratory tamps to maximum dry density in accordance with ASTM Method D698 at a moisture content ranging from optimum to three percentage points above optimum. Water flooding will not be permitted.

3.2 TESTING

- A. The Testing Laboratory's representative will determine the moisture density relationship for each material proposed for use as backfill, in accordance with ASTM Method D698. In place density will be determined in accordance with ASTM Methods D2922 or D1556, and with each type of construction. For walls and trenches, determine the in-place density for each 200 feet of wall or trench, for each lift of fill placed.

3.3 MEASUREMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

END OF SECTION 31 23 23.13

SECTION 31 23 23.16 - CEMENT STABILIZED SAND BEDDING AND BACKFILL

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section specifies cement stabilized sand to be used for backfilling and bedding as called for on the drawings, in other parts of the specifications, or as directed by the Engineer.

1.2 PERFORMANCE

- A. The sand cement mixtures shall produce a minimum unconfined compressive strength of one hundred pounds per square inch (100 psi) in forty eight hours, when compacted to ninety five percent (95%) of Standard Proctor density (ASTM Method D558), without additional moisture control and when cured in plastic bags at a temperature of 73.4° F at plus or minus 3° F and tested in accordance with ASTM D1633.
- B. Random samples of the delivered product will be taken in the field at the direction of the Engineer and tested at the Owners expense.

1.3 MEASUREMENT AND PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Cement shall be Type I Portland cement conforming to ASTM C150. Sand shall be clean durable sand containing not more than the following:
 - 1. Deleterious Materials:
 - a. Clay lumps, when tested in accordance with ASTM C142 shall be less than 0.5 percent. Lightweight pieces, when tested in accordance with ASTM C123 shall be less than 5.0 percent. Organic impurities when tested in accordance with ASTM C40 shall not show a color darker than the standard color.
 - 2. The plasticity index shall be six (6) or less when tested in accordance with ASTM D4318.
 - 3. Sand shall be free of organic matter and deleterious substances and shall meet the following gradation requirement.

<u>Square Sieve Size</u>	<u>% Passing, By Weight</u>
3/8"	100%
No. 200	5 - 30%

- 4. Water shall be clean and clear, free of oils, acids, alkalis, organic matter or other deleterious substances and shall conform to the requirements of ASTM C1602.

2.2 SAND-CEMENT MIXTURE PRODUCT

- A. The mixture shall consist of not less than 1.5 sacks of Portland cement per cubic yard (1.1 sacks per ton) of material mixture as placed. The mixture shall contain sufficient water to hydrate the cement.
- B. The cement, sand and water shall be mixed in a pug mill type mixer, which meets the approval of the Engineer. It shall be mixed for a minimum period of two minutes per batch.

PART 3 – EXECUTION

3.1 APPLICATION

- A. The sand cement mixture shall be placed in maximum eight (8) inch thick lifts, loose measure, and thoroughly rodded and tamped around the pipe, boxes, structures, and paving sections. Placement and compaction shall be performed in a manner that will thoroughly fill all voids without placing undue strain on or displacement of the structure.
- B. Cement stabilized sand backfill below the top of sewers, manholes, inlets or other structures shall be placed equally along all sides of the structure. Cement stabilized sand backfill/bedding shall be placed in a manner that will completely fill all voids in the trench. Should compaction be required to fill all voids in the areas described, hand operated tampers may be used.
- C. Materials not placed and compacted within four (4) hours after mixing shall be rejected. Do not place or compact sand-cement mixtures in standing or free water.
- D. Cement stabilized sand backfill/bedding that is placed in trench bottoms or all other locations between the tops of sewer lines to the bottom of the subgrade, shall be compacted to a minimum of ninety five percent (95%) of Standard Proctor Density (ASTM Method D558), and shall apply to all areas of construction within the limits of the project.
- E. In-place density tests shall be taken at each location, each day, to test the placement of bedding/backfill material as directed by the Engineer. In-place densities shall be determined in accordance with ASTM D6938 or ASTM D1556.

END OF SECTION 31 23 23.16

SECTION 31 31 16 - TERMITE CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Furnishing and applying both pre-construction and post-construction subterranean termite control treatment as described herein on the Project.

1.2 COORDINATION

- A. Each offeror shall be responsible for determining during the proposal period the extent that any addenda issued during the proposal period may affect this Section of the Specifications.
- B. Reference instructions to offerors for requirements regarding substitutions of materials and products.
- C. Where conflicts occur between the Drawings and Specifications, between different drawings, between portions of this Section of the Specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.
- D. Contractor shall notify Structural Pest Control Board (SPCB) prior to application of termite treatment at the site as required by law.
- E. Comply with all federal, state and local requirements and authorities having jurisdiction.

1.3 QUALITY ASSURANCE

- A. Applicator shall be bonded and licensed with all applicable authorities.
- B. Products and application techniques shall meet all requirements of federal, state and local regulations regardless of products and techniques specified herein.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's printed literature describing products and detailed application requirements.
 - 2. Document that product is currently allowed by the Environmental Protection Agency (EPA), the State of Texas, and all applicable county and local authorities for use under building slabs.
 - 3. Material Safety Data Sheet (MSDS).
- B. Samples:
 - 1. Of proposed written warranty.
 - 2. Sample of product use form.
- C. Certification:
 - 1. After completion of Work under this Section, submit manufacturer's signed affidavit, verifying specification compliance of the chemicals, their proportions, and application.

2. Contractor shall certify that pesticide used on project does not contain the chemical or have any ingredient known as "Dursban".

1.5 WARRANTY

- A. Provide written warranty against defects in materials and application for a period of five (5) years after application.
- B. Defects shall include, but not be limited to the following:
 1. Evidence of activity by subterranean type termites.
 2. Damage of building materials due to subterranean termites.
- C. During the warranty period the applicator shall, at his own expense provide additional termite treatment as required to prevent termite activity. Repair or replace building materials damaged by subterranean termite activity during the warranty period at no expense to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Dominion 2L (EPA Reg. No. 53883-229) as manufactured by Control Solutions, Inc.; (800) 242-5562 or comparable product approved by Architect with minimum five (5) years of experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions in order to be considered.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Inspect building earth fill and foundation excavation for readiness and to ensure that soils are not too wet for proper application of treatment.
- B. Post conspicuous warning signs indicating date(s) and time(s) of application and notify contractors working in area of such date(s) and time(s).

3.2 MIXING

- A. Mixing shall be in accordance with manufacturer's printed instructions.

3.3 APPLICATION

- A. Do not apply while school is in session.
- B. Apply to ensure a continuous chemical barrier.
- C. Apply with blue dye for visualization verification.
- D. Pre-Construction Treatment:
 1. Apply an overall treatment to the entire surface of soil or other substrate to be covered by the slab, including areas to be under carports, porches, basement floor, and entrance platforms in accordance with manufacturer's printed instructions and recommended application rates.
 2. Apply along inside of foundation walls, and around plumbing, bath traps, utility services, and other features that penetrate the slab in accordance with manufacturer's printed instructions and recommended application rates.

3. Apply at crawl spaces, at hollow block foundations or voids in masonry resting on the footing, and at plenums in accordance with manufacturer's printed instructions and recommended application rates.
- E. Post-Construction Treatment:
1. Apply a treatment under the slab, including attached porches, carports, entrance platforms, garages and similar slab structures in accordance with manufacturer's printed instructions and recommended application rates. Drill all holes spaced in a manner to allow for application of a continuous chemical barrier. Plug and fill all drill holes in occupied areas or where visually exposed with a suitable sealant recommended by manufacturer.
 2. Apply at existing cracks and cold, construction and expansion joints and around bath traps, plumbing and utility services which penetrate the slab in accordance with manufacturer's printed instructions and recommended application rates.
 3. Apply at crawl spaces in accordance with manufacturer's printed instructions and recommended application rates.
- F. At perimeter grade beams, trench along beams or use rodding as recommended by the manufacturer. The final treatment of the exterior beam will be performed within 30 days of notification of completion of landscaping or one (1) year from the date of completion of construction.
- G. Allow for drying after application, in accordance with manufacturer's instructions, before placing vapor barrier and beginning concrete placement or other construction activities.
- H. All treatment applications must be in compliance with all federal, state, and local laws and regulations with regard to mixing, applying, and disposing of debris and waste.

END OF SECTION 31 31 16

SECTION 31 32 13.17 - CEMENT STABILIZED SUBGRADE

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. This item shall consist of treating the subgrade by the pulverizing, the addition of Portland cement, mixing, wetting and compacting the mixed material to the required density. This item applies to natural ground, embankment or existing pavement structure and shall be constructed as specified herein and in conformity to the typical sections, lines and grades as shown, on the plans or as established by the Engineer.
- B. Cement treatment shall not be mixed or placed when the air temperature is below 40° F and falling, but may be mixed or placed when the air temperature is above 35° F and is rising, the temperature being taken in the shade and away from artificial heat and with the further provision that cement treatment shall be mixed or placed only when weather conditions, in the opinion of the Engineer, are suitable.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Soil shall consist of approved material free from vegetation or other objectionable matter encountered in the existing roadbed and other acceptable material used in the preparation of the roadbed in accordance with this specification.
- B. Portland cement shall be Type I of a standard brand of cement and shall conform to the requirements of ASTM Designation C150.

One sack, containing 1 cubic foot of cement, shall be considered as weighing 94 pounds net. One barrel of cement shall be considered as weighing 376 pounds net and containing 4 cubic feet.

The Contractor, at his option, may use bulk cement, provided the apparatus for handling, weighing and spreading the cement is approved by the Engineer. Cement weighing equipment shall meet the requirements of the Item, "Weighing and Measuring Equipment".

- C. Water shall be free from substances deleterious to the hardening of the cement treatment and shall meet the requirements of the Item, Concrete Pavement.

The ratio of cement to soil will be based on dry material weight and shall be established by the Engineer in the field to provide the desired stability. The normal range is 6-percent to 10-percent by weight. The percentage of moisture in the soil, at the time of the cement application shall not exceed the quantity that will permit the uniform and intimate mixture of soil and cement during the dry mixing operations and shall not exceed the specified optimum moisture content for the soil cement mixture, as determined by ASTM Method D558.

2.2 EQUIPMENT

- A. Equipment necessary for proper construction of the work shall be on the project, in first-class working condition and be approved by the Engineer, both as to type and condition, prior to the start of construction operations. The Contractor shall at all times provide sufficient equipment to enable continuous prosecution of the work.

- B. Portland cement treatment for materials in-place may be constructed with any machine or combination of machines and auxiliary equipment that will produce the results as outlined in this specification.
- C. Mixing may be accomplished by a multiple-pass traveling mixing plant or a single-pass traveling mixing plant.
- D. The equipment provided by the Contractor shall be operated by experienced and capable workmen and shall be that necessary to provide a cement treatment meeting the requirements herein specified.

PART 3 - EXECUTION

3.1 CONSTRUCTION METHODS

- A. It is the primary requirement of this specification to secure a completed course of treated material containing a uniform Portland cement mixture free from loose or segregated areas, of uniform density and moisture content, well bound for its full depth and with a smooth surface suitable for placing subsequent courses. It shall be the responsibility of the Contractor to regulate the sequence of his work, to process a sufficient quantity of material to provide full depth as shown on the plans, to use the proper amount of Portland cement, maintain the work and rework the courses as necessary to meet the above requirements.
- B. The Portland cement shall be mixed to the full depth shown on the plans and in no case, shall it be less than six (6) inches.
- C. The subgrade shall be firm and able to support, without displacement, the construction equipment at the density hereinafter specified. Soft or yielding subgrade shall be corrected and made stable by scarifying and aeration or adding cement and compacting until it is of uniform stability.
- D. Before other construction operations are begun, the subgrade shall be graded, shaped and compacted, as required, to construct the Portland cement treatment for materials in-place in conformance with the lines, grades, thickness and typical cross section shown on the plans. Unsuitable soil or material shall be removed and replaced with acceptable material.
- E. The soil shall be so pulverized that, at the completion of moist-mixing 100-percent by dry weight passes a 1-inch sieve, and a minimum of 80-percent passes a No. 4 sieve, exclusive of gravel or stone retained on these sieves. Old bituminous wearing surfaces shall be pulverized so that 100 percent will pass a 2-inch sieve.
- F. Portland cement shall be spread uniformly on the soil at the rate specified or as approved by the Engineer. If a bulk cement spread is used, it shall be positioned by string lines or other approved methods during spreading to insure a uniform distribution of cement.
- G. Cement shall be applied only to such an area that all operations can be continuous and completed in daylight and within 5 hours of such application.
- H. The percentage of moisture in the soil at the time of cement application, shall not exceed the quantity that will permit uniform and intimate mixture of the soil and cement during dry mixing operations, and it shall not exceed the specified optimum moisture content for the soil cement mixture.
- I. No equipment, except that used in spreading and mixing, will be allowed to pass over the freshly spread cement, until it is mixed with the soil.

- J. After the cement has been applied, it shall be dry mixed with the soil. Mixing shall continue until the cement has been sufficiently blended with the soil to prevent the formation of cement balls when water is applied. Any mixture of soil and cement that has not been compacted and finished shall not remain undisturbed for more than 30 minutes.
- K. Immediately after dry mixing of soil and cement is complete, water as necessary shall be uniformly applied and incorporated into the mixture. Pressurized equipment shall provide an adequate supply to ensure continuous application of the required amount of water to the sections being processed within 3-hours of the application of the cement. Proper care shall be exercised to insure proper moisture distribution at all times. After the last increment of water has been added, mixing shall continue until a thorough and uniform mix has been obtained.
- L. The material shall be compacted to not less than 95-percent of standard proctor density (ASTM Method D698). At the start of compaction, the percentage of moisture in the mixture and in the unpulverized soil lumps, based on dry weights, shall not be below or more than two percentage points above the specified optimum moisture content and shall be less than that quantity which will cause the soil cement mixture to become unstable during compaction and finishing. When the uncompacted soil cement mixture is wetted by rain so that the average moisture content exceeds the tolerance given at the time of final compaction, the entire section shall be reconstructed in accordance with this specification at the sole expense of the Contractor.
- M. The specified optimum moisture content and field density shall be determined from representative samples of the soil, taken in the fields and blended cement in a materials laboratory setting in accordance with ASTM Method D698.
- N. Prior to the beginning of compaction, the mixture shall be in a loose condition for its full depth. The loose mixture shall then be uniformly compacted to the specified density lines and grades.
- O. After the soil and cement mixture is compacted, water shall be uniformly applied, as needed, and thoroughly mixed. The surface shall then be reshaped to the required lines, grades and cross section and then lightly scarified to loosen any imprint left by compacting or shaping equipment.
- P. The resulting surface shall be thoroughly rolled with a pneumatic tire roller and "skinned" by a power grader to achieve final grade, removing all loosened soil and cement from the section. The surface shall then be thoroughly compacted with the pneumatic roller, adding small increments of moisture as needed during rolling. If aggregate larger than a No. 4 screen is present in the mixture, one complete coverage of the section with the flat wheel roller shall be made immediately after the skinning operation. When directed by the Engineer, surface finishing methods may be varied from this procedure, provided a dense uniform surface, free of surface compaction planes, is produced. The moisture content of the surface material must be maintained at its specified optimum during all finishing operations. Surface compaction and finishing shall proceed in such a manner as to produce, in not more than 2-hours, a smooth, closely knit surface, free of cracks, ridges or loose material conforming to the crown, grade and line shown on the plans.

3.2 CURING

- A. After the cement treated course has been finished as specified herein, the surface shall be protected against rapid drying by either of the following curing methods for a minimum period of 3-days, or as directed by the Engineer. These methods of curing are:
 - 1. Maintain in a thorough and continuously moist condition by sprinkling.
 - 2. Apply an asphalt membrane to the treated course, immediately after its completion. The material for the asphalt membrane shall be MC-30. The asphaltic material shall meet the requirements of Item 300, "Asphalt Oils and Emulsions" contained in the Texas Highway Department; "Standard Specifications for Construction of Highways, Streets and Bridges," Latest Edition. The quantity and type of asphalt approved for use by the Engineer shall be

sufficient to completely cover and seal the total surface of the base and fill all voids. If the Contractor elects to use this method, it shall be his responsibility to protect the asphalt membrane from being picked up by the traffic. The asphalt membrane may remain in-place when the proposed surface or base courses are placed. The surface or other base courses may be applied on the finished base as soon after completion as operations will permit.

3.3 CONSTRUCTION JOINTS

- A. At the end of each day's construction a straight transverse construction joint shall be formed by cutting back into the total width of completed work to form a true two-inch depth vertical face free of loose and shattered material.
- B. Cement treatment for large wide areas shall be built in a series of parallel lanes of convenient length and width meeting the approval of the Engineer.

3.4 TRAFFIC

- A. After the 3 day curing period, or as directed by the Engineer, completed sections of cement treated material in-place, may be opened immediately to local traffic and to construction equipment and to all traffic after the curing period, provided the cement treated course has hardened sufficiently to prevent marring or distorting the surface by equipment or traffic.

3.5 MAINTENANCE

- A. The Contractor shall be required, within the limits of his contract, to maintain the cement treated course in good condition until all work has been completed and accepted. Maintenance shall include immediate repairs to any defects that may occur. This work shall be done by the Contractor at his own expense and repeated as often as may be necessary to keep the area continuously intact. Faulty work shall be replaced for the full depth at treatment. It is the intent of this specification that the Contractor construct the plan depth of cement treatment in one homogenous mass. The addition of thin stabilized layers will not be permitted in order to provide the minimum specified depth.

3.6 QUALITY ASSURANCE

- A. The Testing Laboratory's representative will determine the Moisture-Density Relationships in accordance with ASTM Method D698 on material secured from the roadway. Samples will be blended with Portland cement for each type of material encountered.
- B. The Testing Laboratory' representative will determine the in-place density in accordance with ASTM Methods D2922 or D1556. The minimum level of testing will consist of at least three tests for each 1,000 feet per lane of roadway or 4,000 square feet (500 square yards) of embankment.

3.7 MEASUREMENT

- A. The work performed and the material furnished as prescribed by this item will be measured as follows:
 - 1. Manipulation of cement during stabilization of the subgrade will be measured by the square yard of surface area of the completed and accepted work in-place.
 - 2. Portland cement will be measured by the ton of 2,000 pounds.

END OF SECTION 31 23 13.17

SECTION 31 32 13.19 - LIME STABILIZED SUBGRADE

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. This item shall consist of treating the subgrade, by the pulverizing, addition of lime, mixing and compacting the mixed material to the required depth and density, and in the amounts shown on the plans.
- B. This item applies to natural ground, embankment, base or sub-base and shall be constructed to the sections, lines and grades shown on the plans. The subgrade shall be stabilized with lime to a depth of at least 6-inches in the amount recommended by a materials engineering laboratory. The P.I. shall be determined by ASTM Method D4318.

1.2 QUALITY ASSURANCE

- A. The Testing Laboratory's representative will determine the Moisture-Density Relationships in accordance with ASTM Method D698 on material secured from the roadway after stabilization with lime, for each type of material encountered.
- B. The Testing Laboratory's representative will determine the in-place density in accordance with ASTM Method D2922 or D1556. The minimum level of testing will consist of at least three tests for each 1,000 feet per lane of roadway or 4,000 square feet (500 square yards) of embankment.

1.3 MEASUREMENT AND PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Lime for stabilization shall be classified as Type A- Hydrated Lime, or Type B- Commercial Lime Slurry, conforming to the requirements of Section 31 32 13.20 - Hydrated Lime and Lime Slurry.

2.2 EQUIPMENT

- A. The machinery, tools and equipment necessary for proper execution of the work shall be on the project and approved by the Engineer prior to the beginning of construction operations. All machinery, tools and equipment used shall be maintained in a satisfactory and workmanlike manner.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

- A. It is the primary requirement of this specification to secure a completed course of treated material containing a uniform lime soil mixture free from loose or segregated areas, of uniform density and moisture content, well bound for its full depth and with a smooth surface suitable for placing

subsequent courses. It shall be the responsibility of the Contractor to regulate the sequence of his work, to use the proper amount of lime, maintain the work and rework the courses as necessary to meet the above requirements.

- B. The subgrade shall be constructed and shaped to conform to the typical sections, lines and grades as shown on the plans or as established by the Engineer. The subgrade shall be firm and able to support, without displacement, the construction equipment at the density herein specified. Any wet or unstable materials below the secondary grade shall be corrected, as directed by the Engineer, by scarifying, adding lime, and compacting, or other methods until satisfactory stability is obtained. The cost of the repair of the secondary subgrade and any materials below the secondary subgrade is incidental to this Section.
- C. The Contractor shall be required to proof-roll the subgrade, as directed by the Engineer, before using the pulverizing machine and correct any soft areas that this rolling may reveal.
- D. Lime shall be spread only on that area where the first mixing operations can be completed during the same working day. The application and mixing of lime with the material shall be accomplished by the methods hereinafter described as "Dry Placing" or "Slurry Placing". When Type A, Hydrated Lime, is specified, the Contractor may use either method, unless otherwise noted on the plans.
- E. When dry placing, the lime shall be spread by an approved spreader or by bag distribution at the rates shown on the Bid Sheet, or as directed by the Engineer.
- F. The lime shall be distributed at a uniform rate and in such a manner as to reduce the scattering of lime by wind to a minimum. Lime shall not be applied when wind conditions, in the opinion of the Engineer, are such that blowing lime becomes objectionable to traffic or adjacent property owners. A motor grader shall not be used to spread the lime.
- G. The material shall be sprinkled as directed by the Engineer, until the proper moisture content has been secured. Where Type A, hydrated lime is specified and slurry placement is used, the Type A hydrate shall be mixed with water to form a slurry of the solids content designated by the Engineer. A minimum of two mixing passes will be required.
- H. Where Type B, commercial lime slurry is to be used, it shall be of the minimum solids and purity for the applicable grade being used. The distribution of lime shall be at the rates shown on the proposal form, or as directed by the Engineer. Proper application shall be attained by successive passes over a measured section of the roadway, until the proper moisture and lime content has been secured. The distributor truck shall be equipped with an agitator, which will keep the lime and water in a uniform mixture.
- I. The material and lime shall be thoroughly mixed by approved road mixers or other approved equipment, and the mixing continued until, in the opinion of the Engineer, a homogenous friable mixture of material and lime is obtained, such that when all non-slaking aggregates retained on the 3/4-inch sieve are removed, the remainder of the material shall meet the following requirements when tested in accordance with ASTM Method C136, from samples procured from the roadway.

TABLE I

Minimum Passing 1 3/4" sieve	100 Percent
Minimum Passing 3/4" sieve	85 Percent

- J. If gradation is achieved on the first mixing, no additional mixing is required.
- K. The soil lime mixture shall be sprinkled during the mixing operation as directed by the Engineer to provide optimum moisture in the mixing. The subgrade shall be stabilized to a minimum depth of

6-inches and compacted to a minimum of 95-percent of standard proctor density (ASTM D698) at a moisture content of optimum to 3-percent above optimum.

- L. During the interval of time between application and mixing, hydrated lime that has been exposed to the open air for a period of 6-hours, or more, or has had excessive loss due to washing or blowing will not be accepted for payment.
- M. Compaction of the mixture shall begin immediately after final mixing unless approval has been obtained from the Engineer not to do so. The material shall be aerated and/or sprinkled as necessary, to provide the optimum moisture content. Compaction shall begin at the bottom and shall continue until the entire depth of mixture is uniformly compacted.
- N. The material and lime shall be thoroughly mixed by approved road mixers or other approved equipment and the mixing continued until, in the opinion of the Engineer, a homogenous, friable mixture of material and lime is obtained, free from all clods or lumps. Materials containing plastic clays or other materials which will not readily mix with lime shall be mixed as thoroughly as possible at the time of lime application, brought up to the proper moisture content and left to cure 48 to 96, hours as directed by the Engineer. During the curing period the material shall be kept moist as directed.
- O. If a second mixing is required, the material shall be given a final mixing, using approved methods. If the soil binder-lime mixture contains clods, they shall be reduced in size by raking, blading, discing, harrowing, scarifying, or the use of other approved pulverization methods, so that all non-slaking material retained on the 3/4-inch sieve is removed and the remainder of the material shall meet the gradation requirements outlined by Table I. After the second mixing has been completed, the material shall be allowed to cure for a minimum of 3 days, unless otherwise directed by the Engineer.
- P. The material shall be sprinkled and rolled, as directed by the Engineer. All irregularities, depressions or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding or removing material as required and reshaping and re-compacting by sprinkling and rolling. The surface of the course shall be maintained and cured for a minimum of 3 days, prior to placing a base or surface course or until traffic is allowed to travel thereon.
- Q. In addition to the requirements specified for density, the full depth of the material shown on the plans shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section is completed, tests as necessary will be made by the Engineer. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements. Throughout this entire operation, the shape of the course shall be maintained by blading and the surface upon completion shall be smooth and in conformity with the typical section shown on the plans and to the established lines and grades. Should the material, due to any reason or cause, lose the required stability, density and finish before the next course is placed or the work is accepted, it shall be reprocessed and refinished at the expense of the Contractor.

3.2 FINISHING

- A. After the final course of the lime treated subgrade has been compacted, it shall be brought to the required lines and grades in accordance with the typical sections. The completed section shall then be finished by rolling as directed with a pneumatic tire or other suitable roller sufficiently light to prevent hair cracking. The completed section shall be moist, or emulsion cured until covered by base material, unless otherwise directed by the Engineer. If the plans provide for the treated material to be sealed or covered by other courses of material, such seal or course shall be applied within 14 days after final mixing and compaction is completed, unless otherwise directed by the Engineer.

END OF SECTION 31 32 13.19

SECTION 31 32 13.20 - HYDRATED LIME AND LIME SLURRY

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 DESCRIPTION

- A. This Section establishes the requirements for hydrated lime and commercial lime slurry of the type and grade considered suitable for use in the treatment of natural or processed materials or mixtures for subgrade, sub-base and base construction.

1.2 MEASUREMENT AND PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. The various types and grades are defined and identified as follows:
 - 1. Type A, Hydrated Lime: Shall consist of a dry powder obtained by treating quicklime with enough water to satisfy its chemical affinity for water under the conditions of its hydration. This material is to consist essentially of calcium hydroxide or a mixture of calcium hydroxide and a small allowable percentage of calcium oxide, magnesium oxide and magnesium hydroxide. Hydrated lime shall meet the requirements of ASTM Designation.
 - a. When sampled and tested according to prescribed Texas Highway Department procedures, hydrated lime shall conform to the following requirements as to chemical composition:

1)	Hydrate alkalinity, percent by weight	CA (OH) ₂	Min. 90.0%
2)	Unhydrated lime content, percent by weight	CaO	Max. 5.0%
3)	"Free Water" content, percent by weight	H ₂ O	Max. 4.0%
 - b. The percent by weight of residue retained shall conform to the following requirements:

1)	Residue retained on a No. 6	sieve	Max. 0.0%
2)	Residue retained on a No. 10	sieve	Max. 1.0%
3)	Residue retained on a No. 30	sieve	Max. 2.5%
 - c. Specifications for Type "A" applies specifically to the normal hydrate of lime made from "high-calcium" type limestone. Hydrated Lime for stabilization purposes shall be applied, as provided in the governing specifications, as a dry powder or mixed with water to form a slurry.
 - 2. Type B, Commercial Lime Slurry: Shall be pumpable suspension of solids in water. The water or liquid portion of the slurry shall not contain dissolved material in sufficient quantity and/or nature injurious or objectionable for the purpose intended. The solids portion of the mixture, when considered on the basis of "solids content", shall consist principally of hydrated lime of a quality and fineness sufficient to meet the following requirements as to chemical composition, residue and delivered in trucks which shall be equipped with an agitator which will keep the lime and water in a uniform mixture.

- a. Chemical Composition: The "solids content" of the lime slurry shall have a hydrate alkalinity $\text{Ca}(\text{OH})_2$ of not less than 90% by weight.
- b. Residue: The percent by weight of residue retained in the "solids content" of lime slurry shall conform to the following requirements:
 - 1) Residue retained on a No. 6 sieve Max. 0.0%
 - 2) Residue retained on a No. 10 sieve Max. 1.0%
 - 3) Residue retained on a No. 30 sieve Max. 2.5%
- c. Type B: Commercial Lime Slurry shall conform to one of the following grades:
 - 1) Grade 1: The "Dry Solids Contents", shall be at least 31 percent by weight of the slurry.
 - 2) Grade 2: The "Dry Solids Contents", shall be at least 35 percent by weight of the slurry.
 - 3) Grade 3: The "Dry Solids Contents", shall be at least 46 percent by weight.

PART 3 – EXECUTION

3.1 SAMPLING AND TESTING

- A. The sampling and testing of lime slurry shall be as determined by Test Method Tex-600-J, "Lime Testing Procedure".
 1. When Type A: Hydrated Lime is used, the quantity of lime will be measured by the ton of 2000 pounds, dry weight.
 2. When Type B: Commercial Lime slurry, is used, the quantity of lime shall be calculated from the required minimum percent solids based upon the use of Grade 1, Grade 2, or Grade 3 as follows:
 - a. Grade 1: The "Dry Solids Content" shall be at least 31 percent by weight of the slurry and the quantity of lime will be calculated by the ton of 2000 pounds based on the 31 percent dry weight solids.
 - b. Grade 2: The "Dry Solids Content" shall be at least 35 percent by weight of the slurry and the quantity of lime will be calculated by the ton of 2000 pounds based on the 35 percent dry weight solids.
 - c. Grade 3: The "Dry Solids Content" shall be at least 46 percent by weight of the slurry and the quantity of lime will be calculated by the ton of 2,000 pounds based on the 46 percent dry weight solids.

END OF SECTION 31 32 13.20

SECTION 31 32 13.21 - LIME-FLYASH STABILIZED SUBGRADE

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

- A. This item shall consist of treating the subgrade by the pulverizing, addition of lime flyash and/or flyash, mixing and compacting the mixed material to the required density. This item applies to natural ground and embankment and shall be constructed as specified herein and in conformity with the typical sections, lines and grades shown on the Plans.

1.2 QUALITY ASSURANCE

- A. The Materials Engineer will determine the Moisture-Density Relationship in accordance with ASTM Method D698, on material secured from the roadway. Samples shall be blended with Lime-Flyash in the laboratory for each type of material encountered.
- B. The Materials Engineer will determine the in-place density in accordance with ASTM Method D2922 or D1556. The minimum level of testing will consist of at least three tests of 4,000 square feet (500 square yards) of subgrade.

1.3 MEASUREMENT AND PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Hydrated lime shall meet the requirements of ASTM C977 and SECTION 31 32 13.20 – HYDRATED LIME AND LIME SLURRY of these Specifications. When Type B, commercial lime slurry, is specified, the Contractor shall select, prior to construction, the grade to be used and shall notify the Engineer in writing before changing from one grade to another.
- B. Flyash shall meet the requirements of ASTM C618, Class C. Flyash shall also have a minimum CaO content of 20 percent.
- C. Water shall meet the requirements of ASTM Designation C94.

2.2 EQUIPMENT

- A. Machinery, tools and equipment for proper performance of the work shall be on the Project and approved by the Engineer prior to the beginning of construction operations.
- B. All machinery, tools and equipment used shall be maintained in a satisfactory and workmanlike manner.
- C. Hydrated lime and flyash shall be stored and handled in closed, weatherproof containers until immediately before distribution on the subgrade. If storage bins are used, they shall be completely enclosed. Materials in bags shall be stored in weatherproof buildings with adequate protection from ground dampness.

- D. If lime and/or flyash are furnished in trucks, each truck shall have a weight ticket from a certified scale.
- E. If lime and/or flyash are furnished in bags, each bag shall bear the manufacturer's certified weight. Bags varying more than five percent from that weight may be rejected and the average weight of the bags in any shipment, as shown by weighing 50 bags taken at random, shall not be less than the manufacturer's certified weight.

PART 3 – PRODUCTS

3.1 CONSTRUCTION METHODS

- A. It is the primary requirement of this Specification to secure a complete course of treated material containing a uniform lime-flyash or flyash mixture free from loose or segregated areas, of uniform density and moisture content, well bound for its full depth, and with a smooth surface and suitable for placing subsequent courses. It shall be the responsibility of the Contractor to regulate the sequence of his work, to use the proper amount of lime and flyash, maintain the work and rework the courses as necessary to meet the above requirements.
- B. Before other operations are begun, the subgrade shall be graded, shaped, and compacted as required to construct the lime-flyash or flyash treatment for materials in-place in conformance with the lines, grades, thickness and typical cross sections shown on the Plans. Unsuitable soil or material shall be removed and replaced with acceptable material.
- C. The subgrade shall be constructed and shaped to conform to the typical sections, lines and grades as shown on the plans or as established by the Engineer. The subgrade shall be firm and able to support, without displacement, the construction equipment at the density herein specified. Any wet or unstable materials below the secondary grade shall be corrected, as directed by the Engineer, by scarifying, adding lime and/or fly ash, and compacting, or other methods until satisfactory stability is obtained. The cost of the repair of the secondary subgrade and any materials below the secondary subgrade is incidental to this Section.
- D. The Contractor shall be required to proof-roll the subgrade, as directed by the Engineer, before using the pulverizing machine and correct any soft areas that this rolling may reveal.
- E. The Contractor shall be required to use a cutting and pulverizing machine that will remove the subgrade material accurately to the secondary subgrade; and pulverize the material at the same time. He will not be required to expose the secondary grade nor windrow the material. However, the Contractor shall be required to roll the subgrade, before using the pulverizing machine and correct any soft areas that this rolling may reveal. This method will be permitted only where a machine is provided which will ensure that the material is cut uniformly to the proper depth and which has cutters that will plane the secondary grade to a smooth surface over the entire width of the cut.
- F. The cost of the repair of the secondary subgrade and any materials below the secondary subgrade is incidental to this item.
- G. When lime-flyash stabilization is required it shall be a two-phase operation, with the lime placed and allowed to cure, before the flyash stabilization begins.
- H. Application of the lime and the subsequent curing shall be in accordance with SECTION 31 32 13.19 - LIME STABILIZED SUBGRADE. After the subgrade has cured for the time required by that Specification, then flyash stabilization may begin. Flyash stabilization shall be in accordance with this Specification. Unless otherwise noted, the thickness of stabilization shall be 6-inches.

- I. The machine will be of such design that a visible indication is given at all times that the machine is cutting to the proper depth.
- J. Lime shall be spread only on that area where the first mixing operation can be completed during the same working day.
- K. The sequence of application of lime and flyash, with the material, shall be accomplished by the methods hereinafter described as "Dry Placing", or "Slurry Placing". When Type A, hydrated lime is specified, the Contractor may use either method.
- L. The lime or flyash shall be spread by a spreader or by bag distribution at the rate directed by the Engineer.
- M. For dry placing, the lime or flyash shall be distributed at a uniform rate and in such a manner as to reduce the scattering of lime or flyash by wind to a minimum. Lime or flyash shall not be applied when wind conditions are such that blowing lime or flyash becomes objectionable to traffic or adjacent property owners. A motor grader shall not be used to spread the lime or flyash.
- N. The materials shall be sprinkled until the proper moisture content has been secured. However, initial mixing after the addition of lime or flyash will be accomplished dry or with a minimum of water to prevent lime and/or flyash balls.
- O. For slurry placing, the lime or flyash shall be mixed with water in vehicles with approved distributors and applied as a thin water suspension or slurry.
- P. Type B, commercial lime slurry, shall be applied with a lime percentage not less than that applicable for the grade used. The distribution of lime and flyash shall be attained by successive passes over a measured section of roadway until the proper moisture and lime or flyash content has been secured. The distributor vehicle shall be equipped with an agitator, which will keep the lime or flyash and water in a uniform mixture.
- Q. The mixing procedure shall be the same for "Dry Placing or "Slurry Placing", as hereinafter described.
- R. The material shall be uniformly mixed by approved methods. If the soil binder lime mixture contains clods, they shall be reduced in size by raking, blading, discing, harrowing, scarifying or the use of other approved pulverization methods so that when all non-slaking aggregates retained on the 3/4" sieve are removed, the remainder of the material shall meet the following requirements when tested at the field moisture condition, or dry by laboratory sieves in accordance with ASTM Method C136.

Minimum Passing 1-3/4 sieve	100 percent
Minimum Passing 3/4 sieve	85 percent
- S. It is the intent of this Specification that lime and flyash shall be spread as directed by the Engineer.
- T. The amount of lime and flyash used shall be as directed by the Engineer.
- U. During the interval of time between application and mixing, hydrated lime or flyash that has been exposed to excessive loss due to washing or blowing will not be accepted for payment. Spreading, mixing, compaction and finishing for lime-flyash stabilized subgrade should be completed during daylight hours of the same day.
- V. If flyash only is to be used without lime, the following mixing procedures shall apply.

- W. The raw material shall be thoroughly mixed by approved road mixers or other approved equipment, and the mixing continued until a homogeneous, friable mixture is obtained, free from all clods or lumps.
- X. The flyash shall be distributed at a uniform rate and in such manner as to reduce the scattering of flyash by the wind to a minimum. Flyash shall not be applied when wind conditions, are such that blowing flyash becomes objectionable to traffic or adjacent property owners. A motor grader shall not be used to spread flyash.
- Y. The material and flyash shall be thoroughly mixed by approved road mixers or other approved equipment and the mixing continued until a homogeneous, friable mixture of materials is obtained, free from all clods or lumps. If the soil binder-flyash mixture contains clods, they shall be reduced in size by raking, blading, discing, harrowing, scarifying or the use of other approved pulverization methods so that when all nonslaking aggregates, retained on the 3/4" sieve are removed, the remainder of the material shall meet the following requirements when tested at the field moisture condition or dry by laboratory sieves using ASTM Method C136:

Minimum Passing 1-3/4 sieve	100 percent
Minimum Passing 3/4 sieve	85 percent

- Z. Flyash shall be applied only to such an area that all the operations can be continuous and completed in daylight.
- AA. During the interval of time between application and mixing, flyash that has been exposed to the open air for a period of 6 hours or more, or to excessive loss due to washing or blowing will not be accepted for payment. It is recommended that the mixing and compaction of flyash stabilized subgrade be completed within 2 hours in order to take advantage of rapid initial set characteristics.
- BB. Mixing after the addition of flyash will be accomplished dry or with a minimum of water to prevent flyash balls.
- CC. Compaction of the mixture shall begin immediately after adding and mixing of the last stabilizing agent and be completed within 6 hours. The material shall be aerated or sprinkled as necessary to provide the optimum moisture. Compaction shall begin at the bottom and shall continue until the entire depth of the mixture is uniformly compacted to 95 percent of standard proctor density (ASTM D698), to a minimum depth of 6 inches. In addition to the requirements it shall be compacted to the extent necessary to remain firm and stable under the construction equipment. Throughout the entire operation the shape of the course shall be maintained by blading, and the surface upon completion shall be smooth and in conformity with the typical section shown of the Plans and to the established lines and grades.
- DD. After the final layer of the lime-flyash or flyash treated subgrade has been compacted, it shall be brought up to the required lines and grades, and in accordance with the typical sections.
- EE. The resulting surface shall be thoroughly rolled with a pneumatic tire roller and skinned by a power grader to achieve final grade, removing all loosened stabilized material from the section. The surface shall be thoroughly compacted with the pneumatic roller, adding small increments of moisture as needed during rolling. If aggregate larger than a 3/4" screen is present in the mixture, one complete coverage of the section with the flat wheel roller shall be made immediately after the skinning operation. Surface finishing methods may be varied from this procedure to provide a dense, uniform surface, free of surface compaction planes. The moisture content of the surface material must be maintained at optimum during all finishing operations. Surface compaction and finishing shall proceed in such a manner as to produce, in not more than 2 hours, a smooth, closely knit surface, free of cracks, ridges or loose material conformity to the crown, grade and line shown on the Plans.

- FF. After the lime-flyash or flyash treated course has been finished as specified herein, the surface shall be protected against rapid drying by either of the following curing methods for a period of not less than 3 days or as directed by the Engineer.
1. Maintain in a thorough and continuously moist condition by sprinkling.
 2. Apply an asphalt membrane to the treated course, immediately after same is completed. The asphalt material for the membrane shall be MC-30. Asphaltic material shall meet the requirements of Item 300, Oils, Asphalts and Emulsions, of the TxDOT "Standard Specifications for Construction of Highways, Streets and Bridges". The asphalt shall completely cover and seal the total surface of the base and fill all voids. If the Contractor elects to use this method, it shall be his responsibility to protect the asphalt membrane from being picked up by traffic.
- GG. The asphalt membrane may remain in place when the proposed surface or other base courses are applied.
- HH. Completed sections of lime-flyash or flyash treated material in-place may be opened immediately to local traffic and to construction equipment and to all traffic after the curing period, provided the lime-flyash or flyash treated course has hardened sufficiently to prevent marring or distorting the surface by equipment or traffic, and after the minimum 3 day curing period. If the Plans provide for the treated material to be sealed or covered by other courses of material such seal or course shall be applied within 14 days after compaction unless otherwise directed by the Engineer. Should the material, due to any reason or cause, lose the required stability, density and finish before the next course is placed, it shall be reprocessed and refinished at the expense of the Contractor.

END OF SECTION 31 32 13.21

SECTION 31 41 00 - TRENCH SAFETY SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. This item is for furnishing all labor and materials for installation and maintenance of a trench safety system.
- B. For any trench excavation in materials other than solid rock, greater than five (5) feet in depth, or where shown on the plans, the contractor shall provide a trench safety system. This trench safety system shall be in accordance with the appropriate requirements established in the Occupational Safety and Health Administration (OSHA), Safety and Health Regulations, Part 1926, Subpart P - "Excavations, Trenching and Shoring" (latest edition).

1.2 MEASUREMENT

- A. Measurement of the "Trench Safety System" for gravity pipelines and boxes and for pressure pipelines shall be made by the linear foot of trench measured along the centerline of the trench.

1.3 PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION 31 41 00

SECTION 31 50 00 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes temporary excavation support and protection systems.
- B. Related Sections:
 - 1. Section 013200 "Construction Progress Documentation" for recording preexisting conditions and excavation support and protection system progress.
 - 2. Section 015000 "Temporary Facilities and Controls" for temporary utilities and support facilities.
 - 3. Section 312000 "Earth Moving"
 - 4. Section 312319 "Dewatering" for dewatering system for excavations.

1.3 PERFORMANCE REQUIREMENTS

- A. Design, furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.
 - 1. Delegated Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 - 2. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.
 - 4. Monitor vibrations, settlements, and movements.

1.4 SUBMITTALS

- A. Shop Drawings: For excavation support and protection system.
- B. Delegated-Design Submittal: For excavation support and protection system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Other Informational Submittals:
 - 1. Photographs or Videotape: Show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by the absence of, the installation of, or the performance of excavation support and protection systems. Submit before Work begins.
 - 2. Record Drawings: Identifying and locating capped utilities and other subsurface structural, electrical, or mechanical conditions.
 - a. Note locations and capping depth of wells and well points.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
 - 1. Notify all impacted parties including Owner no fewer than five (5) days in advance of proposed interruption of utility.
 - 2. Do not proceed with interruption of utility without Owner's written permission.

- B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from the data.
 - 1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection.
 - 2. The geotechnical report is referenced elsewhere in the Project Manual.

- C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Identify benchmarks and record existing elevations.
 - 1. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Delete this article if Contractor selects temporary excavation support and protection. Revise materials if prescribing excavation support and protection system requirements.

- B. General: Provide materials that are either new or in serviceable condition.

- C. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.

- D. Steel Sheet Piling: ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.
 - 1. Corners: Site-fabricated mechanical interlock or roll-formed corner shape with continuous interlock.

- E. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of size and strength required for application.

- F. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.

- G. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

- H. Tiebacks: Steel bars, ASTM A 722/A 722M.

- I. Tiebacks: Steel strand, ASTM A 416/A 416M.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
 - 1. Shore, support, and protect utilities encountered.
- B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Locate excavation support and protection systems clear of permanent construction so that forming and finishing of concrete surfaces are not impeded.
- D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.
- E. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

3.2 SOLDIER PILES AND LAGGING

- A. Install steel soldier piles before starting excavation. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
- B. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.
- C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

3.3 SHEET PILING

- A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock to form a continuous barrier. Accurately place the piling, using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer. Limit vertical offset of adjacent sheet piling to 60 inches (1500 mm). Accurately align exposed faces of sheet piling to vary not more than 2 inches (50 mm) from a horizontal line and not more than 1:120 out of vertical alignment. Cut tops of sheet piling to uniform elevation at top of excavation.

3.4 TIEBACKS

- A. Tiebacks: Drill, install, grout, and tension tiebacks. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.
 - 1. Test loading shall be observed by a qualified professional engineer responsible for design of excavation support and protection system.

2. Maintain tiebacks in place until permanent construction is able to withstand lateral soil and hydrostatic pressures.

3.5 BRACING

- A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.
 1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Architect.
 2. Install internal bracing, if required, to prevent spreading or distortion of braced frames.
 3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.6 REMOVAL AND REPAIRS

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.
 1. Remove excavation support and protection systems to a minimum depth of 48 inches (1200 mm) below overlaying construction and abandon remainder.
 2. Fill voids immediately with approved backfill compacted to density specified in Section 312000 "Earth Moving."
 3. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.
- B. Leave excavation support and protection systems permanently in place.

END OF SECTION 31 50 00

SECTION 32 01 90 - EXTERIOR LANDSCAPE MAINTENANCE

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Furnish labor, materials and equipment as necessary to provide a landscape maintenance program in accordance with the Specifications and Drawings and including, but not limited to:
 - 1. Monitoring, adjustment and repair of sprinkler irrigation.
 - 2. Watering of trees installed under this Contract in non-irrigated areas.
 - 3. Mowing, edging, weeding and trimming of lawn areas.
 - 4. Pruning and trimming of trees and shrubs.
 - 5. Weeding of mulched areas.
 - 6. Application of fertilizers, insecticides, and herbicides.
 - 7. General site clean up; removal of trash and products of maintenance.

1.2 REQUIREMENTS OF REGULATORY AGENCIES

- A. Perform Work in accordance with all applicable laws, codes, and regulations required by authorities having jurisdiction over such work and provide for all permits required by local authorities.

1.3 CONTRACTOR RESPONSIBILITIES

- A. Contractor shall begin maintenance immediately upon starting any portion of the Work of this Contract.
- B. Contractor's Maintenance Period shall continue 60 Days beyond Substantial Completion of the Work in this Contract.
- C. Irrigation System: Contractor's maintenance of the irrigation system shall consist of monitoring and adjustment of the duration and frequency of the watering schedule, adjustment of heads for coverage and elevation, repair of leaks in both mains and lateral lines and all other work required to establish a complete working irrigation system.
- D. Trees, Shrubs and Groundcovers: Contractor's maintenance of new planting shall consist of watering, cultivating, weeding, mulching, re-staking, tightening and repairing guys, resetting plants to proper grades or upright position, restoration of the planting saucer, and furnishing and applying such sprays and invigorants as are necessary to keep plantings free of insects and disease and in thriving condition.
- E. Lawns: Contractor's maintenance of new lawns shall consist of mowing, watering, weeding, repair of all erosion and reseeding as necessary to establish a uniform stand of the specified grasses.

1.4 PROTECTION

- A. Protect planting areas and lawns at all times against damage of all kinds for duration of maintenance period. Maintenance includes temporary protection fences, barriers and signs as required for protection. If any plants become damaged or injured, because sufficient protection was not provided, treat or replace as directed by Owner at no additional expense to Owner.

1.5 FINAL ACCEPTANCE

- A. Work under this Section will be accepted by Owner's Representative upon satisfactory completion of all work, including maintenance, but exclusive of the required guaranteed irrigation obligations, replacement of plant materials and lawns under the Warranty Period. Upon Final Acceptance, the Owner will assume responsibility for maintenance of the Work.

1.6 WARRANTIES AND REPLACEMENTS

- A. Refer to other Sections of Work.

1.7 MAINTENANCE INSTRUCTIONS

- A. At the completion of work, furnish two (2) copies of written maintenance instructions to Owner and one (1) copy to Owner's Representative for maintenance and care of the irrigation system, seeded areas and all planting throughout the year.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials required for installed items shall match those already in use.
- B. Samples of all materials not specified under other sections of these Specifications shall be submitted for review by Owner's Representative prior to use.
- C. Topdress Fertilizer: Commercial fertilizer with guaranteed analysis of 16-6-8 or as required for application use.

2.2 REQUIRED EQUIPMENT

- A. Contractor shall furnish the following maintenance equipment:
 - 1. Riding Lawnmowers
 - 2. Push Lawnmowers
 - 3. Gasoline Powered Edgers
 - 4. Trash Collection Equipment
 - 5. Line Trimmers
 - 6. Miscellaneous Hand Tools, Rakes, Brooms, Etc.
 - 7. Blowers
 - 8. Other equipment as needed.

PART 3 - EXECUTION

3.1 WATERING

- A. It shall be the responsibility of the Contractor to assume that the correct watering of plant materials is being accomplished through the following irrigation services:
 - 1. Regular deep watering to all new trees until there are definite signs that the trees have established themselves, new growth is apparent, and no trees are experiencing stress conditions. Deep watering shall be accomplished with hoses.
 - 2. Frequent watering to lawn areas to insure against drying. This may be accomplished as above, by the automatic sprinkler system, hand watering or portable sprinklers. Contractor shall monitor settings of automatic sprinkler controls and recommend necessary adjustments according to climatic changes.
 - 3. Contractor shall be responsible for watering areas that do not have irrigation systems.

4. Contractor shall be responsible for damages to irrigation system caused by mowing and other maintenance operations.

3.2 MAINTENANCE OF TURF AREAS

- A. Mowing lawn/grass areas shall be accomplished with sharp, properly adjusted mowers of the correct size for the various areas.
- B. Mowing frequency shall be in accordance with Landscape Maintenance Program. Blade heights shall be set according to the following schedule:
 1. 1-1/2 inches Initial Mowing
 2. 1-1/2 inches April - November
 3. Two (2) inches December - March
- C. In the event of a prolonged rainy period and a surge of leaf growth is anticipated, the mower height may be adjusted to prevent "scalping" or skinning of lawn on preceding cuts.
- D. Lawn shall be edged evenly at all walks, headers and other structures in accordance with Landscape Maintenance Program.
- E. Until the establishment of the turf, the Contractor will be responsible for replacing soils that have eroded onto the paved areas. Residual soils on paving will be removed and if not mingled with objectionable materials may be re-used in eroded areas.
- F. Immediately upon observing any lawn grass spreading into shrub or groundcover areas, the Contractor shall initiate a program of removal and maintain this program throughout the maintenance period.
- G. Any lawn grass appearing in paved areas shall receive an application of soil sterilant according to manufacturer's directions. The sterilant shall be approved and will not be detrimental structurally to paved areas.
- H. Special effort shall be given to the control of fire ants infesting the site. After control is accomplished, the ant mounds shall be lowered and tamped to the existing grade.
- I. Apply topdress fertilizer (10-6-8) 30 days after seeding.
- J. Removal of debris from the site unrelated to horticultural maintenance (paper, bottles, cans, "Pirate" signs, etc.) shall be the responsibility of the Contractor. Frequency in accordance with Landscape Maintenance Program.

3.3 MAINTENANCE OF TREES AND SHRUBS

- A. Contractor shall adjust and tighten as required all tree staking and guying. Removal as directed by Owner's Representative.
- B. Contractor shall deep water all new trees until there are definite signs the trees have established themselves and are pushing out new growth.
- C. Watering basins shall be removed by Contractor after the trees have established themselves or as directed by Owner's Representative. Basins are normally removed one (1) year from time of planting.
- D. Contractor shall be continuously alert for signs of insect presence or damage or the presence or damage from plant fungi. Upon locating such evidence, the Contractor shall report it to the Owner's Representative and take action as directed.

3.4 MOWING, EDGING, TRIMMING, LITTER CLEAN UP, AND IRRIGATION MONITORING

MONTH	NUMBER OF VISITS PER MONTH
January	Two (2)
February	Two (2)
March	Four (4)
April	Four (4)
May	Five (5)
June	Four (4)
July	Five (5)
August	Five (5)
September	Five (5)
October	Three (3)
November	Two (2)
December	Two (2)

3.5 TOPDRESS FERTILIZER

A. Thirty (30) days after seeding.

3.6 MULCHING, WEEDING, WEED CONTROL, GUYING AND STAKING ADJUSTMENT

A. As required at each visit.

3.7 RESEEDING

A. As required upon notice.

END OF SECTION

SECTION 32 13 13 - CONCRETE PAVING

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Concrete paving, including, but not limited to parking lots, aprons, sidewalks, curbs, handicapped accessible ramps, approaches, and miscellaneous exterior concrete shown on drawings.
- B. Traffic lane and parking space paint striping, including, but not limited to painting of curbs and stenciling of signs stipulating FIRE LANES, NO PARKING and BUS LOADING areas, crosswalks, handicapped accessible parking spaces, and other areas shown on drawings or required by authorities having jurisdiction.
- C. Precast concrete wheel stops and accessories shown on drawings.

1.2 QUALITY ASSURANCE

- A. Where standards or requirements of this Section are in conflict with those noted on the Contract Drawings, or the Building Code, the more stringent requirements shall govern. Bring all conflicts and discrepancies to the attention of the Architect and do not start work until such conflicts and discrepancies are clarified and corrected. Failure to do so will not relieve the Contractor from performing the Work correctly at no additional expense to the Owner.

1.3 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO)
 - 1. M-90
 - 2. M-213
- B. American Concrete Institute (ACI)
 - 1. 305, Hot Weather Concreting
 - 2. 306, Cold Weather Concreting
- C. ASTM International (ASTM)
 - 1. A185, Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
 - 2. A615, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 - 3. C33, Standard Specification for Concrete Aggregates
 - 4. C94, Standard Specification for Ready-Mixed Concrete
 - 5. C150, Standard Specification for Portland Cement
 - 6. C260, Standard Specification for Air-Entraining Admixtures for Concrete
 - 7. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
 - 8. C494, Standard Specification for Chemical Admixtures for Concrete
 - 9. C881, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
 - 10. C920, Standard Specification for Elastomeric Joint Sealants
 - 11. C979, Standard Specification for Pigments for Integrally Colored Concrete

- D. Federal Specifications (FS)
 - 1. TT-S-00227E, Elastomeric Joint Sealants
 - 2. TT-P-1952B, Traffic and Airfield Marking Paint, Water Emulsion Base

1.5 PROJECT CONDITIONS

- A. Do not place concrete in contact with frozen earth. Do not commence concrete placement unless temperature is at least 35 degrees F and rising, or slabs until the temperature rises above 40 degrees F.
- B. Discontinue concrete placement when air temperatures exceed 100 degrees F.
- C. Dispose of any concrete that exceeds 95 degrees F as determined by Architect in field.
- D. Do not place concrete during rain.
- E. Cold Weather Placing: Comply with ACI 306 to protect all concrete work from physical damage and reduce strength caused by frost, freezing actions, or low temperatures. Place no concrete against frozen earth.
- F. Hot Weather Placing: Prepare aggregates, mix water and other ingredients, and place, cure, and protect concrete in accordance with the requirements of ACI 305.
- G. Do not apply traffic or zone marking paint on wet or damp surfaces or when rain is imminent. Do not commence painting operations until material, air, and/or surface temperature and dew point are within paint manufacturer's recommended application limits.

1.6 TESTS AND INSPECTIONS

- A. Before starting any work under this section, make all required arrangements with testing agency. Provide testing laboratory with certified reports on proposed cements, aggregates mixing water and admixtures.
- B. Lab shall review design mixes for each type of concrete using previously tested and approved materials.
- C. The testing lab will proportion mixes by laboratory trial batch, using materials to be employed in the work for each class of concrete required and reporting to Architect.
 - 1. Concrete Compression Test - 7 day and 28 day
 - 2. Concrete Slump Test
 - 3. Concrete Air Content
- D. Furnish certified reports of format shown herein of each proposed mix for each type of concrete at least 30 days prior to start of installation of the Work of this Section.
- E. Furnish ready mix delivery tickets to field Architect upon request.

1.7 SUBMITTALS

- A. Product Data: Manufacturer's descriptive literature for concrete admixtures.
- B. Shop Drawings: Show locations and installation procedures. Include details of joints, accessories, reinforcement, and clearances. Include concrete placement sequence schedule.
- C. Concrete Design Mix Reports:
 - 1. One (1) for each type of concrete to be used.

- D. Submit product data and shop drawings for ALL items to be installed.
- E. Refer to Section 01 33 00 for submittal procedures.

1.8 INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13 – Project Coordination
- B. Required Participants:
 - 1. General Contractor Superintendent
 - 2. Placement and Finishing Foreman
 - 3. Concrete Supplier
 - 4. Testing Lab

1.9 MEASUREMENT AND PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

- A. Manufacturers named within this Section are approved for use on the Project for the product for which they are specified. Other manufacturers must have a minimum of five (5) years experience manufacturing the product specified and meet or exceed the specifications for that product. Substitution of products must be in accordance with the General Conditions, Supplementary Conditions, and Section 01 33 00, Submittals to be considered prior to proposal.

2.2 MATERIALS

- A. Formwork:
 - 1. General: Contractor may use any of the following formwork materials if material meets the following and will not stain, or impart any undesirable texture, i.e. wood grain, where such texture would be objectionable in an exposed location.
 - a. Wood Forms:
 - 1) Plywood: PS 1, Douglas Fir or Spruce species.
 - 2) Medium Density Overlay (MDO): One (1) side grade; sound undamaged sheets with clean, true edges.
 - 3) Lumber: Southern Yellow Pine species; No. 2 grade, with grade stamp clearly visible.
 - b. Prefabricated Forms:
 - 1) Preformed Steel Forms: Minimum 16 gauge matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
 - 2) Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- B. Metal Reinforcement:
 - 1. Bars:
 - a. Conform to ACI 315, latest edition.
 - b. Comply with ASTM A615, Grade 60, deformed billet steel bars, unfinished, except Number 3 bars shall comply with ASTM A615, Grade 40, deformed billet steel bars, unfinished.

2. Tie Wire: 16 gauge annealed.

C. Concrete Materials (Other than concrete for extruded curbs, unless noted otherwise)

1. Cement: Type 1, ASTM C150, unless approved otherwise by Architect. Use one (1) brand of cement for entire project.
2. Concrete Admixtures: Provide admixtures produced and serviced by established, reputable manufacturer and used in compliance with manufacturer's recommendations.
 - a. Air-Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures. Provide one (1) of the following, or Architect approved equal:
 - 1) Eucon AEA-92 and Eucon Air Mix 200 by The Euclid Chemical Company.
 - 2) Sika AEA 14 by Sika Corp.
 - 3) MasterAir AE or MasterAir VR by BASF Admixtures.
 - b. Water-Reducing Admixture: ASTM C494, Type A, and containing not more than 0.05 percent chloride ions. Provide one (1) of the following, or Architect approved equal:
 - 1) Eucon WR 75 or Eucon WR 91 by The Euclid Chemical Company.
 - 2) Master Pozzoloth 322 by BASF Admixtures.
 - 3) Plastocrete 161 by Sika Corp.
 - c. High-Range Water-Reducing Admixture (Superplasticizer): ASTM C494, Type F or Type G and containing not more than 0.05 percent chloride ions. Provide one (1) of the following, or Architect approved equal:
 - 1) Eucon 37 by The Euclid Chemical Company.
 - 2) ViscoCrete by Sika Corp.
 - 3) Master Rheobuild 1000 by BASF Admixtures.
3. Prohibited Admixtures: Calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions are not permitted.
4. Integral Color Pigment (Required for new concrete handicapped accessibility ramps): Mineral oxide, lightfast, lime-proof, water-resistant type conforming to ASTM C979. Color(s) shall be as selected by Architect from manufacturer's standard color line. Provide one (1) of the following, or Architect approved equal:
 - a. ChemSystems, Inc.
 - b. Davis Colors
 - c. New Riverside Ochre Co., Inc.
 - d. Scofield Decorative Concrete by Sika Corp.
5. Color Stain (Required for existing concrete handicapped accessibility ramps): A penetrating acrylic concrete stain, designed for adding color to existing concrete. Color(s) shall be as selected by Architect from manufacturer's standard color line. Provide H & C Silicone Acrylic Concrete Stain manufactured by Sherwin Williams, or Architect approved equal.
6. Aggregates:
 - a. Comply with ASTM C33
 - b. Maximum size not larger than 1/5 of narrowest dimension between forms of the member for which concrete is to be used. Not larger than 3/4 of minimum clear spacing between reinforcing bars.
 - c. 1-1/2 inch maximum in paving slabs.
7. Strengths:
 - a. Five and a half (5.5) sack (shall contain no less than 5.5 sacks of Portland cement)/3,500 psi/28 days.
 - b. Strength recommendations on Drawings supersede when they are greater than specified here.
8. Water: Drinking quality.
9. Water - Cement Ratio (lb water per lb of Portland cement):
 - 1) 0.52 Maximum

10. Slump:
 - a. Slump shall be 4 inches plus or minus 1 inch, unless specifically noted otherwise.

- D. Joints:
 1. Construction Joints and Expansion Joints: Refer to Paragraph on Accessories below.
 2. Tooled Control Joint: Scored ¼-inch wide x 1/4 thickness of concrete in depth.

- E. Accessories:
 1. Chairs and Spacers: Heavy-duty plastic-type sized to support all reinforcing steel to proper height directly on properly prepared and compacted subgrade. No sand cushion pads will be permitted. Provide chairs and spacers Series "B" by W.H.C. Products, Inc., E-Z Chair by Dayton Superior, MEDCO PC-4 by Meadow Burke, a CHR Company, GTI Bar Chair by General Technologies, Inc., or approved equivalent. Maximum spacing of chairs shall be 36-inches on center each way.
 2. Form Release Agent: Colorless mineral oil which will not stain concrete or absorb moisture.
 3. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages, Fasteners: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.
 4. Epoxy Adhesive: ASTM C881, two (2) component, 100 percent solids, 100 percent reactive compound suitable for use on dry or damp surfaces. Provide one (1) of the following, or approved equal:
 - a. Euco #452 Epoxy System or Euco #620 Epoxy System by The Euclid Chemical Company.
 - b. Sikadur Hi-Mod by Sika Corp.
 5. Expansion Joints:
 - a. Fiber Joint Filler: Pre-molded asphalt impregnated rigid fiber board. Comply with AASHTO M-213. Use 3/4-inch-thick at expansion joints adjacent to extruded curbs, 1/2-inch-thick at perimeter of footings for ground-set items such as bollards and fence posts where such footings are incorporated into slabs; elsewhere as shown.
 - b. Wood Expansion Joints: Where indicated in the drawing provide construction clear heart grade redwood joints conforming to AASHTO M-90. Provide sizes indicated on drawings. Do not install adjacent to curbs.
 - c. Joint Sealant: Shall be a self-leveling silicone base, cold-applied joint sealing compound complying with DOWSIL 890-SL Silicone Joint Sealant as manufactured by Dow Silicones Corporation or approved equal.
 6. Load Transfer Units:
 - a. Light Duty (sidewalk): 3/4 inch thick clear heart redwood expansion joint form with minimum one (1) inch deep removable top strip, 1/2 inch x 10 inch smooth steel reinforcing bars at 12 inches on center +/- with bond breaker sleeve on one (1) side, and 3/32 inch thick steel bar-support plates each side. Provide custom size as required for full depth of paving and sealant depth as required by sealant manufacturer.
 - b. Medium Duty (Auto) / Heavy Duty (truck/bus traffic): 3/4 inch thick redwood expansion joint form with minimum one (1) inch deep removable top strip, 3/4 inch by 18 inch steel reinforcing bars at 12 inches on center +/- with bond-breaker sleeve on one (1) side and 3/16 inch steel bar-support plates each side. Provide custom size as required for full depth of paving and sealant depth as required by sealant manufacturer.

- F. Curing Compound: The compound shall conform to ASTM C309-1315, Type II (A.I.M. Regulations - VOC Compliant). Provide 1600 White by W. R. Meadows, Inc., or equal products by BASF Admixtures, Dayton Superior, or approved equal.

- G. Other Materials: Provide all items required to complete work which is not specified, or which is not to be provided by other trades.

- H. Extruded Concrete Curbs:
 - 1. Materials:
 - a. Portland Cement: ASTM C150, Type I.
 - b. Aggregate: ASTM C33.
 - c. Water: Clean, free of contaminating material.
 - 2. Epoxy Adhesive: As specified under concrete materials above.
 - 3. Concrete Mixing:
 - a. Slump: No slump allowed.
 - 4. Curing Compound: As specified under concrete materials above.
- I. Traffic and Zone Marking Paint: (As shown on drawings or required)
 - 1. Type: chlorinated rubber paint conforming to the requirements of TT-P-115E. Sherwin Williams product Setfast Chlorinated Rubber Zone Marking Paint TM5126 – White and TM5127 – Yellow or approved equal.
 - 2. Stripe Size: Four (4) inches wide for traffic and parking lanes, unless noted otherwise.
 - 3. Colors:
 - a. Traffic and Parking Striping / crosswalks, directional arrows: White or as selected by Architect.
 - b. Fire Lanes: All curbs at driveways adjacent to building shall be painted solid red with white stenciled lettering to read “FIRE LANE, NO PARKING” in size and spacing required by authorities having jurisdiction. Contractor to verify requirements of local jurisdiction for fire lane striping.
 - c. Accessibility Handicapped Parking: Symbols and spaces shall be in size and color in accordance with ADA and TAS authorities having jurisdiction.
- J. Precast Concrete Wheel Stops: (As shown on drawings or required)
 - 1. Precast of 3,000 psi air-entrained concrete, approximately 6 inches high x 9 inches wide x 6 feet-0 inches long, with chamfered top corners and drainage slots underneath. Unit shall weigh minimum 190 lbs.
 - 2. Anchor Rods: Two (2) No. 4 by 12-inch-long anchor rods located approximately 12 inches from each end of wheel stop.
 - 3. Epoxy Adhesive: As specified under concrete materials above.
- K. ADA Detectable Warning Paver
 - 1. As produced by Pavestone or approved Equal.
 - 2. Color as approved by Architect.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Review approved mix designs with Architect in field.
- B. Clean all mixing and transportation equipment; remove debris from forms; wet forms thoroughly; remove ice and other coatings from reinforcement which might hinder good bond; remove water from place of deposit; and check reinforcement.
- C. Inspection: Examine all areas and conditions under which the Work of this Section will be performed. Correct any conditions detrimental to the approved completion of the work. Do not proceed until all such conditions are corrected.
- D. If thickness of concrete pavement is not labeled on the drawings, the thickness shall be 6-inch thick.

3.2 INSTALLATION

A. Forms:

1. Conform to the shapes, lines and dimensions of the members as shown on the drawings, except as modified under the Earthwork Section of these specifications. Review depths with Architect in field.
2. Care shall be taken to assure that formwork does not stain concrete surfaces.
3. Slab Block-Outs:
 - a. Diamond configuration at paving drains, round or diamond configuration at bollards, fence posts and the like.
 - b. Coordinate with concrete joints, verify with Architect.
4. Slope exterior concrete slabs away from building and towards paving drains. Verify all slopes with Architect prior to start of concrete pour.
5. Form Removal:
 - a. Remove only after concrete has thoroughly hardened.
 - b. Vertical forms for ground-supported slabs may be removed 24 hours after pour.

B. Reinforcing:

1. Cleaning Reinforcement: Free from rust, scale, dirt, or other coatings which will destroy or reduce the bond.
2. Placing Reinforcement:
 - a. Place accurately and adequately secure in position.
 - b. Bar reinforcement in all concrete slabs shall be held in proper locations by use of plastic chairs spaced a maximum distance of 36 inches on center unless noted otherwise.
3. Coverage of Reinforcement: The metal reinforcement shall be protected by the thickness of concrete indicated on the plans.
 - a. Three (3) inches: Concrete deposited against ground without use of forms.
 - b. Two (2) inches: Bars more than 5/8-inch diameter where concrete is exposed to the weather or exposed to the ground but placed in forms.
 - c. 1-1/2 inches: Bars 5/8-inch diameter where concrete is exposed to the weather or exposed to the ground but placed in forms.
 - d. Two (2) inches: In slabs and walks on grade.
 - e. 1-1/2 inches-1-3/4 inches from top: Paving

C. Joints:

1. Construction Joints:
 - a. Shall occur at expansion joints.
 - b. Use at cold joints in paving slabs.
2. Expansion Joints:
 - a. Locate fiber joint filler type where walks and paving abut curbs and at perimeter of slab infill. Joints shall be continuous and full depth and width of slab. Stop 3/4-inch-thick fillers 1/2 inch below top of paving and 1/2-inch-thick fillers 3/8 inch below top of paving for subsequent application of sealant cap; sealant to be applied to within 1/8 inch of slab surface. Verify other locations with Architect where asphalt impregnated fiber joint filler and sealant cap is to be used.
 - b. Locate redwood expansion joints at paving and walk expansion joints where indicated, complete with load transfer units as specified herein and detailed. Joints shall be continuous and full depth and width of slab. Except where detailed without sealant cap, stop expansion joints 1/2 inch below top of paving for subsequent application of sealant cap. Top surface of sealant shall be approximately 1/8 inch below top of adjacent concrete. Install sealant in accordance with manufacturer's instructions. For applications where no sealant cap is to be applied, stop expansion joints 1/8 inch below top of paving surface. Verify other locations with Architect where redwood expansion joint and sealer cap is to be used.
 - c. Install redwood expansion joints 5 feet either side of water lines under pavement.

3. Load Transfer Units: Install straight and true, and in accordance with manufacturer's instructions.
 4. Tooled Joints:
 - a. Steel tool all control joints, edges of expansion joints, and all exposed perimeter edges to smooth bullnose, using an edger having a radius of 1/4 inch, as approved.
 - b. Form control joints in uniform straight lines in locations indicated, but in no case greater than 5 feet apart, uniformly spaced.
- D. Accessories: Install accessories and boxes, sleeves and other required devices furnished by other trades.
- E. Concrete:
1. Conveying:
 - a. Batching, mixing and Delivery Equipment: Use transit mixed concrete from approved batching and mixing plant. Batch, mix, and transport concrete to the site in accordance with provision of ASTM C94.
 - b. Where colored concrete is shown or required, i.e. accessible ramps, use color pigment admixture in concrete. Mix color pigment into concrete in accordance with manufacturer's recommendations to achieve integrally pigmented concrete in specified colors or as selected by Architect.
 - c. Handling concrete from point of delivery and transfer to conveying equipment and to location of final deposit as rapidly as practicable and by methods which prevent segregation and loss of mix materials.
 - d. Provide runways for wheeled conveying equipment from delivery point to location of final deposit.
 - e. Keep interior surfaces of conveying equipment, including chutes and tremies, free from hardened concrete, debris, water and other deleterious materials.
 - f. Pumps may be used only if they can pump the mix designed. Do not add fine aggregate or water to the mix to satisfy needs of a pumping device.
 - g. Use chutes or tremies for placing concrete where a drop of more than 6'-0" is required.
 - h. Addition of water on the job - The maximum water-cement ratio should never be exceeded. If all the water allowed by the specification has not been added at the start of mixing, it may be permissible to add the remaining allowable water at the point of delivery.
 2. Concrete Placement, General:
 - a. Place concrete in compliance with practices and recommendations of ACI 304, and as specified herein.
 - b. Do not deposit concrete on concrete which has hardened sufficiently to form seams or planes of weakness within the section.
 - c. Sections between expansion joints shall be placed in continuous pours; construction joints in paving and walks other than at expansion joint locations will not be permitted.
 - d. Place concrete at such a rate that concrete which is being integrated with fresh concrete is still plastic.
 - e. Deposit concrete as nearly as practicable in its final location to avoid segregation due to rehandling or flowing. Do not subject concrete to any procedure which might cause segregation.
 - f. Screed concrete which is to receive other construction to the proper level to avoid excessive skimming and grouting.
 - g. Do not use concrete which becomes non-plastic and unworkable, or does not meet the required quality control limits, or which has been contaminated by foreign materials.
 3. Slab Placement:

- a. Moisten subgrade the evening before and immediately prior to placement of all paving slabs.
 - b. Deposit and consolidate concrete slabs in a continuous operation, within the limits of all expansion joints, until the placing of a panel or section is completed using vibrating bridge screeds, roller pipe screeds or other methods acceptable to Architect.
 - c. Consolidate concrete during placement by use of the specified equipment, preferably with power driven floats of impact type, thoroughly working concrete around reinforcement and into corners.
 - d. Bring slab surfaces to correct level with a straight edge, and then strike off.
 - e. Use bull floats or darbies to smooth the surface, leaving it free from bumps and hollows.
 - f. Do not sprinkle water on the plastic surface; do not disturb the slab surfaces prior to start of finishing operations.
4. Extruded Curb Placement:
- a. Install to detail in locations shown.
 - b. Apply epoxy resin adhesive to paved surface prior to extruding curb.
 - c. Machine extrude concrete to shape detailed on Drawings, as approved. Trowel form concrete curbs in areas where machine cannot reach.
 - d. Install pre-molded expansion joints where curbs meet poured-in-place concrete and at 60 lineal feet maximum spacing; elsewhere where indicated.
 - e. Cut crack control joints every 20 lineal feet and at beginning of curves with less than five (5) foot radius.
 - f. Hand trowel rough areas to a dense, uniform texture. Bevel curbs 45 degrees at dead ends.
 - g. Spray apply membrane forming curing compound after curb installation.
 - h. Remove and replace curbs which crack; cut out chipped or cracked areas and reinstall new extruded curbs.
 - i. Remove excess concrete from paving surfaces.
- F. Curing:
1. General:
 - a. Protect all freshly placed concrete from premature drying and excessive hot or cold temperature extremes. Start curing procedures on slabs immediately after finishing operation.
 - b. Maintain curing procedures for seven (7) days at minimum temperature of 50 degrees F.; if mean daily temperature drops below 40 degrees F. during this period, extend curing period an equal number of days or provide temporary heat or additional protection to maintain specified minimum temperature of air in contact with concrete.
 2. Curing Exterior Paving and Slabs: Spray paving, walks, curbs and other miscellaneous slabs with liquid membrane-forming compound specified above, applied at not less than the manufacturer's specified and recommended rate.
- G. Finishes:
1. Spreading of dry cement for finishing is not permitted.
 2. Finish all exposed edges and joints with edging tools of 1/4 inch radius.
 3. Exterior Paving and Slabs:
 - a. Floating: Do not begin floating until bleed water sheen has disappeared or until leveled material has stiffened sufficiently for power floating. After power floating, re-float by hand immediately to uniform, true, smooth, granular surface within the specified tolerance.
 - b. Medium Broom Finish: Broom after floating and concrete is hard enough to retain scoring. Use a stiff fiber or wire broom. Broom perpendicular to direction of traffic, typically. Broom in opposite directions at sidewalk panels in a checkerboard pattern or as indicated on drawings.

4. Handicapped Accessible Ramps: Slope surfaces as shown on drawings. Texture ramp by providing raised, truncated domes on the surface of the ramp in accordance with TAS.
 - 1) New Concrete Ramps: Integrally color concrete in color selected by Architect from manufacturer's standard colors to provide contrasting color to that of adjacent concrete.
 - 2) Existing Concrete Ramps: Stain concrete using specified concrete stain in color selected by Architect from manufacturer's standard colors to provide contrasting color to that of adjacent concrete.
 - a) Prior to applying any stain, existing concrete ramps shall be cleaned up of all dirt, oil, grease, and other contaminants.
 - b) Acid etch with 25 percent muriatic acid solution.
 - c) Power wash at 3,000 psi.
 - d) Water test to determine if water absorbs, thereby making it good to stain.
 - e) Allow concrete to thoroughly dry.
 - f) Apply stain in accordance with manufacturer's instructions.

Note: All colors must be approved by Architect prior to their use. Failure to do so, may be cause for rejection of work and removal and replacement of work with new work at Contractor's expense.
 5. Miscellaneous Vertical Surfaces: Finish all vertical surfaces, including but not limited to curbs, risers, low walls and stringer, while concrete is strong enough to stay in place without forms yet green and able to be finished to a homogeneous appearance.
- H. Traffic Lane, Parking Space, and Zone Paint Striping: (As shown on drawings or required)
1. Surface Conditions: Clean and dry, free from dirt, loose paint, oil, grease, wax and other surface contaminants which would affect paint bond.
 2. Allow concrete surfaces to cure the minimum time recommended by the traffic marking paint manufacturer, but in no case less than 30 days prior to applying traffic marking paint.
 3. Locate markings as indicated on drawings. Do not apply paint until layout is verified with Architect. Protect surfaces which are not to receive paint.
 4. Mix paint and apply in accordance with manufacturer's instructions, using skilled labor and proper mechanical equipment to produce uniform, straight lines without bleeding edges or runs.
 5. Paint traffic, parking lanes, and accessibility handicapped parking lines as shown on drawings and to comply with requirements of authorities having jurisdiction.
 6. Paint curbs and stenciled signs for FIRE LANES, NO PARKING, and BUS LOADING areas, crosswalks, handicapped accessible parking spaces, and other areas shown on drawings or required by authorities having jurisdiction. Use proper type, style and size stencils for all numbers and lettering. Do not apply paint until layout is verified with Architect and/or authorities having jurisdiction. Protect surfaces which are not to receive paint.
- I. Precast Concrete Wheel Stops: (As shown on drawings or required)
1. Surface Conditions: Clean and dry, free from dirt, loose paint, oil, grease, wax and other surface contaminants which would affect epoxy bond.
 2. Locate wheel stops as indicated on drawings.
 3. Predrill holes in concrete paving for anchor rods.
 4. Secure wheel stops in 1/8-inch-thick x 3-inch-wide epoxy and drive anchor rods through predrilled holes filled with epoxy grout.
- J. ADA Detectable Warning Paver
1. Install per manufacturer's details and requirements.

3.3 FIELD QUALITY CONTROL

- A. Inspection and Testing Laboratory:
1. Perform the appropriate tests upon notification by the Contractor.

- B. Tolerances:
 - 1. Slope as shown on drawings.
 - 2. Paving sections containing "bird baths" greater than two (2) feet in diameter or 1/8-inch-deep (regardless of size of area) will be removed and re-poured at Contractor's expense.

3.4 PATCHING AND CLEANING

- A. Clean exposed concrete surfaces and adjoining work stained by leakage of concrete to approval of Architect.
- B. Reinforce or replace all deficient work as directed by Architect and at no additional cost to Owner.
- C. Clean all concrete and cement work on completion of this portion of the work.

3.5 DEFECTIVE WORK

- A. Imperfect or damaged work, as determined by the engineer, shall be satisfactorily replaced at the Contractor's expense and shall be in conformity with all the requirements of the Contract Documents. Removal and replacement of concrete work shall be done in such a manner as not to impair the appearance or strength of the structure in any way.

3.6 PENALTY FOR DEFICIENT PAVEMENT THICKNESS

- A. It is the intent of this specification that the pavement be constructed in strict conformity with the thickness and typical sections shown on drawings. Where any pavement is found not so constructed, the following rules relative to adjustment of payment for acceptable pavement and to replacement of faulty pavement shall govern.
- B. Prior to final acceptance, and if deemed necessary by the Engineer, the pavement will be cored by the Testing Laboratory. Locations of core tests may be selected by the Engineer. Regular testing shall occur for every five hundred (500) square yards of placed concrete pavement and at random locations.
- C. For the purpose of establishing an adjusted price for pavement, units to be considered separately are defined as 500 square yards of pavement.
- D. One core will be taken at locations selected by the Engineer or at random in each unit and tested in accordance with ASTM Method C-174. When measurement of the core from any unit is not deficient more than 0.2 inches from the plan thickness, full payment will be made.
- E. If measurement of any core from any unit is deficient more than 0.2 inch but not more than 0.50 inch from the plan thickness two additional cores will be taken from the unit and the average of the three cores determined. The two additional cores will be taken such that the unit will be well represented. If the average thickness of the three cores is deficient more than 0.2 inch but not more than 0.50 inch from the plan thickness, an adjusted unit price as provided below, will be paid for in these areas represented by these cores. At the option of the Engineer, additional cores may be taken in the adjacent unit/units to determine if the deficiency of thickness continues across all lanes of pavement. If the deficiency is found to exist in one (1) or more adjacent units, adjusted unit prices as provided below will be paid for those adjacent units that are found to be deficient.
- F. Price Adjustments: Concrete Pavement Deficiency

Deficiency in Thickness Determined by Cores (in inches)	Proportional Part of Contract Price Allowed (adjustment factor)
No deficient	1.0
Over 0.00 through 0.20	1.0

Over 0.20 through 0.30	0.80
Over 0.30 through 0.40	0.72
Over 0.40 through 0.50	0.68
Over 0.50	0.50 or removal*

*At option of the Engineer.

- G. Any area of pavement found deficient in thickness by more than 0.50 inch, but not more than 0.75 inch, shall be evaluated by the Engineer. If, in the judgement of the Engineer, the area of such deficiency should not be removed and replaced, there will be no payment for the area retained. If, in the judgement of the Engineer, the area of such deficiency warrants removal, the area shall be removed and replaced, at the Contractor's entire expense, with concrete of the thickness shown on the drawings. Any area found deficient in thickness by more than 0.75 inch shall be removed and replaced, at the Contractor's entire expense, with concrete of the thickness shown on the drawings.
- H. No additional payment, over the contract price will be made for any pavement of a thickness exceeding that required on the drawings. Also, planing of concrete pavement shall not be allowed.

END OF SECTION 32 13 13

SECTION 32 16 13 - CONCRETE CURB, GUTTER, SIDEWALKS & DRIVEWAYS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section shall govern for curb, gutter, combined curb and gutter, sidewalks and/or driveways, with or without reinforcing steel composed of Portland cement concrete constructed on approved subgrade, foundation material or finished surface in accordance with the lines and grades established by the Engineer and in conformance with the details shown on the plans. As used in this Section, the word "curb" refers to concrete curb, concrete gutter and combined concrete curb and gutter.

1.2 MEASUREMENT AND PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Concrete used in conventionally formed and extruded construction shall be 3,500 psi (at 28 days) concrete having 5.5 sacks of cement per cubic yard and ¾" coarse aggregate.
- B. Reinforcing steel, if required, shall conform to the requirements of Section 03210 - Reinforcing Steel.
- C. Slump shall be 4 inches plus or minus 1 inch unless specifically noted otherwise.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

- A. For conventionally formed concrete, the subgrade, foundation, or pavement surface shall be shaped to the line, grade and cross-section and if considered necessary by the Engineer, hand tamped and sprinkled. If dry, the subgrade or foundation material shall be sprinkled lightly immediately before concrete is deposited thereon.
- B. Outside forms shall be of wood or metal, of a section satisfactory to the Engineer, straight, free of warp and of a depth equal to the depth required. They shall be securely staked to line and grade and maintained in a true position during the depositing of concrete. Inside forms for curbs shall be of approved material, shall be of such design as to provide the curb required and shall be rigidly attached to the outside forms. The reinforcing steel shall be placed in the position shown by the plans. Care shall be exercised to keep all steel in its proper location.
- C. After the concrete has been struck off and after it has become sufficiently set, the exposed surfaces shall be thoroughly worked with a float. The exposed edges shall be rounded using an edging tool to the radius indicated on the plans.

- D. Sidewalks shall be constructed in sections of the lengths shown on the plans. The different sections shall be separated by a board joint of the thickness shown on the plans, placed vertically and at right angles to the longitudinal axis of the sidewalk. Where the sidewalks or driveways abut a curb or retaining wall, approved expansion material shall be placed along their entire length. Similar expansion material shall be placed around all obstructions protruding through sidewalks or driveways. Sidewalks shall be marked into separate sections, as shown on plans, using approved jointing tools.
- E. Curbs, gutters and curb and gutters shall be placed in sections of 45-foot maximum length unless otherwise shown on the plans. Joints shall be constructed at such locations and of the type as directed and specified on the plans.
- F. For extruded concrete construction, the concrete shall be placed by an extrusion machine approved by the Engineer. When placement is directly on subgrade or foundation materials the foundation shall be hand-tamped and sprinkled if considered necessary by the Engineer. If the concrete is placed directly on the surface material or pavement, such surface shall be thoroughly cleaned. If required by plan details, the cleaned surface shall then be coated with an approved or other coating as specified at the rate of application shown.
- G. The line shall be maintained from a guideline set by the Contractor. The outline shall strictly conform to the details shown on the plans. The forming tube of the extrusion machine shall be readily adjustable vertically, during the forward motion of the machine to provide variable heights necessary to conform to the established grade line. To provide a continued check on the grade, a pointer or gauge shall be attached to the machine in such a manner that a comparison can be made between the extruded work and the guideline. Other methods may be used if approved by the Engineer.
- H. The mix shall be fed into the machine in such a manner and at such consistency that the finished work will present a well compacted mass with a surface free from voids and honeycomb and true to the established shape, line and grade.
- I. Any additional surface finishing specified and/or required, shall be performed immediately after extrusion. Joints shall be constructed at such location as directed by the Engineer and to the details shown on the plans.
- J. When sidewalks are to be placed adjacent to a curb or a curb and gutter, the sidewalk and curb, or curb and gutter may be placed monolithically in one pass of the machine, provided the work is satisfactory to the Engineer.
- K. All concrete placed under this item shall contain 4% + 1-1/2% entrained air. The completed work shall be cured for a period of not less than 72 hours.

END OF SECTION 32 16 13

SECTION 32 18 23.18 - KNITTED NYLON SYNTHETIC TURF SYSTEM WITH FOAM PAD

PART I – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.

1.2 SUMMARY

- A. The work under this section shall consist of furnishing all labor, materials, and equipment necessary to install, in place, all synthetic turf and other materials as indicated on the plans and as specified herein. The installation of all new materials shall be performed in strict accordance with these specifications, the manufacturer's instructions and in accordance with all details and shop drawings.

1.3 SUBMITTALS

- A. Substitutions: Products other than those listed in Section 2.1.A. are acceptable if in compliance with all requirements of these specifications. Submit alternate products with the bid proposal and provide the following:
 - 1. Provide all specifications, product data, certification and required information for proposed alternate. It is the responsibility of the bidder to prove that the product substitution is equal to or greater than the product specified.
 - 2. Provide a 1' x 1' sample of the product substitution
- B. Product Data: For each type of product indicated.
 - 1. Submit manufacturer's catalog cuts, material safety data sheets (MSDS), brochures, specifications, preparation and installation instructions and recommendations
 - 2. All supplied and installed materials and products will meet or exceed the minimum specifications designated in this section. Sufficient data must be submitted to indicate compliance with the Contract Documents
 - 3. Submit instructions for installation.
- C. Test Results: The following test results, certified by a licensed independent testing laboratory, shall be submitted as outlined below
 - 1. With the bid – Mandatory and minimum specifications as shown in Part 2. Bids not meeting the minimum specifications will be rejected.
- D. Shop Drawings: Show fabrication and installation details for synthetic turf including, but not limited to:
 - 1. Proposed locations of all seams in fabric surfacing. Show installation methods and construction.
 - 2. Field lining and marking - Submit a complete scale and dimensional drawing of tufted-in or painted field lines and marking boundaries. Include graphics for center logo artwork (if required) for approval as well.
 - 3. All submittals shall be provided within 14 days after Notice to Proceed

- E. The Manufacturer / Installer shall provide the following samples of the artificial turf selected for this project
 - 1. A 12-inch x 12-inch minimum sample of the exact synthetic turf system that is specified for this project.
 - F. With the bid - Proof that the Manufacturer/Installer is a member, in good standing, of the Synthetic Turf Council
 - G. With the bid - Proof that the turf is manufactured in the United States of America. Foreign-made turf products are not allowed. Bids including foreign materials will be rejected.
 - I. With the bid – Sample Warranty: The Contractor shall provide a warranty to the Owner that covers defects in materials and installation workmanship of the turf for a period of eight (8) years from the date of substantial completion. The turf manufacturer must verify that their representative has inspected the installation and that the work conforms to the manufacturer's requirements and any written directives. The manufacturer's warranty shall include general wear and damage caused from UV degradation. Other items that must be addressed include the following:
 - 1. Acceptable uses for the field
 - 2. Fading
 - 3. Color match within specifications
 - 4. Excessive fiber wear
 - 5. Wrinkling and panel movement
 - 6. Sewn Seam integrity
 - 7. Drainage (through the turf only)
- Exclusions shall include the following:
- 1. Vandalism
 - 2. Acts of God beyond the control of the Owner or the Manufacturer
- J. Maintenance and Operations Data: At the completion of the project submit 3 complete sets, in manual form, of all the manufacturer's recommended procedures and materials for, but not limited to general maintenance, line/markings installation, small repair procedures, cleaning, etc...
 - K. Project Record Documents: Record actual locations of seams, drains, and other pertinent information in accordance with the General Requirements

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications
 - 1. Shall own and operate its manufacturing plant in the United States. Plant must be capable of extruding its own nylon fiber for the system. Plant shall also be capable of tufting the fibers into the backing.
 - 2. Shall be experienced in the manufacture and installation of the specified type of synthetic turf for a minimum of five (5) years.
 - 3. Shall have its own, in-house laboratory where samples of turf are retained and analyzed. Tests shall be performed at all levels of production from the extrusion process to the tufting process and through to the final stages before the turf is loaded onto the truck for delivery.

- B. **Installer Qualifications:** An authorized representative of the synthetic turf manufacturer for installation and maintenance is required for this Project.
 - 1. Installation team shall be an established, experienced in the field installer, with a minimum of two years of experience with 15 foot wide tufted nylon materials. Installer shall have installed a minimum of five (5) 100% glued down fields.
 - 2. Installation team shall be certified, in writing, by the turf manufacturer, as competent in the installation of the specified material, including seaming and proper installation of the pad, and gluing down the system
 - 3. Site superintendent shall have at least five (5) installations similar to this type.
- C. **Source Limitations:** Obtain synthetic turf through one source from a single manufacturer. Any Materials (including the fiber itself) manufactured outside of the United States are not acceptable.
- D. All components and their installation method shall be designed and manufactured for use on indoor or outdoor athletic fields. The materials as hereinafter specified, should be able to withstand full climatic exposure, be resistant to insect infestation, rot, fungus and mildew; to ultra-violet light and heat degradation, and shall have the basic characteristic of flow-through drainage allowing free movement of surface run-off through the turf and directly into prepared granular base and into the field drainage system.

1.5 PROJECT CONDITIONS

- A. **Weather Limitations:** Proceed with installation only when existing and forecasted weather conditions permit synthetic turf work to be performed according to Contractor/Manufacturer's written instructions and warranty requirements.
- B. **Field Measurements:** Indicate measurements on Shop Drawings.

1.6 MAINTENANCE SERVICE

- A. Turf Installation Contractor shall train maintenance staff and/or contracted maintenance staff in the use of the recommended maintenance equipment and provide maintenance guidelines to the facility maintenance staff.

PART TWO – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Pre-Approved manufacturers:
 - 1. AstroTurf®, LLC – AstroTurf® System 5-T
 - 2. PT44 Proturf by Challenger Industries – 100% Nylon – 5mm urethane foam pad
 - 3. Alternate manufacturer is acceptable and must meet and/or be equivalent to all listed requirements, qualifications and specifications.

2.2 MATERIALS

- A. Synthetic Turf System: A complete synthetic turf system consisting of 100% in-house manufactured nylon fibers. Yarn cross-section shall be a nylon extruded diamond monofilament. Pile height shall be nominal ½" Fibers shall be tufted into a single sports caliber fabric matrix and coated with a mechanically applied Biocel™ Polyurethane 5mm foam pad.
 - 1. The carpets' primary backing shall be coated with an acrylic pre-coat and a 5mm Biocel™ Polyurethane foam pad weighing no less than 86 ounces per square yard.
 - 2. The carpet shall be delivered in 15' wide rolls. The rolls shall be of sufficient length to go from sideline to sideline. Head seams, other than at sidelines, will not be acceptable.
- B. The pile surface shall provide good traction in all types of weather with the use of conventional sneaker type shoes, composition mold sole athletic shoes, baseball spikes and screw-on football spikes.
- C. The pile surface shall be suitable for both temporary and permanent line markings using acrylic paint, as per the manufacturer's recommendations.
- D. Adhesive for gluing turf system to the base shall be a one part, high green strength urethane which exhibits high tenacity. Glue shall be Nordot 34D-2 as provided by Synthetic Surfaces, Inc. , Scotch Plains, New Jersey. No substitutions will be allowed.
- E. All glue for gluing seams shall be per manufacturer's recommendations.
- F. Perimeter edge details required for the system shall be as detailed and recommended by the manufacturer, and as approved by the manufacturer.

2.3 FABRIC SURFACE

- A. The pile surface shall resemble freshly mown natural grass in appearance, texture and color.
- B. The pile surface shall be nominally uniform in length.
- C. The entire system shall be resistant to weather, insects, rot, mildew and fungus growth and will be non-allergic and non-toxic.
- D. The synthetic turf system shall have a nominal fiber length of ½".
- E. Each roll shall be minimum 15' wide.
- F. All markings will be painted.

2.4 PRODUCT SPECIFICATIONS

- A. Yarn shall be proven athletic quality 100% nylon monofilament yarn designed specifically for indoor or outdoor use and stabilized to resist the effects of ultraviolet degradation, heat, foot traffic, water and airborne pollutants. Fiber MUST be extruded in-house. Fiber extruded by outside manufacturers shall not be acceptable. The fabric shall possess the following minimum physical characteristics. ASTM testing shall be provided with the bid and any products not meeting the minimum physical characteristics will be rejected:

Pile Yarn Type	Nylon extruded monofilament
Yarn Melting Point	>200 degrees C
Yarn Maximum Elongation	> 30% nominal
Yarn Specific Gravity	1.12
Tufting Gauge	3/16"
Pile Height	1/2"
Pile Weight	42 oz. per square yard
Fabric Width	15'
Fabric Construction	Tufted
Backing	2906 Matrix
Pad	5mm Polyurethane Foam
Pill Burn Test	Pass

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for visual installation tolerances. Proceed with installation only after satisfactory conditions have been corrected.
- B. Certification of prior work: The synthetic turf manufacturer and / or installation contractor shall perform a visual inspection of the field base onto which the synthetic turf system is to be installed and to examine the finished surface for required grade tolerances. After any discrepancies between the required materials, application and tolerance requirements noted have been corrected, the synthetic turf installer should submit a written certification of VISUAL acceptance of the base for installation of the synthetic turf system. Any tests other than VISUAL tests shall be the responsibility of the General Contractor or Landscape Architect.
- C. Installation of all materials shall be performed in full compliance with approved project shop drawings. Only factory trained technicians skilled in the installation of athletic caliber synthetic turf systems, working under the direct supervision of the manufacturer's supervisors, shall undertake the placement of the turf system. The designated Supervisory personnel on the project must be certified, in writing by the turf manufacturer as competent in the installation of these materials, including proper seaming for knitted systems.
- D. All designs, markings, layouts and materials shall conform to all currently applicable NCAA rules and other standards and/or FIH standards that may apply to this type of synthetic grass installation.

3.2 PREPARATION

- A. Inspect delivered field surface fabric and components immediately prior to installation. Any damaged or defective items shall be rejected. Installed artificial system shall be inspected for, but not limited to, the following:
 - 1. Uniformity of product and color
 - 2. Surface bubbles
 - 3. Field markings
 - 4. Field Edge installation

- B. Environmental Conditions: Weather conditions are important for the successful installation of the systems. No work under this section will proceed when:
1. Ambient temperatures are below 45 degrees F.
 2. Material temperatures are below 45 degrees F.
 3. Surfaces are wet or damp
 4. Rain is imminent or falling.
 5. Conditions exist or are imminent, which will be unsuitable to installation requirements of the systems specified herein. Humidity levels will be inside the limits recommended by the adhesive manufacturer to obtain optimum bonding characteristics of the surfaces.

3.3 INSTALLATION OF THE SYNTHETIC TURF SYSTEM

- A. The carpet rolls are to be glued directly onto the properly prepared base. Care is to be taken not to disturb the base.
- B. All seams shall be glued using adhesive as recommended by the turf manufacturer. All work shall be such that the seams shall remain as required for the duration of the warranty period at a minimum. Seams shall be flat, tight and permanent with no separation or fraying.
- C. The perimeter of the field shall be firmly secured to the edge anchors for the life of the warranty and in accordance to project details.

3.4 Field Lining and Markings

- A. General: A complete field "Lining, Marking and Field Boundary" system will be provided with the installation of the surfacing system specified herein. All markings shall be installed in accordance with prior approved project Shop Drawings.
- B. All markings will be painted.
- C. Striping layouts shall be accurately surveyed by the Contractor before painting of field markings

3.5 FINAL ACCEPTANCE

- A. Prior to final acceptance, the Contractor shall submit to the Owner three (3) copies of Maintenance Manuals, which will include all necessary instructions for the proper care and preventative maintenance of the synthetic turf system, including painting and striping.
- B. The Contractor shall provide evidence that the turf can be plowed with conventional rubber bladed snow removal equipment.
- C. The finished playing surface shall appear as mowed grass with no irregularities and shall afford excellent traction for conventional athletic shoes.

3.6 CLEANING

- A. Contractor shall provide the labor, supplies and equipment as necessary for final cleaning of surfaces and installed items. All usable remnants of new material shall remain the property of the Owner. The Contractor shall keep the area clean throughout the project and clear of debris.

Surfaces, recesses, enclosures, etc... shall be cleaned, as necessary, to leave the work area in a clean, immaculate condition ready for immediate occupancy and use by the Owner.

END OF SECTION 32 18 23.18

SECTION 32 31 19 – WROUGHT IRON FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This section includes the following:
 - 1. Steel ornamental fences with solid steel pickets.
 - 2. Pedestrian gates.
- B. Related Sections include the following:
 - 1. Division 2 Section "Earthwork" for filling and for grading work.
 - 2. Division 3 Section "Cast-in-Place Concrete" for concrete post footings.

1.3 DEFINITIONS

- A. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

1.4 SUBMITTALS

- A. Submit product data in the form of manufacturer's technical data, specifications, and installation instructions for fences and gates.
- B. Shop Drawings: Submit shop drawings showing location of fence and gates, including each post, details of post installation, hardware, and accessories. Show sizes and thicknesses of all members, types of materials, methods of connection and assembly, complete dimensions, clearances, anchorage, relationship to surrounding work, and other pertinent details of fabrication and installation.
- C. Samples for Verification: Submit samples for each profile and pattern of fabricated metal and for each type of metal finish required, prepared on metal of same thickness and alloy indicated for the Work. Include samples of the following:
 - 1. Post cap including 12 inch (300-mm) long section of post.
 - 2. Full-size sample of fence, 2 feet wide by full height.
 - 3. Gate hardware including hinges and latch.
- D. Qualification Data: Submit qualification data for fabricator.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Arrange for installation of ornamental metal fences and gates specified in this Section by the same firm that fabricated it.
- B. Fabricator Qualifications: A firm experienced in producing ornamental metal fences and gates similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

1.6 REFERENCES

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- B. ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.
- C. ASTM D523 - Test Method for Specular Gloss.
- D. ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.
- E. ASTM D822 - Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.
- F. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
- G. ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
- H. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
- I. ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.
- J. ASTM F2408 – Ornamental Fences Employing Galvanized Steel Tubular Pickets.

1.7 WARRANTY

- A. All structural fence components (i.e. rails, pickets, and posts) shall be warranted within specified limitations, by the manufacturer for a period of 20 years from date of original purchase. Warranty shall cover any defects in material finish, including cracking, peeling, chipping, blistering or corroding.
- B. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufacturer's warranty shall be guaranteed for five (5) years from date of original purchase.

PART 2 - PRODUCT

2.1 MANUFACTURER

- A. Provide ornamental metal fences and gates as manufactured by Montage II – Heavy Industrial Steel Ornamental Fence System as manufactured by Ameristar Fence Products, Inc. (918) 835-0898 or comparable product approved by the Architect.

2.2 MATERIALS

- A. Steel material for fence panels and posts shall conform to the requirements of ASTM A653/A653M, with a minimum yield strength of 45,000 psi (310 MPa) and a minimum zinc (hot-dip galvanized) coating weight of 0.90 oz/ft² (276 g/m²), Coating Designation G-90.
- B. Material for pickets shall be 1" square x 14 Ga. tubing. The rails shall be steel channel, 1.75" x 1.75" x .105". Picket holes in the rail shall be spaced 4.715" o.c. Fence posts and gate posts shall meet the minimum size requirements of Table 1.

2.3 FABRICATION, GENERAL

- A. Pickets, rails, and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets.
- B. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using a specially calibrated alignment fixture. The aligned pickets and rails shall be joined at each picket-to-rail intersection by Ameristar's proprietary fusion welding process, thus completing the rigid panel assembly (Note: The process produces a virtually seamless, spatter-free good-neighbor appearance, equally attractive from either side of the panel).
- C. The manufactured panels and posts shall be subjected to an inline electrodeposition coating (E-Coat) process consisting of a multi-stage pretreatment/wash, followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils (0.058 mm). The coated panels and posts shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2 (Note: The requirements in Table 2 meet or exceed the coating performance criteria of ASTM F2408).
 - 1. Color: Architect to select from manufacturer's full range.
- D. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Industrial weight fences under ASTM F2408.
- E. Swing gates shall be fabricated using 1.75" x 14ga Forerunner double channel rail, 2" sq. x 12ga. gate ends, and 1" sq. x 14ga. pickets. Gates that exceed 6' in width will have a 1.75" sq. x 14ga. intermediate upright. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding. Gusset plates will be welded at each upright to rail intersection. Cable kits will be provided for additional trussing for all gates leaves over 6'.
- F. Pedestrian swing gates shall be self-closing, having a gate leaf no larger than 48" width. Integrated hinge-closer set (2 qty) shall be ADA compliant that shall include a variable speed and final snap adjustment with compact design (no greater than 5" x 6" footprint). Hinge-closer set (2 qty) shall be tested to a minimum of 500,000 cycles and capable of self-closing gates up to a maximum gate weight of 260 lbs. and maximum weight load capacity of 1,500 lbs. Hinge-closer device shall be externally mounted with tamper-resistant security fasteners, with full range of adjustability, horizontal (.5" - 1.375") and vertical (0 - .5"). Maintenance free hinge-closer set shall be tested to operate in temperatures of negative 20 F to 200 F degrees, and swings to negative 2 degrees to ensure reliable final lock engagement.
- G. Allow for thermal movement resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening up of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fences and gates in accordance with approved shop drawings. Do not begin installation and erection before final grading is established.
- B. Excavation: Drill or hand-excavate (using post-hole digger) holes for posts to diameters and spacings indicated, in firm, undisturbed or compacted soil.
 - 1. If not indicated on Drawings, excavate holes for each post 6 to 8 inches in diameter.

2. Unless otherwise indicated, excavate hole depths not less than 36 inches below the finish grade surface.
- C. Setting Posts in Earth: Center and align posts in holes, space as required by manufacturer. Brace terminal post against structure as required.
1. Protect portion of posts above ground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.
 - a. Unless otherwise indicated, set top of concrete footings 4 inches below finish grade.
- D. Setting Posts in Stone or Existing Concrete:
1. Core drill 3-1/2 inch diameter holes 9 inches deep.
 2. Clean holes of loose material, insert posts, and fill space around post with exterior erosion-resistant anchoring cement, mixed and placed to comply with manufacturer's written instructions.
 3. Leave anchorage joint exposed; wipe off surplus anchoring material; and leave 1/8 inch buildup, sloped away from post.
- E. Fence Assembly: Install fully assembled fence sections as indicated on Drawings. Set bottom rail of fence 3 inches above finish grade unless indicated otherwise.

3.2 CLEANING AND PROTECTION

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work.

PART 4 - TABLES

Table 1 – Minimum Sizes for Montage II Posts			
<u>Fence Posts</u>	<u>Panel Height</u>		
2-1/2" x 12 Ga.	Up to & Including 6' Height		
3" x 12 Ga.	Over 6' Up to & Including 8' Height		
<u>Gate Leaf</u>	<u>Gate Height</u>		
	<u>Up to & Including 4'</u>	<u>Over 4' Up to & Including 6'</u>	<u>Over 6' Up to & Including 8'</u>
Up to 4'	2-1/2" x 12 Ga.	3" x 12 Ga.	3" x 12 Ga.
4'1" to 6'	3" x 12Ga.	4" x 11 Ga.	4" x 11 Ga.
6'1" to 8'	3" x 12 Ga.	4" x 11 Ga.	6" x 3/16"
8'1" to 10'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
10'1" to 12'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
12'1" to 14'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
14'1" to 16'	6" x 3/16"	6" x 3/16"	6" x 3/16"

Table 2 – Coating Performance Requirements		
<u>Quality Characteristics</u>	<u>ASTM Test Method</u>	<u>Performance Requirements</u>
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 1,500 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).

Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).
Weathering Resistance	D822 D2244, D523 (60° Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

Table 3 – Montage II – Post Spacing By Bracket Type										
Span	For INVINCIBLE® 8' Nominal (91-1/2" Rail)				For CLASSIC, GENESIS, & MAJESTIC 8' Nominal (92-5/8" Rail)					
Post Size	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"
Bracket Type	Industrial Flat Mount (BB301)*		Industrial Line 2-1/2" (BB319) 3" (BB320)		Industrial Universal 2.5" (BB302) 3" (BB303)		Industrial Flat Mount (BB301)		Industrial Swivel (BB304)*	
Post Settings ± 1/2" O.C.	94-1/2"	95"	94-1/2"	95"	96"	96-1/2"	96"	96-1/2"	*96"	*96-1/2"
*Note: When using BB304 swivel brackets on either or both ends of a panel installation, care must be taken to ensure the spacing between post and adjoining pickets meets applicable codes. This will require trimming one or both ends of the panel. When using the BB301 flat mount bracket for Invincible style, rail may need to be drilled to accommodate rail to bracket attachment.										

END OF SECTION 32 31 19

SECTION 32 80 00 - LANDSCAPE IRRIGATION

PART 1 - GENERAL

1.1 SCOPE OF WORK

Work in this section shall include all materials, labor, equipment, transportation, and services necessary to install a complete automatic landscape irrigation system as shown on the drawings and as specified herein.

1.2 SYSTEM DESCRIPTION

- A. Location of irrigation heads shown on Drawing are approximate. Actual placement may vary slightly as is required to achieve full, even coverage.
- B. During layout, consult with Owner's Representative to verify proper placement and make recommendations, where revisions are advisable. Minor adjustments in system layout will be permitted to avoid existing fixed obstructions.
- C. Arrange valve stations to operate in an easy to view progressive sequence. Record zone sequence on controller lid.
- D. System requires installation of backflow prevention unit (see plans).

1.3 QUALITY ASSURANCE

Contractor to attend a pre-installation meeting and participate in an installation meeting with Owner's Representative.

1.4 SUBMITTALS

- A. Operations and Maintenance
 - 1. Manufacturer's cut sheet for each element of system to Owner.
 - 2. Manufacturer's printed literature on operation and maintenance of operating elements to Owner.

1.5 SEQUENCING

Install sleeves prior to the installation of all concrete poured in place site elements and paving.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Rockfree soil
 - 1. Backfill soil around PVC pipe.
 - 2. Soil having rocks no larger the 1/4" diameter any dimension.
- B. Pea gravel
 - 1. For use at the bottom of all valve boxes
 - 2. 1/2" maximum round, washed rock.
- C. Sand - fine granular material naturally produced by rock disintegration and free from organic material, mica, loam, clay and other deleterious substances.

- D. Topsoil - existing in-place topsoil material. Remove rocks, roots, sticks, clods, debris and other foreign matter over 1 1/2" longest dimension encountered during trenching.

2.2 COMPONENTS

- A. Pipe, pipe fittings and connections -
1. Pipe shall be continuously and permanently marked with Manufacturers name, size, schedule, type and working pressure.
 2. Pipe size shown on Drawings are minimum. Larger sizes may be substituted without additional cost to Owner.
 3. Pipe -
 - a. Piping on pressure side of irrigation control valves (mains): 3" in diameter and smaller to be Schedule 40.
 - b. Piping on nonpressure side of irrigation control valves (laterals): PVC Class 200.
 4. Fittings shall be same material as pipe.
 5. Swing joints shall be used to connect all heads; Poly Pipe Assembly Acceptable at Owner's discretion.
 6. Concrete donuts may be installed around heads within 2' of all paving at Owner's discretion.
 7. Sleeves -
 - a. Under parking areas, driveways & paving - Schedule 40 PVC pipe.
 - b. Sleeve diameter shall be minimum 4" dia.
 - c. Extend sleeves 24" inches beyond walk or pavement edge and mark location with square steel plate set flush with top of curb or paving.
 8. Glue shall be Christys Red Hot Blue Glue with purple primer or approved equal.
- B. Sprinkler heads -
1. Conform to requirements shown on Drawings as to type, size, radius of throw, pressure and discharge. Equals as approved by Owner's Representative prior to bidding.
 2. Each type of head shall be the product of a single manufacturer.
- C. Automatic Sprinkler Controller(s) -
1. Automatic controller - make and model shown on Drawings. All exposed wire shall be enclosed in solid pipe conduit.
 2. Control wire shall be UF-UL listed, color coded copper conductor direct burial size 14. Tape control wire to side of main line, minimum of every 10' feet. Where control wire leaves main or lateral line, enclose it in Class 200 PVC conduit. Use 3M DBY waterproof wire connectors at splices and located all splices within valve boxes. Each common wire may serve only one controller. Provide two extra wires per Controller and label accordingly. Place locator wire in main line trench from source to furthest valve. Multi-strand wire may be used to connect system wires to controller in building, but may not be used underground. All conduit penetrations at building shall be caulked with sealant. Any exposed wire shall be in rigid conduit.
 3. Rain Sensor (wireless) shall be installed at each controller location.
- D. Valves -
1. Electric valves - make and model shown on Drawings.
 2. Isolation valves - make and model shown on Drawings (sized to line).
 3. Backflow preventer - make and model shown on Drawings.
 4. Quick coupler valve - make and model shown on Drawings.
- F. Valve Accessories
1. Valve boxes for all electric valves, isolation valves and quick couplers

- a. Rainbird VB model valve boxes or approved equal to be used.
- b. Rectangle boxes are to be used for all valves.
- c. Round boxes to be used for isolation valves, grounding rods, decoders and misc. small system accessories.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protection
 1. During construction and storage, protect materials from damage and prolonged exposure to sunlight.
 2. Work of other Sections damaged during course of work by this Section shall be replaced or repaired by original installer at this Section's expense.
 3. Do not cut existing tree roots. Hand trench around existing roots.
- B. Drawings show arrangement of piping. Should local conditions necessitate rearrangement, obtain approval of Owner's Representative before proceeding with work.

3.2 INSTALLATION

- A. Trenching and backfilling
 1. Pulling of pipe is not permitted.
 2. Over excavate trenches 2 inches and bring back to indicated depth by filling with fine, rock-free soil and sand.
 3. In no case shall there be less than 2 inches of rock free soil or sand surrounding pipe.
- B. Sleeving
 1. Sleeve water line and control wires under walks and paving.
- C. Installation of Pipe
 1. Install pipe in manner to provide for expansion and contraction as recommended by manufacturer.
 2. Unless otherwise indicated on Drawings, install main lines with a minimum cover of 18" based on finished grade and install remaining lateral lines with a min. of 12" of cover based on finish grade.
 3. Install pipe and wires under driveways and parking areas in specified sleeves 24" min. below finish grade or as shown on Drawings.
 4. Solvent weld joints -
 - a. Do not make solvent weld joints if ambient temperature is below 40 degrees F.
 - b. Allow joints to set at least 24 hours before applying pressure to PVC pipe.
 5. Tape threaded connections with teflon tape.
- D. Electric Valves and Controller
 1. Install controller, control wires and valves in accordance with manufacturer's recommendations and according to electrical code.
 2. Install valves in plastic valve boxes. Locate valve box tops at finished grade. Do not install more than one valve per box.
- E. Backflow Preventer
 1. Install as per manufacturer's recommendations or per City code.
 2. Insulate backflow prevention device.

- F. Sprinkler Heads
 - 1. Prior to installation of sprinkler heads, open control valve and use full head of water to flush out system.
 - 2. Set lawn heads adjacent to existing walks, curbs, and other paved areas to grade and eight (8") off of existing paving.

3.3 TESTING

- A. Install a pressure gauge on the downstream side of the backflow in a test port. Pressure system to max available pressure point. Shut off backflow to isolate pressure. Maintain said max pressure for 48 hours and document four separate verification checks.

3.4 ADJUSTING

- A. Adjust heads to proper grade when turf is sufficiently established to allow walking on it without appreciable harm. Such lowering or raising of heads shall be part of the original contract with no additional cost to Owner.
- B. Adjust sprinkler heads for proper distribution and trim so spray does not fall on building.
- C. Adjust watering time of valves to provide proper amounts of water to all plants.

3.5 FINAL INSPECTION AND ACCEPTANCE

- A. Work under this Section will be accepted by the Owner's Representative upon satisfactory completion of all work and "punch list" items generated by Substantial Completion, but exclusive of Contractor obligations under warranty.
- B. Acceptance will include a 2 hour Owner orientation session with Contractor and Owner/operator.
- C. Contractor shall provide Record Drawing showing accurate locations of sleeves, valves, meters, vacuum breakers, controllers and mainline, etc. This Record Drawing shall be full scale plan and a reduced laminated half size plan. These shall be given to Owner at Substantial Completion.

3.6 MAINTENANCE

- A. Maintenance shall begin immediately after system is installed and continue until Owner acceptance at Substantial Completion. Maintenance shall include all watering operations, monitoring, adjustments to watering schedule, head adjustments and/or replacements, etc.

3.7 WARRANTY AND REPLACEMENTS

- A. In addition to the manufacturer's guarantees or warranties, all work shall be warranted for one year from the date of Substantial Completion against defects in material, equipment, and workmanship by Contractor. Warranty shall also cover repair of damage in materials, equipment and workmanship to the satisfaction of the Owner.
- B. Contractor shall not be held responsible for failure/damage due to vandalism, storms, etc. during the Warranty Period. Report such conditions to the Owner.

END OF SECTION

SECTION 32 90 00 - LANDSCAPE PLANTING

PART 1 - GENERAL

1.1 SCOPE OF WORK

This section specifies the requirements for providing planting materials and their installation as shown on the drawings and as specified herein.

1.2 REFERENCE STANDARDS

- A. American Joint Committee on Horticultural Nomenclature Standardized Plant Names
- B. Texas Association of Nurserymen, Grades and Standards for Nursery Stock.
- C. ANSI: American National Standards Institute
 - a. Z60.1: Nursery Stock
- D. National Arborist Association Standards
- E. Association of Official Agriculture Chemists

1.3 QUALITY ASSURANCE

Contractor to attend pre-installation meeting and participate in an installation meeting with Owner's Representative.

PART 2 - MATERIALS

2.1

- A. Topsoil: Existing soil or borrow soil shall be natural, friable, fertile soil possessing characteristics of the local area. Existing topsoil is defined as the total amount of soil stripped less the vegetative layer. Soil to be free of subsoil, stones, clay, clod, sticks and roots. Topsoil containing nut grass or dallis grass will be rejected.
- B. Compost: Major nutrients: Nitrogen, Phosphorus, Potassium. Secondary: Calcium, Magnesium, Sulfur. Micronutrients: Iron, Manganese, Zinc, Copper. Materials to be fully composted under sustained temperatures to 165 degrees with a PH averaging 6.5 to 7.0.
- C. Mulch: All mulch shall be shredded hardwood mulch.
- D. Wound Dressing: if needed, shall be 'Tree Kote' or approved equal.
- E. Sand: shall be final grade sand (not bank sand).
- F. Edging: shall be 3/16" Landscape steel edging if specified on plans.
- G. Staking material:
 - 1. hose shall be 2 ply reinforced rubber hose.
 - 2. wire shall be no.10 or 12 gauge twisted taunt with one wire per hose or treetie.
 - 3. stakes shall be metal (6.5' length) (2 per 45 gal and smaller; 3 per 65 gal; 4 per 100 gal tree).

2.2 PLANTS

- A. Planting shall be of normal growth, free of disease, insects, insect eggs and larva, and have strong root systems. Plant material shall be typical for variety and species and conform to size specified in the plant list.
- B. All plant material shall meet or exceed the size specified in the plant list.
- C. Plants shall be subject to inspection and approval by the Owner at their place of growth and upon delivery for conformation to specification requirements. Such approval shall not impair the right of inspection and rejection during progress of the work.
- D. Submission of bids will be understood that the Contractor fully understands the plans and specifications; that all plants and materials will be available in size, character and number at the time of installation. No substitutions will be allowed after bids are received.

2.3 PLANTING PREPARATION

- A. Rock, underground construction work, tree roots or obstructions encountered in the excavation of tree or shrub pits shall be brought to the attention of the Owner. Proceed with work after alternate locations have been designated or approved by the Owner's Representative.

PART 3 - EXECUTION

3.1 WORK PROCEDURE

- A. Planting Mix: all tree pit areas shall be backfilled with 50% specified planting mix. Shrub & ground over bed areas to receive 6-8" of specified planting mix and tilled into native up to 12" deep.

-Planting mix as follows: 50% topsoil, 25% compost, 25% sand (not bank sand).
- B. Excavation for container trees shall be twice the width of the container (with angled sides) and the depth shall be the container depth.
- C. Set plants at same relationship to finish grade as they bore to the ground from which they were in their container. Use prepared soil mixture for backfilling plant pit.
- D. When plant pits have been backfilled approximately 2/3 full, water thoroughly before installing remaining soil to top of pit, eliminating all air pockets.
- E. Form a earth saucer around the perimeter of plant pits.
- F. Water all plants immediately after planting.
- G. Mulch all planting areas 2"-3" deep immediately after planting.
- H. Staking of all trees by Contractor in accordance with plan details. Plants shall stand plumb after staking and all trees shall be staked within 24 hours of planting. Stakes shall be driven into the ground outside of the excavated hole.

3.2 CLEAN UP

As planting operations proceed, all rope, wire, empty containers, rocks, clods and all other debris

shall not be allowed to accumulate, but shall be removed daily and the site kept as clean as possible at all times. After planting operations are finished, all paved areas shall be cleaned by sweeping and washing if necessary.

3.3 MAINTENANCE

- A. Maintenance (including all watering operations) shall begin immediately after each plant is planted and continue until the project is accepted by the Owner at Substantial Completion.
- B. Maintenance shall include watering, weeding, cultivating, mulching, removal of dead materials, resetting plants to proper grades or upright positions, and furnishing and applying sprays or chemicals as necessary to keep the planting free of insects and disease.

3.4 PROTECTION

Planting areas and plants shall be protected during installation at all times against trespassing and damage of all kinds until acceptance of the project by the Owner. If any plants become damaged, injured or stolen, they shall be treated or replaced as directed by the Owners Representative at no additional cost to the Owner.

3.5 INSPECTION AND ACCEPTANCE

Work under this Section will be accepted by the Owner's Representative upon satisfactory completion of all work and "punch list" items generated by Substantial Completion review, but exclusive of replacement of plant materials under the Warranty Period.

3.6 WARRANTY PERIOD AND REPLACEMENTS

Contractor shall warrant unconditionally that all trees, shrubs, groundcovers planted under this contract will be healthy and in flourishing condition of active growth for one year from date of Substantial Completion.

Any delay in completion of planting operations which extends the planting into more than one planting season will extend the Warranty Period correspondingly.

Replace without cost to the Owner, and as soon as weather conditions permit, all dead plants and all plants not in vigorous, thriving conditions as determined by the Owner's Representative during and at the end of the Warranty Period. Plants shall be free of dead or dying branches and branch tips and shall bear foliage of a normal density, size and color. Replacements shall closely match adjacent specimens of the same species and shall be subject to all requirements of this specification.

Replacements shall be warranted through one (1) full growing season.

END OF SECTION

SECTION 32 92 00 - Turf and Grasses

PART 1 - GENERAL

1.1 SCOPE OF WORK

Scope of work under this Section of the specifications shall include all approved materials, labor, equipment, transportation and services required and incidental thereto, in conformity with the plans and specifications, including but not limited to fine grading, hydromulching and sodding areas, fertilizing, maintenance, clean-up, guarantee and replacement and other work related thereto.

1.2 QUALITY ASSURANCE

Contractor to attend a pre-installation meeting and participate in an installation meeting with Owners Representative.

1.3 SUBSTITUTIONS

Substitutions must be submitted 10 days before proposals are due, if accepted an Addendum will be issued, otherwise no substitutions are allowed. See Architects for any other requirements.

PART 2 - MATERIALS

2.1 Site shall include Common Bermuda solid sod (see plan for each indicated area).

- A. Common Bermuda solid sod as called for on plans. Schedule deliveries to coincide with topsoil operations and laying. During wet weather allow sod to dry sufficiently to prevent tearing. During dry weather, protect sod from drying out. Water as necessary to insure vitality and to prevent excess loss of soil while handling. Sod which dries out will be rejected.

PART 3 - EXECUTION

3.1 PREPARATION - Grades to be approved by Owner prior to sodding or hydromulch operations.

- A. Protection
 - 1. Take care and preparation in work to avoid conditions which will create hazards. Post signs or barriers as required.
 - 2. Provide adequate means for protection from damage through excessive erosion, flooding, heavy rains, etc. Repair or replace damaged areas.
- B. Surface Preparation for hydromulch
 - 1. Clean all areas of weeds and debris prior to any soil preparation or grading work.
 - 2. Remove core plugs, soil clods, rocks, weeds, roots and construction debris and dispose of off site.
 - 3. Perform grading and shaping refinements to ensure proper flow of water away from structures.
 - 4. Grades to be approved before hydromulch application.
- C. Surface Preparation for solid sod

1. Clean all areas of weeds and debris prior to any soil preparation or grading work.
2. Remove all core plugs, debris, roots, rocks, clods and construction debris and dispose off site.
3. Add a minimum of one (1") inch or as needed of final grade material as a setting bed for sod.
4. Sod areas to be graded to achieve proper final elevations, eliminating all bumps, ridges or depressions to provide for smooth drainage.
5. Grades to be approved before sodding.

3.2 INSTALLATION

A. Hydromulch

1. Apply seed with approved spray equipment and water (to keep moist) seeded areas.
2. Reseed areas that do not show germination until an acceptable stand of grass is obtained. Bare areas must be less than 3" in any direction.

B. Hydromulch Seed Mixes:

1. Spring Summer Mix (Approx. April 1st – September 1st)
Pure Hulled Bermuda Seed 110# Per Acre
Fertilizer 13-13-13 350# Per Acre
1. Fall Winter Mix (Approx. September 1st – March 31st)
Pure Unhulled Bermuda Seed 75# Per Acre
Gulf Annual Rye (or approved equal) 40# Per Acre
Fertilizer 13-13-13 350# Per Acre
OR
Pure Unhulled Bermuda Seed 75# Per Acre
Turf Type Fescue 40# Per Acre
Fertilizer 13-13-13 350# Per Acre

B. Bermuda solid sod

1. Lay sod in rows with staggered joints. Butt sections closely without overlapping or leaving gaps between sections. Joints to be sand filled as needed.
2. Roll sodded areas in two directions perpendicular to each other. Repair and re-roll areas with depressions, lumps or other irregularities.
3. Water sodded areas immediately after sod laying to obtain moisture penetration through sod into top four (4") inches of soil.

3.3 CLEAN UP

As planting operations proceed, all rope, wire, empty containers, rocks, clods and all other debris shall not be allowed to accumulate, but shall be removed daily and the site kept as tidy as possible at all times. After planting operations are finished, all paved areas shall be cleaned by sweeping and washing if necessary.

3.4 PROTECTION

Planting areas shall be protected during installation at all times against trespassing and damage of all kinds until acceptance of the project by the Owner. The Contractor shall be responsible for damage to the grass areas during the construction or renovation project, regardless if a sub-contractor, equipment or vandals caused the damage.

3.5 MAINTENANCE

- A. Maintenance shall begin by owner upon owner acceptance after Substantial Completion.
- B. Hydromulched areas will be accepted as complete when a uniform stand of grass has been obtained. Bare areas must be less than 3" in any direction.

3.6 INSPECTION AND ACCEPTANCE

Work under this Section will be accepted by the Owner's Representative upon satisfactory completion of all work and "punch list" items generated by Substantial Completion review.

3.7 WARRANTY PERIOD AND REPLACEMENTS

Contractor shall warrant unconditionally that grass planted under this contract will be healthy and in flourishing condition of active growth for one year from date of Substantial Completion.

Any delay in completion of planting operations which extends the planting into more than one season will extend the Warranty Period correspondingly.

Replace without cost to the Owner, and as soon as weather conditions permit, all dead grass as determined by the Owner's Representative during and at the end of the Warranty Period. Replacements shall be warranted through one full growing season.

END OF SECTION

SECTION 32 92 13 - HYDRO-MULCH SEEDING

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The work covered by this section consists of furnishing all plant, labor, materials, equipment, supplies, supervision and tools and performing all work necessary to top soiling, smoothing, seeding, fertilizing, watering maintenance and cleanups of side slopes, all in accordance with these specifications.
- B. The hydro-mulch seeding operations, together with all necessary related work, shall conform to the requirements specified in this section. The area(s) to be hydro-mulch seeded shall be noted in the construction documents.

1.2 MEASUREMENT & PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. All seed must meet the requirements of the U.S. Department of Agriculture Rules & Regulations as set forth in the Federal Seed Act and the Texas Seed Law.
- B. Type of seed, purity and germination requirements, rate of application and planting dates are as follows:

TABLE I

Type	Application Rate Pounds per Acre	Planting Date
Hulled Common Bermuda Grass 98/88	40	Jan. 1 to Apr. 15
Unhulled Common Bermuda Grass 98/88	40	Jan. 1 to Apr. 15
Annual Rye Grass, including Gulf	50	Jan. 1 to Apr. 15
Hulled Common Bermuda Grass 98/88	40	Apr. 15 to Oct. 1
Hulled Common Bermuda Grass 98/88	40	Oct. 1 to Jan. 1
Unhulled Common Bermuda Grass 98/88	40	Oct. 1 to Jan. 1

- C. Fertilizer shall be water soluble with an analysis of 10 percent nitrogen, 20 percent phosphoric acid and 10 percent potash. Rate of application shall be 500 pounds per acre, except during the period of April 15 through September 1, when the rate shall be reduced to 400 pounds per acre. The fertilizer shall be delivered to the site in bags or other convenient containers, each fully labeled, conforming to the applicable State Fertilizer Laws and bearing the name and warranty of the producer.
- D. Mulch shall be virgin wood cellulose fiber made from whole wood chips. Within the fiber mulch material, at least 20 percent of the fibers will be 10.7mm in length and 0.27mm in diameter. Rate of application shall be 2000 pounds per acre. Soil Stabilizers such as Terra Type III (or approved equal) shall be applied at a rate of 40 pounds per acre on side slopes and Terra Tack I (or approved equal) shall be applied at a rate of 40 pounds per acre on flatter portions.
- E. Wood cellulose fiber mulch, for use in the grass seed and fertilizer, shall be processed in such a manner that it will not contain germination or growth inhibiting factors. It shall be dyed an appropriate color to allow visual metering of its application. The wood cellulose fibers shall have the property of becoming evenly dispersed and suspended when agitated in water. When sprayed uniformly on the surface of the soil, the fibers shall form a blotter-like ground cover, which readily absorbs water and allows infiltration to the underlying soil. Weight specifications from suppliers for all applications shall refer only to the underlying soil. Weight specifications from suppliers, shall refer only to the air-dry weight of the fiber. The mulch material shall be supplied in packages having a gross weight not in excess of 100 pounds and must be marked by the manufacturer to show the dry weight content. Suppliers shall be prepared to certify that laboratory and field testing of their product has been accomplished and that it meets all of the foregoing requirements.
- F. Water shall be free from oil, acid, alkali, salt and other substances harmful to the growth of grass. The water source shall be subject to approval, prior to use.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Immediately after the finished grade has been approved, begin hydro-mulching operations to reduce erosion and excessive weed growth.
- B. Hydraulic equipment used for the application of fertilizer, seed and slurry of prepared wood fiber mulch shall have a built-in agitation system with an operating capacity sufficient to agitate, suspend and homogeneously mix a slurry containing up to forty (40) pounds of fiber plus a combined total of 70 pounds of fertilizer solids for each 100 gallons of water. The slurry distribution lines shall be large enough to prevent stoppage. The discharge line shall be equipped with a set of hydraulic spray nozzles, which provide even distribution of the slurry on the area to be seeded. The slurry tank shall have a minimum capacity of 800 gallons and shall be mounted on a traveling unit, which may either be self-propelled or drawn with a separate unit which will place the slurry tank and spray nozzles within sufficient proximity to the areas to be seeded, so as to provide uniform distribution without waste. The Engineer may authorize equipment with a smaller tank capacity, provided the equipment has the necessary agitation system and sufficient pump capacity to spray the slurry in a uniform coat.
- C. Care shall be taken that the slurry preparation take place on the site of the work. The slurry preparation should begin by adding water to the tank when the engine is at half throttle. When the water level has reached the height of the agitator shaft, good re-circulation shall be established and seed shall be added. Fertilizer shall then be added, followed by wood pulp mulch. The wood pulp mulch shall only be added to the mixture after the seed and when the tank is at least one-third filled with water. The engine throttle shall be opened to full speed when the tank is half filled with water.

All the wood pulp mulch shall be added by the time the tank is two-third to three-fourths full. Spraying shall commence immediately when the tank is full. The operator shall spray the area with a uniform visible coat, by using the green color of the wood pulp as a guide.

3.2 APPLICATION

- A. The Contractor shall obtain approval of hydro-mulch area preparation from the Engineer prior to application.
- B. Operators of hydro-mulching equipment shall be thoroughly experienced in this type of application. Apply the specified slurry mix in a motion to form a uniform mat at the specified rate. Operators shall keep the hydro-mulch within the areas designated and keep from contact with other plant material. Immediately after application, thoroughly wash off any plant material, planting areas or paved areas not intended to receive slurry mix.
- C. Keep all paved and planting areas clean during maintenance operations. Contractor shall keep hydro-mulching within the areas designated and keep from contact with other plant material.
- D. If in the opinion of the Engineer, unplanted skips and areas are noted after hydro-mulching, the Contractor shall be required to seed the unplanted areas with the grasses that were to have been planted at no additional cost to the Owner.

3.3 CONTRACTOR'S MAINTENANCE AND GUARANTEE PERIOD

- A. The hydro-mulch seeding shall be adequately watered until established. Any areas damaged by erosion or areas that do not have any acceptable turfing shall be redone to the satisfaction of the Engineer. Maintenance of grass areas shall be for 60 days after the completion of the project and shall consist of watering, weeding, repair of all erosion and reseeding, as necessary to establish a uniform stand of the specified grasses. The Contractor shall guarantee growth and coverage of hydro-mulch planting under this contract to the effect that a minimum of 95% of the area planted will be covered with the specified planting after 60 days.
- B. Prior to final acceptance, the Contractor shall be responsible for one (1) mowing per month between the months of April to September and shall mow every thirty (30) days plus or minus five (5) after the initial mowing. The Contractor shall also be responsible for one (1) mowing every six (6) weeks between the months of October to March. In addition, the Contractor shall water the entire sodded and hydro-mulched areas to a saturated depth of one (1) inch at least once a week between the months of April to September and at least once a month between the months of October to March.
- C. The Contractor shall make a second application of specified hydro-mulch planting to those bare areas not meeting specified coverage as determined by the Engineer. Such replanting is to be performed within 60 days of initial application and upon notification by the Engineer to replant.
- D. The Contractor shall apply top dress fertilizer (delayed action), at the rate of 10 pounds per 1000 square feet at 25 days after hydro-mulching of all new lawn areas.
- E. Top dress fertilizer shall be 16-6-8.

END OF SECTION 32 92 13

SECTION 32 92 23 - FERTILIZER

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Fertilizing shall consist of providing and distributing fertilizer over such areas as are designated for block sodding or seeding, for erosion control, and in accordance with these specifications.

1.2 MEASUREMENT

- A. Acceptable material for "Fertilizer" will be measured by the C-WT (100 lbs) as determined by approved scales or guaranteed weight of sacks shown by manufacturer.

1.3 PAYMENT

- A. No separate payment shall be made for materials furnished or work performed under this Section. Include the cost of same in the contract price bid for work of which this is a component part.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. All fertilizer used shall be delivered in bags or containers clearly labeled showing analysis. A pelleted or granulated fertilizer shall be used with an analysis of 10-10-5, unless otherwise specified. The figures in the analysis represent the nitrogen, phosphoric acid and potash nutrients respectively as determined by the methods of the Association of Official Agricultural Chemists. The sources of nitrogen in the fertilizer shall be roughly balanced between ammonical (quick release) and nitrate nitrogen (slow release).
- B. With permission of the Engineer, fertilizer of a different analysis may be substituted. It shall be pelleted or granulated fertilizer with a lower concentration. The total amounts of nutrients furnished and applied per acre shall equal or exceed that specified for each nutrient.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

- A. When fertilizer is included in the specifications, pelleted or granulated fertilizer shall be applied uniformly over the area specified to be fertilized and, in the manner, directed for the particular item of work. Fertilizer shall be dry and in good physical condition. Fertilizer that is powdered or caked will be rejected. Distribution of fertilizer for the particular item of work shall meet the approval of the Engineer.
- B. Unless otherwise indicated on the plans, fertilizer shall be applied uniformly at the average rate of 480 pounds per acre when "Sodding for Erosion Control", and 400 pounds per acre when "Seeding for Erosion Control".

END OF SECTION 32 92 23

SECTION 32 92 23.16 - SOLID SODDING

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Solid Sodding for erosion control shall consist of providing and planting Bermuda grass, or other acceptable sod along or across such areas as are designated on the plans and in accordance with the specification requirements herein outlined.

1.2 MEASUREMENT AND PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. The sod shall consist of live, growing Bermuda grass (ninety-five percent pure), secured from sources where the soil is fertile and has been fumigated. Bermuda sod shall have a healthy virile root system of dense, thickly matted roots throughout and grown in a sandy loam soil consisting of a minimum of 60% sand. Sod grown in fat clayey materials are not acceptable. The sod shall be cut from the field so that there is a minimum of one-half inch of soil on the roots of the sod, and so that no roots show on the bottom of the soil. Sod shall be dense, with the grass having been mowed to 1-inch height before lifting from the field. Sod shall be in a vigorous condition, dark green in color, free of disease and harmful insects. The contractor shall not use sod from areas where the grass is thinned out, nor where the grass roots have been dried out by exposure to the air and sun to such an extent as to damage its stability to grow when transplanted. The sod shall be free from obnoxious weeds or other grasses and shall not contain any matter deleterious to its growth or which might affect its subsistence or hardiness when transplanted. Unless the area has been closely pastured, it shall be closely mowed and raked to remove all weeds and long-standing stems.
- B. Care shall be taken at all times to retain the native soils on the roots of the sod during the process of excavation, hauling and planting. Sod material shall be kept moist from the time it is dug, until planted. When so directed by the Engineer, the sod existing at the source shall be watered to the extent required, prior to excavating. Do not stack sod for more than 36 hours between the time of cutting and the time of installation. The Engineer reserves the right to reject any sod deemed unacceptable for installation.
- C. All planting shall be done between the average date of the last freeze in the spring and six weeks prior to the average date for the first freeze in the fall, according to the U.S. Weather Bureau.
- D. Fertilizer shall conform to the requirements of SECTION 32 92 23 - FERTILIZER and shall be applied at the rate of 480-pounds per acre.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

- A. Immediately after the finished grade has been approved, begin sodding operations to reduce excessive weed growth. If the sod bed is dry immediately prior to sod installation, dampen the surface with a fine mist of water.
- B. Grass shall be turf sod, cut into approximately 18 inch wide by 24-inch long pieces, or 18 inch wide by continuous length rolls.
- C. All areas to be sodded shall be raked to true lines, free from all unsightly variations, bumps, ridges or depressions. All sticks, stones, roots or other objectionable material, which might interfere with the formation of a finely pulverized seedbed, shall be removed from the soil.
- D. Lay sod so that adjacent strips butt tightly, with no spaces between strips. Lay sod on mounds and slopes, with strips parallel to contours. Stagger joints. Tamp and roll the sod thoroughly to make contact with the sod bed, or as directed by the Engineer.
- E. Peg sod on slopes three to one or steeper with pegs driven through sod into soil, until pegs are flush with the turf. Space pegs 18 inches on center. Pegs to be 1 inch square, 6 inches long or, 6-inch lengths of lath. Commercial fertilizer as outlined in SECTION 32 92 23 - FERTILIZER shall be applied to the entire sodded area at the prescribed rates, immediately following laying of the sod. Immediately after fertilizing, water the entire area to a saturated depth of 2-inches.
- F. Immediately after installation of the sod, remove sod clumps on soil, wash off any plant materials and pavements not to have sod. Edges along curbs and drives, walkways, etc., shall be carefully trimmed and maintained until accepted.

3.2 CONTRACTOR'S MAINTENANCE AND GUARANTEE PERIOD

- A. Maintenance of sodded areas shall be for 60 days after completion of the project and shall consist of watering, weeding, repair of all erosion and resodding as necessary to establish a uniform growth of the specified grass. The Contractor shall guarantee growth and coverage of the sod planted under this contract to the effect that a minimum of 95% of the area planted will be covered with the specified planting after 60 days. Sod panels that are dead or dying shall be replaced.
- B. The Contractor shall be responsible for one mowing, in the event that the time between sodding and final acceptance exceeds thirty days.
- C. The Contractor shall make a second planting to those bare areas not meeting specified planting as determined by the Engineer. Such replanting is to be performed within 90 days of initial application and upon notification by the Engineer to replant.

END OF SECTION 32 92 23.16

SECTION 33 01 30.13 - SANITARY SEWER TCEQ MANHOLE REQUIREMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

- A. This section provides for those TEXAS WATER CODE AMENDMENTS as published in the Texas Register with an **Effective date of September 1, 2008**. These requirements are binding for all Sanitary Sewer Manholes.

1.2 SUBMITTALS

- A. Submit product data and shop drawings for ALL items to be installed.
- B. Refer to Section 01 33 00 for submittal procedures.

1.3 SYSTEM DESCRIPTIONS

- A. Design Requirements:
 - 1. Manholes shall be placed at all points of change in alignment, grade or size of sewer, at the intersection of all sewers and the end of all sewer lines that will be extended at a future date. Any proposal which deviates from this requirement shall be justified to the satisfaction of the TCEQ Executive Director. Clean-outs with watertight plugs may be installed in lieu of manholes at the end of sewers which are not anticipated to be extended. Such installations must pass a leakage test and a deflection test for all flexible lines.

1.4 MEASUREMENT AND PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Manholes shall be monolithic, cast-in-place concrete, fiberglass, precast concrete, HDPE or of equivalent construction as shown on the Plans. Brick manholes shall not be used, nor shall brick be used to adjust manhole covers to grade.

PART 3 - EXECUTION

3.1 CONSTRUCTION DETAILS

- A. The maximum required manhole spacing for sewers with straight alignment and uniform grades are in the following table. Reduced manhole spacing may be necessary depending on the utility's ability to maintain its sewer lines. Areas subject to flooding require special consideration to minimize inflow.

Pipe Diameter (inches)	Maximum Manhole Spacing (feet)
6 - 15	500
18 - 30	800

36 - 48	1000
54 or larger	2000

- B. Watertight, size-on-size resilient connectors allowing for differential settlement shall be used to connect pipe to manholes. Pipe to manhole connectors shall conform to ASTM C-923. Other types of connectors may be used when approved by the TCEQ. Manholes should not allow surface water to drain into them. If manholes are located within the 100-year flood plain, the manhole covers shall have gaskets and be bolted or have another means of preventing inflow. Where gasketed manhole covers are required for more than three manholes in sequence, an alternate means of venting shall be provided at less than 1500 foot intervals. Vents should be designed to minimize inflow. Impervious material should be utilized for manhole construction in these areas in order to minimize infiltration.
- C. Diameter
1. Manholes shall be sufficient inside diameter to allow personnel to work within them and to allow proper joining of the sewer pipes in the manhole wall. The inside diameter of manholes shall be not less than 48 inches.
- D. Inverts
1. The bottom of the manhole shall be provided with a "U" shaped channel that is as much as possible a smooth continuation of the inlet and outlet pipes. For manholes connected to pipes less than 15 inches in diameter the channel depth shall be at least half the largest pipe diameter. For manholes connected to pipes 15 to 24 inches in diameter the channel depth shall be at least three fourths the largest pipe diameter. For manholes connected to pipes greater than 24 inches in diameter the channel depth shall be at least equal to the largest pipe diameter. In manholes with pipes of different sizes, the tops of the pipes shall be placed at the same elevation and flow channels in the invert sloped on an even slope from pipe to pipe. The bench provided above the channel shall be sloped at a minimum of 0.5 inches per foot. Where sewer lines enter the manhole higher than 24 inches above the manhole invert, the invert shall be filleted to prevent solids deposition. A drop pipe should be provided for a sewer entering a manhole more than 30 inches above the invert.
- E. Covers
1. Manhole covers of nominal 30-inch or larger diameter are to be used for all sewer manholes.
- F. Access
1. Design of features for entering manholes shall be guided by the following criteria.
 - a. It is suggested that entrance into manholes in excess of four feet deep be accomplished by means of a portable ladder. Other designs for ingress and egress should be given careful evaluation considering the safety hazards associated with the use of manhole steps under certain conditions.
 - b. Where steps are used, they shall be made of a non-corrosive material and be in accordance with applicable OSHA specifications as published by the United States Department of Labor.

3.2 TESTING

- A. Manholes shall be tested for leakage separately and independently of the wastewater lines by hydrostatic exfiltration testing, vacuum testing, or other methods acceptable to the Commission. If a manhole fails a leakage test, the manhole must be made watertight and retested. The maximum leakage for hydrostatic testing shall be 0.025 gallons per foot diameter per foot of manhole depth per hour. Alternative test methods must ensure compliance with the above allowable leakage. Hydrostatic exfiltration testing shall be performed as follows: all wastewater lines coming into the manhole shall be sealed with an internal pipe plug, then the manhole shall be filled with water and maintained full for at least one hour. For concrete manholes a wetting period of 24 hours may be

used prior to testing in order to allow saturation of the concrete.

B. Procedure for Vacuum Testing

1. Vacuum test according to ASTM C 1244, latest edition.
2. The test head shall be placed at the top of the manhole in accordance with the manufacturer's recommendations.
3. A vacuum of 10 in. of mercury shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop from 10 in. to 9 in. of mercury.
4. The manhole shall be considered as passing if the time for the vacuum reading to drop from 10 in. of mercury to 9 in. of mercury meets or exceeds the values indicated in Table 1.
5. If the manhole fails the initial test, necessary repairs shall be made by a method approved by The Engineer. The manhole shall then be retested until a passing test is obtained.
6. Use or failure of this vacuum test shall not preclude acceptance of the manhole by appropriate water exfiltration testing, or other preapproved means and methods.

TABLE 1 - MINIMUM TEST TIMES FOR VARIOUS MANHOLE DIAMETERS

Depth (Feet)	Diameter (in.)								
	30	33	36	42	48	54	60	66	72
	Time (sec.)								
8	11	12	14	17	20	23	26	29	33
10	14	15	18	21	25	29	33	36	41
12	17	18	21	25	30	35	39	43	49
14	20	21	25	30	35	41	45	51	57
16	22	24	30	34	40	45	52	58	67
18	25	27	32	38	45	52	59	65	73
20	28	30	35	42	50	53	65	72	81
22	31	33	39	46	55	64	72	79	89
24	33	36	42	51	59	64	78	87	97
26	36	39	46	55	64	75	85	94	105
28	39	42	49	59	69	81	91	101	113
30	42	45	53	63	74	87	98	108	121

END OF SECTION 33 01 30.13

SECTION 33 11 00 - WATER DISTRIBUTION SYSTEM (PVC)

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. These specifications shall govern the furnishing and placing of water distribution lines, fittings, valves, fire hydrants, and other appurtenances. The pipe and accessories shall be installed in accordance with the requirements of these specifications at the locations and depths indicated on the plans, and shall be of the classes, sizes and dimensions shown thereon. The installation of pipe shall include all joints, connections to new or existing pipes, and installation of all fittings, valves, fire hydrants, and appurtenances.

1.2 GENERAL

- A. Piping for water mains shall be of the type and materials specified herein, at the Contractor's option, unless otherwise indicated on the drawings or in this section. The pipe and accessories shall be new and unused. The interior of the pipe shall be thoroughly cleaned of foreign matters before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells and joints. Any pipe that has the grade or joint disturbed after laying shall be taken up and re-laid. Pipe shall not be laid in water, or when trench or weather are unsuitable for the work. Water shall be kept out of the trench until the jointing is complete. When work is not in progress, open ends of pipe and fittings shall be securely closed so that no trench water, earth or other substance will enter the pipes or fittings. Any section of pipe found to be defective before or after laying shall be replaced with sound pipe without additional expense to the Owner.

1.3 SUBMITTALS

- A. Submit product data and shop drawings for ALL items to be installed.
- B. Refer to Section 01 33 00 for submittal procedures.

1.4 WATER LINE - SANITARY SEWER LINE CROSSINGS

- A. The water pipe shall not be laid closer horizontally than 9 feet in all directions and parallel lines must be installed in separate trenches. Where the nine-foot separation distance cannot be achieved, the following shall apply. The sewer line need not be disturbed where the water line shall be installed parallel to an existing sewer line that shows no evidence of leakage and the water line is installed above the sewer line a minimum of two feet vertically and four feet horizontally. Should excavation for the water line produce evidence that the sewer is leaking, the sewer line shall be replaced as described in SECTION 33 33 13 - SANITARY SEWER LINES. The sewer line shall not be disturbed where a new water line is to cross over (by two feet or more) existing sewer lines showing no evidence of leakage.

1.5 METHOD OF MEASUREMENT AND PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All pipe shall be new and made in the United States. All plastic pipe must also bear the National Sanitation Foundation Seal of Approval (NSF-PW) and have an ASTM design pressure rating of at least 150 psi or a standard dimension ratio of 26 or less. Water Distribution Lines must be installed in accordance with the manufacturer's instructions. All water Line materials and appurtenances shall comply with Section 290.44(b) of the Texas Natural Resource Conservation Commission Rules and Regulations for Public Water Systems regarding lead banned from piping and joints.

2.2 POLYVINYL CHLORIDE (PVC) PIPE

- A. Requirements for unplasticized polyvinyl chloride (PVC) pipe with bell joints which are integral to the pipe and are well thickened so that standard dimension ratios are maintained or exceeded.
- B. Plastic pipe in 4" and larger sizes shall conform to all requirements of AWWA C900 - DR 18, Class 150.
- C. Plastic pipe in 2", 2 1/2" and 3" sizes shall conform to all requirements of ASTM D 2241 for PVC pipe and be pressure rated at 200 psi with a standard dimension ratio (SDR) of 21 for Class 200 for both barrel and bell dimensions.
- D. Plastic pipe in sizes smaller than 2" shall conform to all requirements of Schedule 40 and have Schedule 80 fittings.

2.3 COPPER TUBING

- A. All 3/4", 1", 1-1/2" and 2" copper tubes for underground service shall Be Type "K" soft annealed with the proper bending temper. All 3/4" And 1" tubes shall be furnished in coils, each containing 60 feet; FLAT coils are preferred. Other diameters of tubes shall be furnished in straight lengths of 20 feet.

2.4 BRASS FITTINGS

- A. All brass fittings shall conform to ASTM Specifications B-62- 52 And shall be those manufactured by the Mueller Company or preapproved equivalent.

2.5 FITTINGS

- A. All fittings shall be cast iron or ductile iron and shall conform to the latest edition of AWWA Specifications.
- B. All ductile iron fittings shall be coated outside with a bituminous coating of either coal tar or asphalt. The inside coating shall be a cement-mortar lining in accordance with AWWA Specification.
- C. All fittings shall be new and made in the United States.
- D. All ductile iron fittings shall be approved by Underwriters Laboratories and shall be accepted by the State Fire Insurance Commission for use in city water distribution systems without penalty.
- E. Rubber gaskets for these fittings shall be manufactured in accordance with AWWA specifications.

2.6 GATE VALVES

- A. All gate valves shall be designed for a cold hydrostatic working pressure of 175 pounds per square inch for valves with diameters of 3-12 inches, inclusive with shop test of 300 pounds per square inch and a working pressure of 150 pounds per square inch for valves with diameters of 16-48 inches, inclusive with shop test to 300 pounds per square inch. All gate valves shall conform to the requirements of AWWA C500-86 Specification. Valves will be equipped with O-ring stem seals.
- B. Gate valves shall be iron body, *resilient seated*, non-rising stem conforming to the requirements of AWWA C509-87 and shall open counter-clockwise. Tapping valves shall be flanged to fit a tapping sleeve on one side and shall be mechanical joint on the other side, with provisions for attaching a standard tapping machine. Gate Valves, fourteen (14) inches and smaller, shall be designed for vertical installation; gate valves, sixteen (16) inches and larger, shall be designed for operation with the stem horizontal or vertical as shown on the plans. Horizontal valves shall be provided with enclosed lubricated bevel gears, bronze gate roller and tracks, bypass valve, and two (2) inch operating nuts on main and bypass valves. Vertically mounted valves sixteen (16) inches and larger shall be designed for operation with the stem vertical and shall be provided with enclosed lubricated spur gears, bypass valve and two (2) inch operating nuts on main and bypass valves. Valves in two (2) inch cast iron screw joint pipe may be two and one-half (2-1/2) inches brass, non-rising stem, wedge disc with thread hubs. Gate valves shall be Mueller, Stockham, M & H or a preapproved equivalent.
- C. Unless otherwise specified, all gate valves shall be installed complete with valve box.

2.7 FIRE HYDRANTS

- A. Fire hydrants shall be Mueller Super Centurion or an approved equivalent.
- B. Each hydrant shall be factory tested to a hydrostatic pressure of 300 psi with valve in both the open and closed positions. The direction of opening nut shall be counterclockwise and shall be cast on the head of the hydrant. Hose nozzles shall be bronze or non-corrosive metal and threads shall be national standard. The main valve opening shall be either five and one-fourth (5-1/4) inches in diameter or six and one-fourth caps shall be provided with gaskets. Bury length shall be three and one-half (3-1/2) feet unless otherwise noted on the plans. Hydrants shall be provided with "dry top" which prevents stem threads from contacting water, and "break-off" type barrel and stem.
- C. Hydrants shall be painted with shop coating in accordance with AWWA C502 specification. Final coats of paint will be applied by Contractor in accordance with fire department requirements.
- D. Contractor shall verify and make nozzle threads consistent with local fire department.

2.8 AIR VALVES

- A. Air valves shall be of the type indicated on the plans. The assembly shall not leak nor shall the valve stick under service conditions.

2.9 CORPORATION COCKS

- A. Corporation cocks shall be of the size specified on the plans. Inlet threads shall be Mueller thread or approved equal. Outlet threads shall be one size larger than listed cock size. Corporation cocks shall be Mueller, H-15000 or a preapproved equivalent.

2.10 VALVE BOXES

- A. Valve boxes shall be cast iron, adjustable height with cover marked "water". Valve boxes shall be

Alamo Iron Works #813-30 or a preapproved equivalent.

2.11 WATER METERS

- A. Water meters shall conform to the requirements of AWWA C700, latest revision and shall be of the displacement type. Case shall be bronze, and the register shall be sealed. Accuracy shall be at least 100% plus or minus 1.5% of actual through put. Maximum operating pressure shall be 150 psi. Unless noted otherwise, meters shall be as manufactured by Sensus Technologies, Inc. or a preapproved equivalent.
- B. Boxes for water meters shall be of a key-lock type.

PART 3 - EXECUTION

3.1 CONSTRUCTION METHODS

- A. Unless otherwise specified, the provisions of this section shall conform to AWWA C600-64 specifications.

3.2 LAYING AND JOINTING

- A. Pipe, fittings, valves, and hydrants shall be carefully handled to avoid damage. While they are suspended over the trench, before lowering, they shall be inspected for defects and rung with a light hammer to detect cracks. To ensure proper seating for the spigot and against the shoulders of the bell, each joint shall be lightly swung against the last joint laid before unhooking the sling. Joints of small diameter pipe, installed by hand, shall be properly seated by using an iron bar or other suitable lever to force the spigot end against the shoulders of the bell of the last previously laid joint. Before any pipe is laid, all dirt shall be removed from the inside, and all lumps, blisters, excess tar coat, dirt, oil, grease, and moisture shall be removed from inside the bell and from outside the spigot end. All pipe shall be laid and maintained to the lines and grades shown on the plans or as established on the ground by the Engineer. Wherever it is necessary to deflect pipe from a straight line, the degree of deflection at each joint shall not exceed the maximum deflection recommended by the manufacturers of the pipe being laid. Bell ends shall face the direction of laying. After pipe is laid, care shall be taken to avoid the entrance of dirt, water or other substances by the use of tight bulkheads or plugs.
- B. Gasket material shall be kept in clean containers and shall not be allowed to come in contact with the ground. Gasket material which has become contaminated or dirty shall be destroyed.
- C. Mechanical joints shall be installed in accordance with the manufacturer's recommendations.
- D. Unless otherwise shown, valves shall be located on the extension of street property line. Every valve, including bypass valves, shall be provided with a valve box. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the operating nut, with the cover flush with the pavement surface or such other level as directed.
- E. Hydrants shall be located as shown on the Plans and in a manner that will provide complete accessibility and will prevent damage from vehicles. All hydrants shall stand plumb and shall have their pumper connections at right angles to the street. When placed immediately behind the curb, the hydrant barrel shall be set so that no portion of the steamer or hose connection cap will be less than six (6) inches from the gutter face of the curb.
- F. Minimum cover on water lines shall be forty-eight (48) inches unless otherwise specified, but in no case shall the top of any water line be less than 24 inches below the finished ground surface.

3.3 EXCAVATION

- A. All excavations are to be by the open-trench method, unless the Engineer orders that certain sections of the mains are to be laid in tunnels or bored.
- B. The minimum width of the bottom of the trench shall be such that there will be six inches space on each side between the pipe and the walls of the trench. The width of the trench at the surface is not to be less than at the bottom.
- C. When excavating machinery is being used, the same shall cut the trench to a grade slightly higher than the bury indicated by the proposal and the trench shall then be fine graded.
- D. The trench must always be opened and excavated to the finished grade for a distance of at least 50 feet in advance of the last made-up joint. Water mains into which the mains under construction are to be connected must be located well in advance of such connection to allow for possible adjustment of alignment and/or grade.
- E. Bell holes must be excavated in advance of placing the pipe. Materials used shall be placed at locations so as not to interfere unnecessarily with the use of the streets by the public, and not more than two streets intersections shall be closed at any time. The street surface along the line of the trench must be kept free of surplus spoil.
- F. The expense of restoring the original condition of improved property in connection with grass, shrubs or any other improvements must be borne by the Contractor. All trees adjacent to the trench must be protected and the trees on public or private property must not be cut unless permission, in writing, is granted.

3.4 BEDDING

- A. Sand bedding shall be as shown on the Plans with a minimum compacted depth of six inches.

3.5 ROCK EXCAVATION

- A. No rock is anticipated, and no extra compensation will be allowed for rock excavation.

3.6 JACKING, BORING & TUNNELING

- A. This item shall govern for the furnishing and installation of pipe by the methods of jacking, boring or tunneling as shown on the Plans and in conformity with this Specification.
- B. Pipe shall be of the size, type, and class specified on the Plans, or other types as may be specified by the Engineer or designated on the Plans.
- C. Jacking: If the grade of the pipe at the jacking end is below the ground surface, suitable pits or trenches shall be excavated for the purpose of conducting the jacking operations and for placing end joints of the pipe. Wherever end trenches are cut in the sides of the embankment or beyond it, such work shall be sheeted securely and braced in a manner satisfactory to the Engineer to prevent earth caving.
- D. Where pipe is required to be installed under railroad embankments or under highways, streets, or other facilities by jacking or boring methods, construction shall be made in such a manner that will not interfere with the operation of the railroad, street, highway, or other facility, and shall not weaken or damage any embankment or structure. During construction operations, barricades and lights to safeguard traffic and pedestrians shall be furnished and maintained, as directed by the Engineer, until such time as the backfill has been completed and then shall be removed from the site.

- E. Heavy duty jacks suitable for forcing the pipe through the embankment shall be provided. In operating jacks, even pressure shall be applied to all jacks used. A suitable jacking head, usually of timber, and suitable bracing between jacks and jacking head shall be provided so that pressure will be applied to the pipe uniformly around the ring of the pipe. A suitable jacking frame or back stop shall be provided. The pipe to be jacked shall be set on guides, properly braced together, to support the section of the pipe and to direct it in the proper line and grade. The whole jacking assembly shall be placed so as to line up with the direction and grade of the pipe. In general, embankment material shall be excavated just ahead of the pipe and material removed through the pipe, and the pipe forced through the embankment with jacks, into the space thus provided.
- F. The Contractor shall furnish for the Engineer's approval, a plan showing his proposed method of handling, including the design for the jacking head, jacking support of back stop, arrangement and position of jacks, pipe guides, etc., complete in assembled position. The approval of this plan by the Engineer will not relieve the Contractor from his responsibility to obtain the specified results.
- G. The excavation for the underside of the pipe, for at least one-third of the circumference of the pipe, shall conform to the contour and grade of the pipe. A clearance of not more than two inches (2") may be provided for the upper half of the pipe. This clearance is to be tapered off to zero at the point where the excavation conforms to the contour of the pipe. The distance that the excavation shall extend beyond the end of the pipe depends on the character of the material, but it shall not exceed two feet (2') in any case. This distance shall be decreased on instructions from the Engineer, if the character of the material being excavated makes it desirable to keep the advance excavation closer to the end of the pipe.
- H. The pipe, preferably, shall be jacked from the low or downstream end. Lateral or vertical variation in the final position of the pipe from the line and grade established by the Engineer will be permitted only to the extent of one inch (1") in 10 feet, provided that such variation shall be regular and only in one direction and that the final grade of flow line shall be in the direction indicated on the plans. If the Contractor desires, he may use a cutting edge of steel plate around the head end of the pipe extending a short distance beyond the end of the pipe with inside angles or lugs to keep the cutting edge from slipping back onto pipe.
- I. When jacking of pipe is once begun, the operation shall be carried on without interruption, insofar as practicable, to prevent the pipe from becoming firmly set in the embankment.
- J. Any pipe damaged in jacking operations shall be removed and replaced by the Contractor at his entire expense.
- K. The pits or trenches excavated to facilitate jacking operations shall be backfilled immediately after the jacking of the pipe has been completed.
- L. Boring: The boring shall proceed from a pit provided for the boring equipment and workmen. Excavation for pits and installation of shoring shall be as outlined above under "Jacking". The location of the pit shall meet the approval of the Engineer. The holes are to be bored mechanically. The boring shall be done using a pilot hole. By this method approximately a two-inch (2") pilot hole shall be bored the entire length of the crossing and shall be checked for line and grade on the opposite end of the bore from the work pit.
- M. This pilot hole shall serve as the centerline of the larger diameter hole to be bored. Excavated material will be placed near the top of the working pit and disposed of as required. The use of water or other fluids in connection with the boring operation will be permitted only to the extent to lubricate cuttings. Jetting will not be permitted.
- N. In unconsolidated soil formations a gel-forming colloidal drilling fluid consisting of at least 10% of high grade carefully processed bentonite may be used to consolidate cuttings of the bit, seal the walls of the hole, and furnish lubrication for subsequent removal of cuttings and installation of the

pipe immediately thereafter.

- O. Allowable variation from line and grade shall be as specified under "Jacking". Overcutting in excess of one inch (1") shall be remedied by pressure grouting the entire length of the installation.
- P. Tunneling: Where the characteristics of the soil or the size of the proposed pipe would make the use of tunneling more satisfactory than jacking or boring, or where called for on the Plans, a tunneling method may be used.
- Q. The excavation for pits and the installation of shoring shall be as outlined above under "Jacking".
- R. The lining of the tunnel shall be of steel of sufficient strength to support the overburden. The Contractor shall submit his proposed liner method to the Engineer for review. Review by the Engineer shall not relieve the Contractor of the responsibility for the adequacy of the liner method.
- S. The space between the liner plate and the limits of excavation shall be pressure-grouted or mud-jacked.
- T. Access holes for pouring concrete shall be spaced at maximum intervals of ten feet.
- U. If corrugated galvanized metal pipe is used, joints may be made by field bolting or by connecting bands, whichever is feasible.
- V. Clean-up: Contractor's equipment, surplus material and surplus earth shall be removed from the job following the final test of mains and all street surfaces replaced before the final estimate will be approved.
- W. The Owner shall have the right to make connections with and operate all or any part of the main when, in the opinion of the Engineer, such connection does not in any way interfere with the progress of the work, but it is understood that by making such use or connections the Owner does not accept the sewer or waive his right to object to any defect found therein, until the same has been finally inspected by the Engineer and found to be in accordance with the specifications.

3.7 CROSSING STATE HIGHWAYS AND RAILROADS

- A. When water lines cross highways, railroads, or town streets under the jurisdiction of the TxDOT or other public body or corporation, the Contractor shall secure permission from the controlling authority before installing such lines.

3.8 WET CONNECTIONS

- A. Wet connections are defined as connections made to a line in the existing system by interrupting water service. They shall be made at such points as are shown on the plans or as designated by the Engineer. The method and the equipment to be used shall be submitted to the Engineer for approval before any work is done.
- B. Any time that the interruption of water service in the existing system is necessary because of operations under this contract, the Contractor shall notify the City Water Superintendent forty-eight (48) hours in advance. The Contractor will not operate any valve in the existing water system.

3.9 LOWERING OF EXISTING MAINS

- A. When a main is to be lowered in order to conform with new construction, the initial excavation shall be done in such a manner as to permit the mains to rest on several dirt benches, or wooden blocks if soil conditions are unsatisfactory for the benches. The pipe shall then be supported by ropes, cables or chains to overhead supports; the dirt benches or wooden block removed, and the pipe

slowly and evenly lowered into position. After the mains have been lowered, each damaged joint must be re-tightened as directed by the Engineer.

3.10 REMOVING PIPE

- A. Salvageable joint materials from each joint of the pipe must be removed and reclaimed for the Owner and all corporation cocks disconnected and the holes plugged with plugs furnished by the Owner before the pipe is raised from its original position. After raising the pipe from the trench, it shall be pulled apart at the joints and all foreign material removed from the bells and spigots.
- B. All removed materials are to remain the property of the Owner and shall be hauled to the Owner's storage yard.
- C. The unit bid prices for removing mains shall include the removal, the cleaning of exterior and connection surface and hauling to designated storage yards, of all fittings, valves, flushing valves, and other appurtenances.

3.11 TRENCH BACKFILL

- A. All trench backfill above pipe embedment shall conform to the following requirements:
- B. Tamped backfill placed in six-inch (6") layers and compacted to 95% density will be required for the full depth of the trench beneath pavement, surfacing, driveways, curbs, gutters, walks, or other surface construction or structures as well as beneath street, road, or highway shoulders.
- C. In areas other than that described above, backfill shall be placed and tamped in six inch (6") layers until one foot above top of the pipe, then the balance of the backfill shall be placed in twelve inch (12") layers with Compaction approximately equal to that of the adjacent undisturbed material. To compensate for settlement below surface grade backfill material shall be added as necessary and compacted.

3.12 SURPLUS EARTH

- A. Any surplus excavated material shall be disposed of as directed by the Engineer. If the Engineer notifies the Contractor that the Owner does not have use for this material, it shall become the property of the Contractor to dispose of as he wishes without injury to the Owner or any individual.

3.13 STREET SURFACES

- A. In all streets the surface of the trenches after being refilled, dried and settled, shall be finished in the most workmanlike manner without needless delay and shall in every respect be equal in quality, character, material and workmanship to the street improvements existing over the line of the trench immediately prior to making the excavation. The expense of restoring the streets must be included in the price bid per linear foot for mains, except as otherwise provided herein.
- B. All concrete paving, road gravel, and road shell ordered placed on streets will be paid for at the unit price bid.
- C. On gravel, shell and asphalt surfaced streets, the trench shall be filled as otherwise specified up to within eight inches of the surface of the street. The trench shall then be filled with gravel or shell, as ordered by the Engineer, to a point approximately one (1) inch higher than the street level. After all other work is completed and before the job is finally accepted, the Contractor shall go back and place such additional gravel or shell as is ordered by the Engineer. No extra payment for road gravel or stabilized shell.
- D. On concrete streets the trenches shall be filled as otherwise specified within six (6) inches of the

surface of the street, and then filled with road gravel or shell to a point approximately one (1) inch higher than the street level. After all other work is completed, the Contractor shall go back and remove sufficient shell and install six (6) inches of concrete as ordered by the Engineer. The concrete used shall be paid for at the unit price bid in the proposal schedules.

- E. On asphalt surfaced streets, the gravel or shell base shall be placed as stated above. At such time as directed by the Engineer, the gravel or shell base shall be leveled smooth approximately one (1) inch below the existing asphalt surface. The new asphalt pavement shall then be placed and rolled or tamped to a smooth and even surface.

3.14 CROSSINGS TO BE KEPT OPEN

- A. At such street crossings and other intermediate points as may be designated by the Engineer, the trenches shall be bridged in such proper and secure manner as to prevent any serious interruption of travel upon the roadway and sidewalks, the cost thereof to be borne by the Contractor.
- B. Clean Up: Contractors equipment, surplus material and surplus earth shall be removed from the job following the final test of mains and all street surfaces replaced before the final estimate will be approved.
- C. Laying Pipe: In general, the bottom of the trench shall be shaped to give full support to the lower quarter of each pipe. If the foundation is rock or other hard material, a bed of sand or suitable earth shall be placed upon the subgrade and well compacted. The thickness of the bed shall be not less than two (2) inches nor more than six (6) inches. If the foundation is of such material or if conditions are such that the pipe cannot be otherwise properly supported or if the load on the pipe so requires, a concrete cradle as hereinafter specified shall be provided. In all cases water shall be kept out of the trench until the masonry or jointing material has sufficiently hardened. The pipe shall be laid to grade shown on the plans or as directed by the Engineer. Each pipe shall be inspected for defects prior to being lowered into the trench and shall be carefully cleaned in both bell and spigot. Pipe laying shall proceed up-grade with spigot ends pointing in direction of flow. Pipes shall be laid so that each pipe shall rest upon the full length of its barrel with holes excavated to accommodate bells. Except by special permission, no pipe shall be laid except in the presence of an inspector. Any defective pipe laid or any pipe which has had its grade of joint disturbed after laying shall be taken up and replaced.
- D. Before joining the inside of the bells and outside of the spigots shall be dry and clean. The joint shall be made as recommended by the manufacturer of the joint material. Water shall not be allowed in the trenches while the pipes are being laid. The Contractor shall not open up more trenches than the available pumping facilities are able to de-water, to the satisfaction of the Engineer. Bells shall be entirely free of water when joints are made, regardless of the type of joint, and no water shall be allowed to rise over the joint until it has set.

3.15 HOUSE CONNECTIONS

- A. House connections to main pipe shall be made by tapping the main and installed corporation cock of the size designated. The corporation cock shall be screwed securely into position. The copper service, polyethylene or butylene pipe shall be connected to the corporation cock and laid in accordance with the specifications contained herein for laying pipe.

3.16 INSTALLING WATER METERS AND METER BOXES

- A. Water Meters: The ground shall be excavated to such depth that the top of the box is flush with normal ground level. The tail piece of the meter shall be inserted into the service lines as near to the curb cock as possible, or directly into the curb cock. The meter shall then be set in such position that the bottom of the meter is at least two (2) inches above ground. The house side of the meter shall then be connected to the service line running to the house. It is essential that the meters shall

be set plumb and in line with the service line and all connections made in a neat and workmanlike manner.

- B. Meter Boxes: The meter box shall be set on firm ground so that the top of the meter box is flush with the ground surface, and the box is level and plumb. Ground shall be carefully backfilled and tamped around the meter box to leave a neat appearance.

3.17 SETTING FIRE HYDRANTS

- A. Fire hydrants shall be set where shown on the plans or ordered by the Engineer.
- B. Excavate underneath the drain outlet of each fire hydrant a space twelve (12) inches square and six (6) inches deep and fill with gravel. Place the gravel up around bottom of the flushing hydrant not less than three (3) inches above the drain outlet. Not less than two (2) cubic feet of gravel shall be placed around each flushing hydrant. The gravel shall be carefully covered with a layer of one ply roofing paper before trench around the hydrant is refilled. All hydrants shall be carefully blocked and placed to prevent expansion of stub line from water pressure. See plan sheet for blocking details.

3.18 STERILIZATION OF PIPELINES

- A. Unless otherwise specified, sterilization of new water lines shall be done in accordance with AWWA C651-86 specification.
- B. The contractor shall furnish all labor equipment, and materials necessary for the sterilization of the new pipelines, which shall be sterilized before being tested and placed in service. The lines shall be sterilized by the application of a chlorinating agent. The chlorinating agent may be liquid chlorine, liquid chlorine gas-water mixture, or a calcium hypochlorite solution, which shall be fed into the lines through a suitable solution-feed device or other methods approved by Engineer. The chlorinating agent shall be applied at or near the point from which the line is being filled, and through a corporation stop or other approved connection inserted in the horizontal axis of the newly laid pipe. The water being used to fill the line shall be controlled to flow into the section to be sterilized very slowly, and the rate of water entering the pipe that the chlorine dose applied to the water entering the line shall be a minimum of 50 ppm of chlorine residual of not less than twenty five (25) ppm after twenty-four (24) hours standing in the pipe. At the end of the retention period, all treated water shall be thoroughly flushed from the lines until the replacement water in the lines shall have a chlorine residual of not more than 0.4 parts per million.
- C. Solvent cemented or welded joint pipes shall be sterilized using a sterilizing agent other than liquid chlorine and/or calcium hydrochloride.
- D. Where no suitable outlet is available for flushing dead ends, the Contractor shall furnish and install outlet valves of sufficient size to adequately flush the new mains at the locations designated by the Engineer, for which payment shall be made at the unit price bid for the size valve installed. After the lines are sterilized and flushed and tested as specified above, samples of water shall be taken from the mains for bacteriological tests. If the samples fail to meet the health departments standard requirements, the disinfection process as outlined above shall be repeated and continued until the tests show results that meet the health departments requirements.

3.19 HYDROSTATIC TEST

- A. The Contractor shall provide all necessary equipment and shall perform all work required in connection with the tests. All pressure pipe installations shall be tested for leakage in the presence of the Engineer. The Engineer shall be given a minimum of 24 hours' notice for each and every test. Tests that are not performed in the presence of the Engineer will not be accepted.

- B. The test pressure shall be 1.5 times the maximum force main design pressure or 150 pounds per square inch gauge, whichever is greater. The test shall be held for a period of four (4) hours. The new system shall be tested in sections between valves. The length of test sections shall not exceed 2,000 feet unless authorized by the Engineer. Each test section shall be slowly filled with water, care taken to expel all air from the pipe. If necessary, the pipes shall be tapped at high points to vent the air. There will be no extra charge to the Owner for venting.
- C. At the end of the test period, the amount of leakage shall be determined by the quantity of water that must be supplied into the pipe, or any valved section thereof, to maintain pressure within five pounds per square inch of the specified test pressure, after the air in the pipe has been expelled. The maximum allowable leakage shall be calculated using the following formula.
1. $L = SD((P)^{1/2})/133,200$, where L = leakage in gal/hr
 2. S = length of pipe in feet
 3. D = inside diameter of pipe in inches
 4. P = pressure in pounds per square inch
- D. If the quantity of leakage exceeds the maximum amount calculated, the failed section will be rejected and not accepted until it meets the above requirements.
- E. Upon completion of all sterilization and testing, the Contractor shall provide personnel to open all valves and operate all hydrants, as directed, in the presence of a representative of the Engineer.

END OF SECTION 33 11 00

SECTION 33 33 13 - SANITARY SEWER LINES

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. Work under this Section includes furnishing all plant, labor, materials, equipment, tools, incidentals and the performance of all work necessary to complete all sanitary sewers and appurtenances, as shown on the drawings and herein specified including the following:
 - 1. Sanitary Sewers
 - 2. Sanitary Sewer Manholes and Cleanouts
 - 3. Service Connections
 - 4. Force Main

1.2 SUBMITTALS

- A. Submit product data and shop drawings for ALL items to be installed.
- B. Refer to Section 01 33 00 for submittal procedures.

1.3 METHOD OF PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Sanitary sewer pipe shall be one or any of the following materials or any combination as required by the Plans.
 - 1. PVC
 - a. Polyvinyl Chloride (PVC) Pipe for Pressure Rated Lines shall be of the best quality, push-on type, with factory pre-molded gasketed joints. Pipe shall conform to ASTM D-2241 for PVC pipe.
 - b. PVC pipe for gravity sewer should be of the best quality, bell and spigot, with factory pre-molded gasketed joints. Pipe shall conform to ASTM D-3034, SDR 26, for PVC pipe, unless otherwise noted on the plans. All PVC pipe shall be manufactured from Cell Class 12454B in accordance with ASTM D-1784.
 - 2. Ductile Iron Pipe
 - a. Ductile Iron Pipe shall be designed in accordance with ANSI Standard A21.50 (AWWA C-151), or the latest revision thereof. Ductile iron pipe shall be thickness Class 50, pressure rated for 150 PSI unless otherwise indicated on the plans or in the Special Provisions of the Specifications. Pipe and fittings shall be lined with 20 mils of epoxy. Extend lining from plain or beveled end to rear of gasket socket.
 - b. The exterior of the pipe shall have a bituminous coating approximately one mil in thickness.
 - c. Polyethylene encasement for use on ductile iron pipe and fittings shall be eight (8) mils thick and conform to the latest revision of ANSI Specification A21.5 (AWWA C-105). All pipe, fittings and appurtenances shall be Polyethylene encased.

- d. Polyethylene encasement shall be installed in accordance with the latest revision of ANSI 21.5 (AWWA C-105) standard and shall prevent contact between the buried pipe and appurtenances and the surrounding backfill and bedding material but is not intended to be a completely air and watertight enclosure. Overlaps shall be secured by use of adhesive polyethylene tape, plastic string, binder twine or any other material capable of holding the encasement in place until the backfilling operations are completed.
 - e. Pipe shall be encased in polyethylene tubes with sheets being used in irregular shapes if the tube is not adaptable.
3. Centrifugally Cast Fiber Glass Pipe
- a. Centrifugally Cast Fiber Glass Pipe, joints and fittings supplied under this specification shall, as a minimum, conform to the requirements of AWWA C950-81, AWWA Standard for Glass-Fiber Reinforced Thermosetting-Resin Pressure Pipe and ASTM D3517, Standard Specification for Reinforced Plastic Mortar Pressure Pipe, in the case of pressure pipes, and ASTM D3262, Standard Specification for Reinforced Plastic Mortar Sewer Pipe, in the case of gravity sewer pipes. Prior to manufacturing, the pipe supplier shall provide the Engineer with independent laboratory test reports certifying that the pipe has been tested in accordance with and exceeds all minimum requirements of ASTM D-2992 and ASTM D-3681. Manufacturer's "in house" test reports will not be acceptable as a substitute for independent laboratory testing.
 - b. The Manufacturer shall use only approved polyester resin systems for which he can provide a proven history of performance in this particular application. The historical data shall have been acquired from a composite material of similar construction and composition as the proposed product.
 - c. The reinforcing glass fibers used to manufacture the components shall be of highest quality commercial grade of glass filaments with binder and sizing compatible with impregnating resins.
 - d. Silica sand or other suitable materials may be used.
 - e. Resin additives, such as pigments, dyes, and other coloring agents, if used, shall in no way be detrimental to the performance of the product nor shall they impair visual inspection of the finished product.
- B. Joints
- 1. PVC
 - a. PVC Pipe bell and spigot joints shall be factory pre-molded, compression type joints of elastomeric material.
 - b. The integral bell gasketed joint shall be designed so that when assembled, the elastomeric gasket inside the bell is compressed radially on the pipe spigot to form a positive seal. The joint shall be so designed to avoid displacement of the gasket when installed in accordance with the manufacturer's recommendation. The joints shall conform to ASTM D-3212 specification standards.
 - c. All gaskets shall be molded into a circular form and extruded to the proper section and then sliced into circular form and shall consist of a properly vulcanized high-grade elastomeric compound.
 - d. The basic polymer shall be natural rubber, synthetic elastomer or a blend of both, and meeting the physical requirements prescribed within this specification. The gasket shall provide an adequate compressive force so as to affect a positive seal under all combinations of joint tolerances. The gasket shall be the only element depended upon to make the joint flexible and watertight. The gaskets shall conform to ASTM F-477 specification standards.
 - 2. Ductile Iron Pipe
 - a. Ductile Iron Pipe and Fittings Push-on joints shall conform to ANSI Standard A21.11, Section 11-2.3 (AWWA C-111 Section 11-2.3) the latest revision thereof.

- All required lubricant shall be included with the pipe and/or fittings. These joints shall be used for underground installation of the sewer.
- b. Mechanical joints shall conform to ANSI Standards A21.10 and A21.11 latest revision. All required lubricant shall be included. These joints shall be used for underground installation. Bolts underground shall be cadmium plated.
 - c. Flanged joints for pipe shall conform to ANSI Standard A21.15 (AWWA C-115) the latest revision thereof. Flanges shall be class 125 drilled and faced in accordance with ANSI Standard B16.1. Required nuts, bolts and gaskets are to be included with Pipe and/or fittings. These joints shall be used inside structures and above ground installation.
 - d. Flanged joints that are fabricated by someone other than the pipe manufacturer shall be made from Class 53 pipe to ensure that the wall thickness in the threaded area is not less than that of Class 50 pipe. The OWNER or his authorized representative shall have the right to make periodic inspections of the fabricators shop.
3. Centrifugally Cast Fiber Glass Pipe
- a. Centrifugally Cast Fiber Glass Pipe shall be field connected with fiberglass sleeve couplings that utilize elastomeric sealing rings as the sole means to maintain joint water-tightness. The joints must meet the performance requirements of ASTM D4161.
 - b. Flanges, elbows, reducers, tees, wyes, and other fittings shall, when installed, be capable of withstanding all operating conditions. They may be contact molded or manufactured from mitered sections of pipe joined by glass fiber reinforced overlays. For design pressures of over 150 psi, Type 316 stainless steel fittings or fusion epoxy-coated steel fittings shall be provided.
- C. Manholes
1. All manholes shall be constructed, complete with covers, in accordance with the details shown on the Drawings. Manholes shall be constructed of solid precast curved segmental concrete units, circular sections specially cast for use in manhole construction, or of fiberglass reinforced plastic in accordance with the Plans and as approved by the Engineer.
 2. Manholes shall be constructed of materials which shall conform to the following:
 - a. Concrete: As specified in the concrete specification.
 - b. Segmental Concrete: ASTM C 139, except as modified herein.
 - c. Circular Precast Sections: ASTM C 478
 - d. Castings:
 - 1) Iron: ASTM A 48
 - 2) Coating: Hot Asphaltum varnish applied at the foundry.
 - e. Fiberglass: Heavy wall, Owens-Corning Fiberglas or L.F. Manufacturing, Inc. Provide "O" ring for all pipe connections. The concrete base for a standard 48-inch diameter fiberglass manhole shall be a minimum of 6'x 6'x 15" thick with #5 bars at 12" on center each way. Backfill with bank sand or approved equivalent in 12" maximum lifts. Compact each lift to 95% standard proctor density.
 - f. All manholes shall have stainless steel manhole inserts (inflow preventers) installed under the manhole covers to prevent infiltration.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

- A. Laying Pipe
1. Pipe shall be protected from lateral displacement by means of pipe embedment material installed as provided in the trench backfill specification. Under no circumstances shall pipe

- be laid in water and no pipe shall be laid under unsuitable weather or trench conditions.
2. When jointed in the trench, the pipe shall form a true and smooth line. Pipe shall not be trimmed except for closures, and pipe not making a good fit shall be removed. Permissible defects shall be placed in the top of the pipe.
 3. Unless otherwise approved by the Engineer, the laying of pipe shall be begun at the lowest point and the pipe shall be installed so that the spigot ends point in the direction of flow.
 4. The installation of all pipes and fittings shall meet the requirements of the manufacturer's published installation instructions. The Manufacturer must supply a suitable qualified field service representative to be present periodically during the installation of the pipes.
 5. Alignment and Grade
 - a. Unless otherwise shown on the plans, all pipe shall be laid straight between changes in alignment and at a uniform grade between changes in grade. All lines shall be laid so that each section between manholes will lamp.
 - b. The Contractor shall erect substantial batter boards at intervals of not more than 50 feet. Batter boards or approved laser light shall be used to determine and check pipe subgrades. Not less than three batter boards shall always be maintained in proper position when trench grading is in progress.

B. Trench Construction

1. All excavated material should be stockpiled in a manner that will not endanger the work. Hydrants under pressure, water and gas valves, manhole covers, fire and police call boxes, or other utility controls should be left unobstructed and accessible until work is completed. Gutters should be kept open, or other satisfactory provisions should be made for street drainage. Natural water courses should not be obstructed. Unless otherwise approved, stockpiles should not obstruct adjacent streets, walks, or driveways.
2. The maximum earth load on flexible pipe (PVC pipe) results from the consolidated prism of earth directly over the width of the pipe. If design load on the pipe is calculated based on embankment conditions (prism), the trench may be excavated to a width which is as wide as is dictated by practical and economical construction.

Types of construction for various anticipated conditions are described as follows:

- a. **Narrow Unsupported, Vertical-Walled Trench:** The amount of pavement to be removed and replaced and amount of embedment material used may dictate that the most economical installation is the narrow, vertical-walled trench. The width of narrow trenches as determined by the minimum working room for a man to place haunching material should provide a minimum of 18 inches for 4" and 6" size pipes and not more than 6 to 9 inches clearance on each side of the pipe for 8" and larger sizes. In narrow trenches the pipe embedment should be compacted all the way to the trench walls.

NARROW TRENCH WIDTH, MINIMUM

Nominal Pipe Size Inches	No. of Pipe Diameters (O.D.)	Trench Width Minimum
4	4.3	18
6	2.9	18
8	2.9	24
10	2.5	26
12	2.4	30
15	2.0	30

- b. **Unsupported Sub-Ditch Trench:** A Variation of the narrow vertical-walled trench is to lay the pipe in a sub-ditch and back cut or slope the sides of the excavation above the top of the pipe. This type of construction may be permitted where no

inconvenience to the public or damage to property, buildings, subsurface structures, or pavements will result. In such case, the width of the sub-ditch below the top of pipe should be established as shown in "NARROW TRENCH WIDTH" Table.

- c. **Wide Trench:** Wide trenches are classified as trenches whose width at the top of the pipe is greater than 2-1/2 pipe diameters on each side of the pipe or a total of 6 pipe diameters. There is no limit to the maximum width of the trench beyond 2-1/2 pipe diameters from the side of the pipe since the maximum earth load on flexible pipe does not exceed the weight of the earth prism directly over the pipe. However, the pipe embedment in wide trenches should be compacted to a point at least 2-1/2 pipe diameters from each side of the pipe.
- d. **Supported Trench:** Where an unstable or flowing soil condition is encountered in the trench wall, such as may be found by excavation below ground water or in weak or non-cohesive soils, this condition must be stabilized before laying the pipe. Depending upon the severity of the condition, jacks, a trench shield or box to support the trench during pipe laying operations may be necessary. If the condition is too severe, it may be necessary to leave any sheeting in place or to use chemical or cement grouting of the soil adjacent to the excavation to prevent migration between the material used beneath and around the pipe and trench wall material.

SUPPORTED TRENCH WIDTH, MINIMUM

Nominal Pipe Size (Inches)	No. of Pipe Diameters (O.D.)	Trench Widths, Minimum (Inches)
4	8.5	36
6	5.7	36
8	4.3	36
10	4.0	42
12	3.4	42
15	3.1	48

- e. Widths are based upon 8 to 10 inches clearance on each side of the pipe to the inner face of trench supports. The trench supports are assumed to be 6-inch-thick trench box or shield walls of 4-inch wales inside of 2-inch sheeting. Exceptionally deep trenches with thicker sheeting and bracing or other systems of trench support may require variations of these trench widths. Timber sheeting, where used below the top of the pipe, should be driven approximately 2 feet below the bottom of the pipe and be left in place approximately 1.5 feet above the top of pipe. In supported trenches, compaction of foundation and embedment materials should extend to the trench wall or sheeting left in place.
- f. **Movable Sheeting, Trench Boxes or Shields:** When using movable trench support, care should be exercised not to disturb the pipe location, jointing or its embedment. Removal of any trench protection below the top of the pipe and within 2-1/2 pipe diameters of each side of the pipe should be prohibited after the pipe embedment has been compacted. For this reason, movable trench supports should only be used in either wide trench construction where supports extend below the top of the pipe or on a shelf above the pipe with the pipe installed in a narrow, vertical-wall sub-ditch. Any voids left in the embedment material by support removal should be carefully filled with granular material which is adequately compacted. Removal of bracing between sheeting should only be done where backfilling proceeds and bracing is removed in a manner that does not relax trench support. When advancing trench boxes or shield, prevent longitudinal pipe movement or disjointing.

3. Dewatering
 - a. Where conditions are such that running or standing water occurs in the trench bottom or the soil in the trench bottom displays a "quick" tendency, the water should be removed by pumps and suitable means such as well points or pervious underdrain bedding until the pipe has been installed and the backfill has been placed to a sufficient height to prevent pipe flotation. Care should be taken that any underdrain is of proper gradation and thickness to prevent migration of material between the underdrain, pipe embedment and native soils in the trench below and at the sides of the pipe.
 4. Preparation of Trench Bottom
 - a. The trench bottom shall be excavated below grade to provide the specified depth of bedding and support for the full length of the pipe. Any part of the trench bottom excavated below grade should be backfilled to grade and should be compacted as required to provide firm pipe support. When an unstable subgrade condition is encountered which will provide inadequate pipe support, additional trench depth should be excavated and refilled with suitable foundation material. In severe conditions special foundations may be required such as wood pile or sheeting capped by a concrete mat, wood sheeting with keyed-in plank foundation, or foundation material processed with cement or chemical. A cushion of acceptable bedding material should always be provided between any special foundation and the pipe. Ledge rock, boulders, and large stone should be removed to provide four inches of soil cushion on all sides of the pipe and accessories.
 5. Laying of Pipe
 - a. Proper implements, tools, and equipment should be used for placement of the pipe in the trench to prevent damage. Under no circumstances should the pipe or accessories be dropped into the trench.
 - b. Pipe bells should be laid on the upstream end. Pipe laying should commence at the lowest elevation and should terminate only at manholes, service branches or clean-outs. All foreign matter or dirt should be removed from the pipe interior. Pipe joints should be assembled with care. Whenever pipe laying is interrupted, the open ends of installed pipe should be closed to prevent entrance of trench water, mud, or foreign matter.
- C. Branch Fittings
1. Fittings for service branches in new construction should be molded or fabricated with all gasketed connections. Taps into existing lines should use a gasketed fitting in conjunction with a repair sleeve coupling or a gasketed saddle wye or tee with all stainless-steel clamps. Saddles may be mounted on pipe with solvent cement or gasket but should be secured by metal banding. Saddles should be installed in accordance with manufacturer's recommendations. Holes for saddle connections should be made by mechanical hole cutters or by keyhole saw or sabre saw. Holes for wye saddles should be laid out with a template and should be de-burred and carefully beveled where required to provide a smooth hole shaped to conform to the fitting. Fittings which are prefabricated using pipe sections, molded saddles and PVC solvent cement may be used, provided the solvent cement used in fabrication has cured at least 24 hours prior to installation. Cemented mitered connections without socket reinforcement should not be used. PVC Primer and solvent cement should be used in accordance with the cement manufacturer's recommendations and ASTM D2855, Making Solvent-Cemented Joints with PVC Pipe and Fittings. After solvent cementing saddles, temporary band clamps should be quickly placed both upstream and downstream of the saddle and tightened.

D. Service Lines

1. Service Lines from the property line to the collection sewer should be at a minimum depth of 3 feet at the property line and should be laid to straight alignment and uniform slope of not less than 1/4 inch per foot for 4-inch pipe and 1/8 inch per foot for 6-inch pipe. Where collection sewers are deeper than 7 feet a vertical standpipe or stack is required unless otherwise provided for on the Plans. The standpipe or stack does not require concrete encasement; it shall be uniformly supported by compacted backfill.

E. Bedding

1. Sanitary sewer line bedding and embedment material shall comply with ASTM D-2321, Class I or II.
2. Bedding is required to bring the trench bottom up to grade. Bedding material should be placed to provide uniform and adequate longitudinal support under the pipe. Blocking should not be used to bring the pipe to grade. Bell holes at each joint should be provided to permit the joint to be assembled properly while maintaining uniform pipe support. A compacted depth of 4 to 6 inches is general sufficient bedding thickness. In trenches which have natural materials of fine grains, and in conditions where migration of trench wall material into bedding material can be anticipated, either wide trench construction or well graded bedding material without voids should be used.
3. The most important factor affecting pipe performance and deflection is the haunching material and its density. Material should be placed and consolidated under the pipe haunch to provide adequate side support to the pipe while avoiding both vertical and lateral displacement of the pipe from proper alignment. Where coarse materials with voids have been used for bedding, the same coarse material should be used for haunching and consideration shall be given to using wide trench construction. Haunching is placed up to the pipe spring line.

F. Backfill

1. Initial backfill (pipe embedment) shall be completed to a point at least 12 inches over the top of the pipe utilizing Class I or Class II materials as defined in ASTM D-2321.
2. All Trench backfill above pipe embedment shall conform to the requirements of Class III material (or better) as defined in ASTM D-2321.
3. Tamped backfill placed in six-inch (6") layers and compacted to 95% density will be required for the full depth of the trench beneath pavement, surfacing, driveways, curbs, gutters, walks, or other surface construction or structures as well as beneath street, road or highway shoulders.
4. In areas other than that described above, backfill shall be placed and tamped in six inch (6") layers until one foot above top of the embedment material then the balance of the backfill shall be placed in twelve inch (12") layers with compaction approximately equal to that of the adjacent undisturbed material. To compensate for settlement below surface grade backfill material shall be added as necessary and compacted.
5. If flooding, jetting or puddling is employed for compaction, care should be taken to prevent drainage and flotation of the pipeline. Saturation should not be used during freezing weather. Erosion of support at the pipe sides and bottom by water jetting should be prevented. Apply only enough water to give complete saturation. Allow time for the saturated soil on each layer to dewater and solidify until it will support the weight of workers.
6. Take care to avoid contact between the pipe and compaction equipment. Do not use compaction equipment directly over the pipe until sufficient backfill has been placed to ensure that such equipment will not damage or disturb the pipe.
7. At least 30 inches of cover over the top of the pipe should be provided before the trench is wheel-loaded. At least 48 inches of cover should be provided before using mobile trench compactors of the hydro hammer or impactor type.
8. Any surplus excavated material shall be disposed of as directed by the Engineer. If the Engineer notifies the Contractor that the Owner does not have use of this material, it shall become the property of the Contractor to dispose of as he wishes without injury to the Owner or any individual.

G. Street Surfaces

1. In all streets the surface of the trenches after being refilled, dried and settled, shall be finished in the most workmanlike manner without needless delay and shall in every respect be equal in quality, character, material and workmanship to the street improvements existing over the line of the trench immediately prior to marking the excavation. The expense of restoring the streets must be included in the price bid per linear foot for mains, unless otherwise provided.
2. On gravel or limestone, surfaced streets, the trench shall be filled as otherwise specified up to within 4 inches of the surface of the street unless otherwise called for on the Plans. The trench shall then be filled with gravel or limestone, as ordered by the Engineer, to a point approximately 1 inch higher than the street level. After all other work is completed and before the job is finally accepted, the Contractor shall go back and place such additional gravel or limestone as ordered by the Engineer.
3. On concrete streets the trenches shall be filled as otherwise specified within 6 inches of the surface of the street unless otherwise call for on the Plans, and then filled with flexible base to a point approximately 1 inch higher than the street level. After all other work is completed, the Contractor shall go back and remove sufficient flexible base and install concrete of the thickness ordered by the Engineer.
4. On asphalt surfaced streets, the gravel or limestone base shall be placed as stated above. At such time as the gravel or limestone base shall be leveled smooth approximately one inch below the existing asphalt surface, the new asphalt pavement shall then be placed and rolled or tamped to a smooth and even surface.

H. Pipe Crossing Trenches

1. Where any pipe crosses a trench, such as sewer pipe, water or gas pipe, having an exposed joint in the trench, and in the opinion of the Engineer the pipe will not safely span the trench without danger of breaking, it must be supported with a reinforced concrete beam constructed in the following manner: A trench under said cross pipe shall be opened up to a point varying from two (2) to six (6) feet back from the sides of the main trench as the Engineer may direct, so that a timber box may be placed around the pipe and supported by two (2) struts, one on each side of the trench, and resting on a plank across the bottom of trench, underneath the line and of such dimensions as is necessary, to properly support the ends of the beam and pipe which it carries. The width of this box shall be twice and the depth, not to exceed 12", shall be three times the outside diameter of the pipe supported. The box shall then be filled with 3000 psi concrete with a sufficient number of bars of reinforcing steel placed one (1) inch above bottom of box extending the entire length thereof, to provide an area of steel equal to one percent of the sectional area of concrete in the beams. The timber used as forms and struts must be left in the trench.
2. Should it become necessary to change the position of such pipe, conduit or structure, the Engineer shall be notified at once of the locality and circumstances and shall thereupon give directions as to what shall be done, and the Contractor shall conform thereto, and shall be paid (upon the estimate of the Engineer) for materials furnished and for the labor performed upon such change, insofar as it may be additional to that contemplated. The Contractor shall be responsible for injuries to persons and property, for all damage to any pipe, conduit, sewer or other structures injuriously affected by the work, and the Owner shall not be liable thereof.

I. Jacking, Boring & Tunneling

1. This item shall govern for the furnishing and installation of pipe by the methods of jacking, boring or tunneling as shown on the Plans and in conformity with this Specification.
2. Pipe shall be of the size, type, and class specified on the Plans, or other types as may be specified by the Engineer or designated on the Plans.
 - a. Jacking
 - 1) If the grade of the pipe at the jacking end is below the ground surface, suitable pits or trenches shall be excavated for the purpose of conducting

- the jacking operations and for placing end joints of the pipe. Wherever end trenches are cut in the sides of the embankment or beyond it, such work shall be sheeted securely and braced in a manner satisfactory to the Engineer to prevent earth caving.
- 2) Where pipe is required to be installed under railroad embankments or under highways, streets, or other facilities by jacking or boring methods, construction shall be made in such a manner that will not interfere with the operation of the railroad, street, highway, or other facility, and shall not weaken or damage any embankment or structure. During construction operations, barricades and lights to safeguard traffic and pedestrians shall be furnished and maintained, as directed by the Engineer, until such time as the backfill has been completed and then shall be removed from the site.
 - 3) Heavy duty jacks suitable for forcing the pipe through the embankment shall be provided. In operating jacks, even pressure shall be applied to all jacks used. A suitable jacking head, usually of timber, and suitable bracing between jacks and jacking head shall be provided so that pressure will be applied to the pipe uniformly around the ring of the pipe. A suitable jacking frame or back stop shall be provided. The pipe to be jacked shall be set on guides, properly braced together, to support the section of the pipe and to direct it in the proper line and grade. The whole jacking assembly shall be placed so as to line up with the direction and grade of the pipe. In general, embankment material shall be excavated just ahead of the pipe and material removed through the pipe, and the pipe forced through the embankment with jacks, into the space thus provided.
 - 4) The Contractor shall furnish for the Engineer's approval, a plan showing his proposed method of handling, including the design for the jacking head, jacking support or back stop, arrangement and position of jacks, pipe guides, etc., complete in assembled position. The approval of this plan by the Engineer will not relieve the Contractor from his responsibility to obtain the specified results.
 - 5) The excavation for the underside of the pipe, for at least one-third of the circumference of the pipe, shall conform to the contour and grade of the pipe. A clearance of not more than two inches (2") may be provided for the upper half of the pipe. This clearance is to be tapered off to zero at the point where the excavation conforms to the contour of the pipe. The distance that the excavation shall extend beyond the end of the pipe depends on the character of the material, but it shall not exceed two feet (2') in any case. This distance shall be decreased on instructions from the Engineer, if the character of the material being excavated makes it desirable to keep the advance excavation closer to the end of the pipe.
 - 6) The pipe, preferably, shall be jacked from the low or downstream end. Lateral or vertical variation in the final position of the pipe from the line and grade established by the Engineer will be permitted only to the extent of one inch (1") in 10 feet, provided that such variation shall be regular and only in one direction and that the final grade of flow line shall be in the direction indicated on the plans.
 - 7) If the Contractor desires, he may use a cutting edge of steel plate around the head end of the pipe extending a short distance beyond the end of the pipe with inside angles or lugs to keep the cutting edge from slipping back onto pipe.
 - 8) When jacking of pipe is once begun, the operation shall be carried on without interruption, insofar as practicable, to prevent the pipe from becoming firmly set in the embankment.
 - 9) Any pipe damaged in jacking operations shall be removed and replaced by the Contractor at his entire expense.

- 10) The pits or trenches excavated to facilitate jacking operations shall be backfilled immediately after the jacking of the pipe has been completed.
- b. Boring
- 1) The boring shall proceed from a pit provided for the boring equipment and workmen. Excavation for pits and installation of shoring shall be as outlined above under "Jacking". The location of the pit shall meet the approval of the Engineer. The holes are to be bored mechanically. The boring shall be done using a pilot hole. By this method approximately a two-inch (2") pilot hole shall be bored the entire length of the crossing and shall be checked for line and grade on the opposite end of the bore from the work pit.
 - 2) This pilot hole shall serve as the centerline of the larger diameter hole to be bored. Excavated material will be placed near the top of the working pit and disposed of as required. The use of water or other fluids in connection with the boring operation will be permitted only to the extent to lubricate cuttings. Jetting will not be permitted.
 - 3) In unconsolidated soil formations a gel-forming colloidal drilling fluid consisting of at least 10% of high grade carefully processed bentonite may be used to consolidate cuttings of the bit, seal the walls of the hole, and furnish lubrication for subsequent removal of cuttings and installation of the pipe immediately thereafter.
 - 4) Allowable variation from line and grade shall be as specified under "Jacking". Over cutting in excess of one inch (1") shall be remedied by pressure grouting the entire length of the installation.
- c. Tunneling
- 1) Where the characteristics of the soil or the size of the proposed pipe would make the use of tunneling more satisfactory than jacking or boring, or where called for on the Plans, a tunneling method may be used.
 - 2) The excavation for pits and the installation of shoring shall be as outlined above under "Jacking".
 - 3) The lining of the tunnel shall be of steel of sufficient strength to support the overburden. The Contractor shall submit his proposed liner method to the Engineer for review. Review by the Engineer shall not relieve the Contractor of the responsibility for the adequacy of the liner method.
 - 4) The space between the liner plate and the limits of excavation shall be pressure-grouted or mud-jacked.
 - 5) Access holes for pouring concrete shall be spaced at maximum intervals of ten feet.
 - 6) If corrugated galvanized metal pipe is used, joints may be made by field bolting or by connecting bands, whichever is feasible.
- J. Clean Up
1. Contractor's equipment, surplus material and surplus earth shall be removed from the job following the final test of mains and all street surfaces replaced before the final estimate will be approved.
 2. The Owner shall have the right to make connections with and operate all or any part of the main when, in the opinion of the Engineer, such connection does not in any way interfere with the progress of the work, but it is understood that by making such use or connections the Owner does not accept the sewer or waive his right to object to any defect found therein, until the same has been finally inspected by the Engineer and found to be in accordance with the specifications.
- K. Water Line Crossing
1. **Water line/new sewer line separation:** When new sanitary sewers are installed, they shall be installed no closer to waterlines than nine feet in all directions. Sewers that parallel

waterlines must be installed in separate trenches. Where the nine-foot separation distance cannot be achieved, the following guidelines will apply.

- a. Where a sanitary sewer parallels a waterline, the sewer shall be constructed of cast iron, ductile iron, or PVC meeting ASTM specifications with a pressure rating for both the pipe and joints of 150 psi. The vertical separation shall be a minimum of two feet between outside diameters and the horizontal separation shall be a minimum of four feet between outside diameters. The sewer shall be located below the waterline.
 - b. Where a sanitary sewer crosses a waterline and the sewer is constructed of cast iron, ductile iron, or PVC with a minimum pressure rating of 150 psi an absolute minimum distance of six inches between outside diameters shall be maintained. In addition, the sewer shall be located below the waterline where possible and one length of the sewer pipe must be centered on the waterline.
 - c. Where a sewer crosses under a waterline and the sewer is constructed of ABS truss pipe, similar semi-rigid plastic composite pipe, clay pipe, or concrete pipe with gasketed joints, a minimum two-foot separation distance shall be maintained. The initial backfill shall be cement stabilized sand (two or more bags of cement per cubic yard of sand) for all sections of sewer within nine feet of the waterline. This initial backfill shall be from one quarter diameter below the centerline of the pipe to one pipe diameter (but not less than 12 inches) above the top of the pipe.
 - d. Where a sewer crosses over a waterline, all portions of the sewer within nine feet of the waterline shall be constructed of cast iron, ductile iron, or PVC pipe with a pressure rating of at least 150 psi using appropriate adapters. In lieu of this procedure the new conveyance may be encased in a joint of 150 psi pressure class pipe at least 18 feet long and two nominal sizes larger than the new conveyance. The space around the carrier pipe shall be supported at five feet intervals with spacers or be filled to the spring line with washed sand. The encasement pipe should be centered on the crossing and both ends sealed with cement grout or manufactured seal.
2. **Water Line/manhole separation:** Unless sanitary sewer manholes and the connecting sewer can be made watertight and tested for no leakage, they must be installed so as to provide a minimum of nine feet of horizontal clearance from an existing or proposed waterline. Where the nine-foot separation distance cannot be achieved, a carrier pipe may be used where appropriate.

3.2 MANHOLES & CLEANOUTS

A. Manholes

1. Manhole covers shall have the designation "SEWER" on top.
2. All concrete segmental units shall be saturated with water before laying and shall be damp but free from surface water when laid.
3. All mortar shall be used within 40 minutes after mixing. Mortar which has begun to take on initial set shall be discarded and shall not be mixed with additional cement or new mortar. Manhole inverts shall be carefully constructed to maintain the proper velocities through the manhole be greater than that of the outgoing pipe. The shape of the invert shall conform exactly to the lower half of the pipe it connects. Side branches shall be connected with as large radius of curve as practicable. All inverts shall be troweled to a smooth clean surface.
4. Concrete filling between the sewer invert and walls of manholes shall be flush with top edges of the inverts and slope up from the invert at the rate of 2 inches per foot.
5. Circular precast sections shall be provided with a rubber O-Ring to seal the joints between sections. After the sections are in place, the outside of each joint shall be plastered with cement mortar.
6. Stubs shall be provided in manholes at the locations shown on the plans. Stubs shall be not less than 2.0 feet long and shall terminate in a bell and plug.

7. Manhole installation shall be in strict compliance with the manufacturers recommended installation procedures when precast or pre-molded units are used.
8. Excavation shall be adequate to accommodate the concrete foundation slab and to provide working room around the manhole.
9. Backfilling around manholes shall not begin until concrete base has cured for 24 hours. Backfill using native soil free of foreign objects, stones, concrete, or debris. Backfill in 12-inch layers to avoid uneven loading. Do not allow equipment to impact manholes during backfill operations.
10. Do not backfill above flat areas at top of cone of manholes to allow for installation of concrete chimney.
11. Construct chimneys using precast concrete rings to bring manholes to finished grade.
12. Cast iron for manhole frames and covers shall conform to the dimensions shown on detail drawings and shall be clean, free from sand and blow holes or other defects. Holes in cover must be free from plugs or burrs. Bearing surfaces of frames and covers are to be machined so that even bearing occurs when covers are seated in the frames.
13. Drop manholes shall be constructed where called for in the construction plans and/or where sewer lines enter the manhole higher than 24 inches above the manhole invert. On drop manholes, the invert shall be fitted to prevent solids deposition. A drop pipe should also be provided for a sewer line entering a manhole more than 24 inches above the invert.
14. Cleanouts are required were shown on the plans and on all onsite 6-inch and 4-inch sanitary sewer lines. Spacing shall be every 100ft measured from the upstream entrance of the cleanout.

3.3 SERVICE CONNECTIONS

- A. Locate all service connections as shown on Plans and layout with an approved plug. The exact location of all service connections shall be established in the field by Owner's Representative. Contractor shall locate all service connections on his as-built drawings.
- B. Stacks shall be provided wherever top of the sewer is 8' - 0" or greater below the surface of the ground. Stacks shall be in accordance with details shown on Drawings.

3.4 TESTS

- A. All pipe installations shall be tested in the presence of the Engineer. The Engineer shall be given a minimum of 24 hours' notice for each and every test. Tests that are not performed in the presence of the Engineer will not be accepted.
 1. Low Pressure Air Test
 - a. After completing backfill of a section of sewer line the Contractor shall, at his expense, conduct a Line Acceptance Test using low pressure air. The test shall be performed using stated equipment according to the stated procedures and under the observation of the Engineer.
 2. Equipment
 - a. The equipment shall meet the following minimum requirements:
 - 1) Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected.
 - 2) Pneumatic plugs shall resist internal test pressure without requiring external bracing or blocking.
 - 3) All air used shall pass through a single control panel.
 - 4) Three individual hoses shall be used for the following connections.
 - 5) From the control panel to pneumatic plugs for inflation.
 - 6) From the control panel to the sealed line for introducing the low-pressure air.
 - 7) From the sealed line to control panel for continually monitoring the air pressure rise in the sealed line.

3. Procedures

- a. All pneumatic plugs shall be seal-tested before being used in the actual test installation. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 25 psig. The plugs shall hold against this pressure without bracing and without movement of the plugs out of the pipe.
- b. After a manhole to manhole reach of pipe has been backfilled and cleaned, and the pneumatic plugs have been checked by the above procedures, the plugs shall be placed in the line at each manhole and inflated to 25 psig. Low pressure air shall be introduced into this sealed line until the internal air pressure reaches 4 psig greater than the average back pressure of any ground water that may be over the pipe. At least 2 minutes shall be allowed for the air pressure to stabilize. After the stabilization period (3.5 psig minimum pressure in the pipe), the air hose from the control panel to the air supply shall be disconnected, the portion of the line being tested shall be termed "Acceptable" if that portion of the line does not lose air at a rate greater than 0.0015 cfm per square foot of internal pipe surface when tested at an average pressure of 3.0 psig greater than the back pressure. This back pressure is that which is exerted by ground water that may be over the invert of the pipe at the same time as of the test. The above requirements shall be accomplished by performing the test as follows:
- c. The minimum time required (in minutes for the pressure to decrease from 3.5 to 2.5 psig - greater than the average back pressure of any ground water that may be over the pipe) shall not be less than the time computed by the following equation:

$$T = 0.0850(D)(K)/(Q), \text{ where } T = \text{time for pressure to drop 1.0 pounds per square inch gauge in seconds}$$
$$K = 0.00049DL, \text{ but not less than 1.0}$$
$$D = \text{average inside diameter in inches}$$
$$L = \text{length of line of same pipe size in feet}$$
$$Q = \text{rate of loss, assume } 0.0015 \text{ ft}^3/\text{min}/\text{sq ft internal surface}$$

- d. In areas where ground water is known to exist, the Contractor shall install a 1/2-inch diameter capped pipe nipple approximately 10 inches long, through the manhole wall on top of one of the sewer lines entering the manhole. This shall be done at the time the sewer line is installed. Immediately prior to the performance of the Line Acceptance Tests, the ground water shall be determined by removing the pipe cap, blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic tube to the pipe nipple. The hose shall be held vertically and a measurement of the height (in feet) of water over the invert of the pipe shall be taken after the water has stopped rising in the plastic tube. The height shall be divided by 2.3 feet to re-establish the pounds of pressure that will be added to all readings.

4. Results

- a. If the installation is determined unacceptable by the above test, the Contractor shall determine, at his own expense, the source of the leakage, he shall then repair or replace all defective materials and/or workmanship.

B. Manhole Testing

1. Upon completion of installation, each manhole will be visually inspected to ensure the watertight integrity. All manholes on the project shall be vacuum tested in accordance with ASTM C 1244, latest edition, or otherwise tested in a manner preapproved by the Engineer. Manholes shall be tested for leakage separately and independently of the wastewater lines.
 - a. In Wet Ground Conditions
 - 1) The ground shall be water-jetted around the manhole to ensure a positive

head of water; and that after completely saturating the earth surrounding the manhole, a visual inspection shall be made and the manhole shall be found to be bottle tight. If any seepage appears, the manhole will be deemed to have not passed the test. In Dry Ground Conditions

- 2) All wastewater lines coming into the manhole shall be sealed with an internal pipe plug, then the manhole shall be filled with water and maintained full for at least one hour. For concrete manholes a wetting period of 24 hours may be used prior to testing in order to allow saturation of the concrete. The maximum leakage for hydrostatic testing shall be 0.025 gallons per foot diameter per foot of manhole depth per hour. Alternative test methods must ensure compliance with the above allowable leakage.
- 3) Should any manhole not pass this test, it shall be resealed and retested at the Contractor's expense until satisfactory test results have been achieved.

C. Hydrostatic Test for Force Mains

1. The Contractor shall provide all necessary equipment and shall perform all work required in connection with the tests. All pressure pipe installations shall be tested for leakage.
2. The test pressure shall be 1.5 times the maximum force main design pressure or 150 pounds per square inch gauge, whichever is greater. The test shall be held for a period of four (4) hours. The new system shall be tested in sections between valves. The length of test sections shall not exceed 2,000 feet unless authorized by the Engineer. Each test section shall be slowly filled with water, care taken to expel all air from the pipe. If necessary, the pipes shall be tapped at high points to vent the air. There will be no extra charge to the Owner for venting.
3. At the end of the test period, the amount of leakage shall be determined by the quantity of water that must be supplied into the pipe, or any valved section thereof, to maintain pressure within five pounds per square inch of the specified test pressure, after the air in the pipe has been expelled. The maximum allowable leakage shall be calculated using the following formula.

$$L = (S)(D)(P^{0.5}) / 133,200, \text{ where } L = \text{leakage in gal/hr}$$

S = length of pipe in ft
D = inside diameter of pipe in inches
P = pressure in pounds per square inch

4. If the quantity of leakage exceeds the maximum amount calculated, the failed section will be rejected and not accepted until it meets the above requirements.

D. Deflection Test

1. The Contractor shall provide all necessary equipment and shall perform all required work to complete a deflection test on all gravity sanitary sewer lines installed.
2. Each sanitary sewer line is to be tested for deflection after the backfill has been in place for at least 30 days. The allowable deflection is not to exceed 5%; therefore, the mandrel, rigid ball, etc. used should be sized to 95% of the inside pipe diameter. The test shall be performed without mechanical pulling devices. Any lines with a deflection greater than the allowable are to be replaced.

END OF SECTION 33 33 13

SECTION 33 41 00 - STORM SEWERS AND APPURTENANCES

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

- A. This section covers storm sewers, culverts, manholes, headwalls, inlets, junction boxes and miscellaneous items indicated in connection with the storm sewer system, complete. Excavation, trenching and backfilling are covered under SECTION 31 23 00 – CONSTRUCTION OF UNDERGROUND UTILITIES.

1.2 SUBMITTALS

- A. Submit product data and shop drawings for ALL items to be installed.
- B. Refer to Section 01 33 00 for submittal procedures.

1.3 MEASUREMENT AND PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS FOR STRUCTURES

- A. Precast Concrete Structures
 - 1. **Unless otherwise specified, only precast concrete structures shall be installed.** Precast structures shall be traffic duty. Concrete for precast structures shall have a design strength of 4500 psi at 28 days. Precast structures shall be monolithic in design. Reinforcing steel shall be Grade 60 and shall meet ASTM A615.
- B. Mortar
 - 1. Mortar for pipe joints and connections to other drainage structures shall be composed of one part by volume of Portland Cement and two parts of sand. The Portland Cement shall conform to the requirements of Federal Specification SS-C-192, Type I or II. The sand shall conform to the requirements of AASHTO Specification M-45. Hydrated lime may be added to the mixture of sand and cement in an amount equal to ten percent (10%) of the volume of cement used. Hydrated lime shall conform to the requirements of Federal Specification SS-L-351, or ASTM Specification C-141. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar but shall in no case exceed six gallons of water per sack of cement. Water shall be clean and free of injurious acids, alkalies, and organic impurities. The mortar shall be used within thirty (30) minutes from the time the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar bead on the outside shall be protected for such period as is necessary to obtain satisfactory curing.
- C. Cast Iron
 - 1. Cast iron shall conform to ASTM Standard Specification A 48, latest edition, for Class 20 gray cast iron. Cast iron shapes shall conform to the dimensions shown and shall be clean and perfect, free from sand or blow holes, or other defects. Castings shall be factory coated

with asphaltum varnish. Twenty-three and one-half inch (23-1/2") manhole covers will be used for sewers forty-eight inches (48") diameter or less. Thirty-two-inch (32") manhole covers will be used for sewers in excess of forty-eight inches (48") in diameter.

D. Brick

1. **Brick structures shall only be used when specifically indicated on the drawings.** All structures shall be constructed, complete with covers in accordance with the details shown on the Drawings. Structures shall be constructed of solid precast segmental concrete masonry units or circular sections specially cast for use in manhole construction.

a. When Structures are to be constructed of brick, materials shall conform to the following:

Concrete:	As specified in the concrete specification.
Brick:	ASTM 662, Grade MW.
Segmental Concrete:	ASTM C139, except as modified herein. 1) Curing: Steam cured for at least 8 hours 2) Minimum Thickness: Upper 12 feet of manhole - 8 inches; Portion below 12 feet - 12 inches
Circular Precast Sections:	ASTM C478
Mortar:	1) Portland Cement - ASTM C150, Type II 2) Hydrated Lime - ASTM C207, Type S 3) Sand - Concrete Sand (fine aggregate which has been sieved through an 8-mesh screen 4) Volumetric Proportions - 1-part Portland Cement, 1/2-part hydrated lime, 3 parts sand 5) Mixing - Cement, lime, and sand shall be thoroughly mixed dry and only enough water added to form a mortar of the proper consistency.
Castings:	1) Iron - ASTM A 48 2) Coating - Hot asphaltum varnish applied at the foundry.

2.2 PIPE FOR CULVERTS AND STORM DRAINS

A. Pipe for storm drains and culverts shall be reinforced concrete pipe (RCP), ASTM C 76, Class III, unless otherwise indicated. Where HDPE (High-Density Polyethylene) is specified, the joints shall meet ASTM F477 and ASTM D3212 (watertight joints). All pipes shall have a smooth interior.

PART 3 - EXECUTION

3.1 CONSTRUCTION

A. All concrete segmental units shall be saturated with water before laying and shall be damp but free

from surface water when laid.

- B. All mortar shall be used within 30 minutes after mixing. Mortar which has begun to be taken on initial set, shall be discarded and shall not be mixed with additional cement or new mortar. All segmented concrete manholes shall be plastered on all outside surfaces and three feet (3') above the invert on all inside surfaces with mortar not less than one-half inch (1/2") thick. Manhole inverts shall be carefully constructed to maintain the proper velocities through the manhole with no increase in the velocity in the outgoing pipe. The shape of the invert shall conform exactly to the lower half of the pipe it connects. Side branches shall be connected with as large radius of curve as practicable. All inverts shall be troweled to smooth clean surface. Concrete filling between the sewer invert and walls of manholes shall be flush with top edges of the inverts and slope up from the invert at the rate of two inches (2") per foot. Circular precast sections shall be provided with a mastic gasket to seal the joints between sections. After the sections are in place, the outside of each joint shall be plastered with cement mortar.
- C. Piping shall be constructed of the materials specified in this section, and in the manner indicated on the Drawings. Pipe shall be laid true to the grades shown on the Drawings. Any line in which opening or faulting of the joints occurs during backfill or before final inspection and acceptance, such that infiltration of material or a change in flow characteristics results, must be repaired or replaced to the satisfaction of the Engineer. Under no circumstances shall pipe be laid on unsuitable soft material, and no pipe shall be laid when trench conditions or weather are unsuitable for such work. Full responsibility for the diversion of drainage and dewatering of trenches during construction shall be borne by the Contractor. Any section of the pipe already laid that is found to be defective or damaged shall be taken up and re-laid or replaced as directed by the Engineer immediately, without additional cost to the Owner.

3.2 INSTALLATION OF CONCRETE PIPE AND PRECAST CONCRETE BOX CULVERT

- A. Laying Pipe
 - 1. The laying of pipes on the prepared foundation shall be started at the outlet and with the spigot or tongue ends pointing in the direction of flow and shall proceed toward the inlet end with the abutting sections properly matched, true to the established lines and grades. The Contractor shall furnish and place in position all the necessary batter boards for controlling the work. The batter boards shall be of sufficient size timber and shall be substantially supported. The boards and all location stakes must be properly maintained in place. The Contractor shall also furnish, at his own expense, good sound twilled lines for use in giving lines and grades and necessary plummets and graduated poles of an approved form.
 - 2. Proper facilities shall be provided for hoisting and lowering the sections of pipe into the trenches without disturbing the prepared foundation and the sides of the trench. The ends of the pipe shall be carefully cleaned before the pipes are placed. As each length of pipe is laid, the mouth of the pipe shall be protected to prevent the entrance of earth or bedding material. The pipes shall be fitted and matched so that when laid in the bed they shall form a smooth, uniform conduit. Shape trench bottom and perform excavation as specified under SECTION 31 23 00 – CONSTRUCTION OF UNDERGROUND UTILITIES. Shore and sheet as specified in SECTION 02150 - TRENCH SAFETY per Plans, and referenced documents.
- B. Joints in Concrete Pipe
 - 1. Unless otherwise specified, joints in reinforced and unreinforced concrete pipe, shall either be neoprene or rubber gasket joints as hereinafter described. Cold compound joints shall only be allowed when specifically noted in the specifications or contract drawings.
- C. Neoprene or Rubber Gasket Joints
 - 1. Joints made with neoprene, rubber, or other similar material that has been approved by the Engineer will be acceptable for use with reinforced or non-reinforced concrete pipe,

either tongue and groove or bell and spigot. The ends of the pipe must be accurately made and designed for use with the gaskets. The type of joint and the gasket must have the approval of the Engineer and may be submitted to the Engineer for approval prior to submitting bids for work on which its use is intended. The joint material and workmanship shall be such as to provide a watertight joint. Joints shall, unless otherwise specified, be pointed on the outside with cement mortar.

D. Bell and Spigot Pipe – Cold Compound Joints

1. The inside of the pipe bells and the outside of the spigot ends shall, while dry, be completely coated with joint primer. This coating shall be applied sufficiently in advance so that the primer will be thoroughly dry when the pipe is laid. Pipe twenty-four inches (24") and larger shall be primed at the point of manufacture. Apply a fillet of compound on the bottom half of the inside of the bell, press enough dry twisted jute into the compound to pass around the pipe and lap at the top and shove home the spigot of the pipe. Bring the jute around the pipe, firmly caulk into place. The jute should be sufficient to fill one-fourth (1/4) the depth of the bell. Fill the remaining three-fourths (3/4) of the depth of the bell with compound, taking care to leave no voids and provide sufficient compound to form a fillet sloping forty-five degrees from the outer end of the bell to the barrel of the next pipe.
2. Compound used for these joints shall be a well-known brand of material of proven worth, uniform in consistency and approved by the Engineer as being equal to RAM-NECK. Primer shall be of the type recommended by the manufacturer of the compound used.

E. Tongue and Groove Pipe – Cold Compound Joints

1. Unless otherwise specified, this type of joint shall be used for tongue and groove pipe joints not made with approved neoprene or rubber gaskets. The compound and primer shall be the same as described herein for use with bell and spigot pipe.
2. Both ends of the pipe shall, while clean and dry, be coated with primer on all surfaces that will be in contact with the compound. The primer shall be allowed to dry before the pipe is laid. Twenty-four inches (24") and larger pipe shall be primed at the factory.
3. After pipe has been set to proper line and grade in the trench a one-half (1/2") thick layer of the compound shall be troweled or otherwise placed on the groove end of the pipe covering about two-thirds (2/3) of the joint face around the entire circumference. Next the tongue end of the next pipe shall be shoved home with sufficient pressure to make a tight joint. Care shall be taken to avoid leaving ridges of the compound projecting into the pipe in a manner that would obstruct the flow. The Contractor will make the necessary adjustment in the quality and consistency of the compound as the work progresses.
4. An outside band of the joint compound shall be installed completely around the circumference of the pipe at the joint. This will necessitate digging "bell holes" at each joint. The band shall have a thickness at the center of at least three-quarter inch (3/4) tapering uniformly to nothing approximately three inches (3") each side of the center. Where Class A bedding is used, the band may be omitted on portions of the joint that will be embedded in the cement-stabilized sand bedding.

F. Corrugated Steel Pipe

1. Fully bituminous coated corrugated steel pipe shall conform to FS WWP 405, Class I or II, Shape 1, 2, 3, with Coating A. Gauge of pipe shall be as indicated on the Drawings.
2. The space between pipe and connecting bands shall be kept free of dirt and grit so that corrugations fit snugly. Connecting band shall be tapped with soft head mallet of wood, rubber or plastic while being tightened to take up slack and insure tight joint. Fill annular space between abutting sections of fully paved pipe and pipe arch with bituminous material after jointing.
3. Unless otherwise specified, field joints shall be made with outside bands, each consisting of one or two pieces. Type, size, and gauge of band and size of angles and bolts shall be

as indicated on the Drawings or as applicable for gauge and type of pipe used.

3.3 INSTALLATION OF HDPE PIPE

- A. HDPE Drainpipe shall be high-density corrugated polyethylene heavy-duty pipe and shall be manufactured in conformance with the latest AASHTO specifications of M294 Type S and AASHTO M252. (ADS N12 or equivalent are acceptable materials)
- B. Joints and Fittings: Pipe and fittings shall conform to AASHTO M294 and AASHTO M252. Couplers shall cover not less than one full corrugation on each annular section of pipe.
- C. Bedding Material: Bedding material shall be cement-stabilized sand unless otherwise noted in the plans. **Refer to Specification 31 23 23.16 – Cement Stabilized Sand Bedding and Backfill.**

3.4 MANHOLES

- A. Installation
 - 1. Manhole installation shall be in strict compliance with the manufacturer's recommended installation procedures.
 - 2. Excavation shall be adequate to accommodate the concrete foundation slab and to provide working room around the manhole.
- B. Stubs
 - 1. Stubs shall be provided in manholes at the locations shown on the Plans. Stubs shall be not less than 2.0 feet long and shall terminate in a bell and plug.
- C. Backfilling
 - 1. Backfilling around manholes shall not begin until concrete base has cured for twenty-four (24) hours. Backfill using native soil free of foreign objects, stones, concrete, or debris. Backfill in layers not to exceed twelve inches (12") to avoid uneven loading. Do not allow equipment to impact manholes during backfill operations.
 - 2. Do not backfill above flat areas at top of cone of manholes to allow for installation of concrete chimney.
- D. Finishing Manhole to Grade
 - 1. Construct chimneys using precast concrete rings to bring manholes to finish grade.
 - 2. Seal both the top and the bottom faces of concrete rings with "RAM-NEK" rope type mastic sealant.
- E. Manhole Frames and Covers
 - 1. Cast iron for manhole frames and covers shall conform to the dimensions shown on detail drawings and shall be clean, free from sand and blow holes or other defects. Manhole covers and Inlet Grates shall include all graphics, logos, and verbiage required by all regulatory agencies having jurisdiction over the project. Holes in cover must be free from plugs or burrs. Bearing surfaces of frames and covers are to be machined so that even bearing occurs when covers are seated in the frame.

END OF SECTION 33 41 00

SECTION 33 44 19 - STORM WATER MANAGEMENT

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 STORM WATER MANAGEMENT

- A. "Storm Water Management" shall consist of all requirements to comply with current Texas Commission on Environmental Quality (TCEQ) Texas Pollutant Discharge Elimination System (TPDES) Construction Storm Water Discharge Regulations and Requirements.

1.2 SCOPE

- A. The scope of this item includes satisfying the TPDES Permit Regulation including, but not limited to, any permits that shall be obtained and any construction practices, equipment, materials, labor, and structures necessary to conform with these regulations.

1.3 STANDARDS

- A. This section will be governed by the regulations of the city and or county have jurisdiction over the project.
- B. All provisions, technical specifications, guidelines, intent and construction practices detailed within this handbook will be considered a part of the technical specification and will have full force and effect regarding this project.

1.4 PERMITS

- A. The Contractor is responsible for the planning and implementation procedures for storm water pollution prevention plans (SWPPP) for this construction site. The SWPPP shall be fully developed and implemented before submitting a Notice of Intent (NOI) that this project will be covered by the final TPDES general permit requirements.
- B. The Contractor shall file the NOI with the TCEQ at least seven (7) days prior to the commencement of construction activities.
- C. The Contractor shall also prepare and submit inspection reports pertaining to the Storm Water Management for the City and file the Notice of Termination after the site has been stabilized.

1.5 PAYMENT

- A. Storm Water Management will be incidental to all other Bid Items in the bid proposal.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

3.1 CONSTRUCTION

- A. The Contractor is responsible for all construction activities, structures, etc., associated with implementing the TPDES Permit and the SWPPP. This includes, but is not limited to, filter fabric fences, straw bale fences, temporary hydro-mulch seeding, sodding, inlet protection barriers, etc. that pertain to the intent of this section.

END OF SECTION 33 44 19

SECTION 34 41 13 TRAFFIC SIGNALS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Refer to Harris County Engineering Department (HCED) Specifications, dated October 10, 2023 or City of Humble specifications when working in public right of way.
- C. This section contains HCED items:
 - 1. 618 – Conduit
 - 2. 636 – Signs
 - 3. 682 – Traffic Signal Heads
 - 4. 684 – Traffic Signal Cables
 - 5. 863 – Twelve Inch LED Traffic Signal Lamp Unit

ITEM 618
CONDUIT

618.1 DESCRIPTION.

This Item shall govern for furnishing and installing of electrical conduits and fittings for traffic signal post or pedestal bases. Unless otherwise shown on the drawings, all conductors shall be in conduit except when in metal poles. All conduits and fittings shall be of the sizes and types shown on the drawings. Each section of conduit shall bear evidence of approval of Underwriter's Laboratories.

The Contractor may, at his own expense, use conduit of larger size than specified on the drawings providing that the larger size is used for the entire length of the conduit run.

Conduit terminating in posts or pedestal bases shall extend vertically approximately 2 inches above the concrete foundation. Field bends in rigid metal conduit shall have a minimum radius of 12 diameters of the nominal size of the conduit.

618.2 MATERIALS.

Rigid Steel Conduit. When rigid metal galvanized conduits are specified or shown on the drawings, all conduits, including elbows, couplings and nipples, shall be standard weight schedule 40 zinc-coated steel rigid threaded conduit (Hot-Dip Galvanized), with the following requirements:

NOM. SIZE (Inches)	OUTSIDE DIA. (Inches)	INSIDE DIA. (Inches)	WALL THICKNESS (Inches)	THREADS (Per Inch)	FEET/ BUNDLE	WEIGHT (lbs./100')
1/2	0.840	0.622	0.109	14	50	79
3/4	1.050	0.824	0.113	14	50	105
1	1.315	1.049	0.133	11-1/2	50	130
1-1/4	1.660	1.380	0.140	11-1/2	30	201
1-1/2	1.900	1.610	0.145	11-1/2	30	249
2	2.375	2.067	0.154	11-1/2	10	332
2-1/2	2.875	2.469	0.203	8	10	527
3	3.500	3.068	0.216	8	10	682
3-1/2	4.000	3.548	0.226	8	10	831
4	4.500	4.026	0.237	8	10	972

NOM. SIZE (Inches)	OUTSIDE DIA. (Inches)	INSIDE DIA. (Inches)	WALL THICKNESS (Inches)	THREADS (Per Inch)	FEET/ BUNDLE	WEIGHT (lbs./100')
5	5.563	5.047	0.258	8	10	1,314
6	6.625	6.065	0.280	8	10	1,745

PVC Conduit. When polyvinyl chloride conduits are specified or shown on the drawings, all conduits, including elbows, couplings, and nipples shall be a minimum of schedule 40 PVC conduit, with the following requirements:

NOM. SIZE (Inches)	OUTSIDE DIA. (Inches)	INSIDE DIA. (Inches)	WALL THICKNESS (Inches)	WEIGHT (lbs./100')
1/2	0.840	0.622	0.109	16
3/4	1.050	0.824	0.113	21
1	1.315	1.049	0.133	31
1-1/4	1.660	1.380	0.140	42
1-1/2	1.900	1.610	0.145	50
2	2.375	2.067	0.154	67
2-1/2	2.875	2.469	0.203	107
3	3.500	3.068	0.216	140
3-1/2	4.000	3.548	0.226	169
4	4.500	4.026	0.237	199

618.3 CONSTRUCTION.

Each length of galvanized rigid metal conduit, where used, shall be reamed and threaded on each end and couplings shall be made up tight. White-lead paint or equal shall be used on threads of all joints.

PVC conduit shall be joined by solvent-weld method in accordance with the conduit manufacturer's recommendation. No reducer couplings shall be used unless specifically indicated on the drawings.

All conduits and fittings shall have the burrs and rough places smoothed and shall be clean and free of obstructions before the cable is installed. Ends of the conduits shall be capped or plugged until installation of cable.

Upon request of HCED, the Contractor shall draw a full-time metal brush, attached by swivel joint to a pull tape through "metal conduit" and a special template having a diameter not less than 75 percent of the inside diameter through PVC conduits to ensure that the conduit is clean and free from

obstructions. A nylon or non-metal pull tape shall be used in pulling cable and conductors through PVC conduit. Metal tapes will not be permitted in PVC conduit. The conduits shall be placed as shown on the drawings or as directed by HCED.

Unless otherwise shown on the drawings or directed by HCED, conduit placed in an open trench shall be placed at least 24 inches deep.

Conduit placed for concrete encasement shall be secured and supported in such a manner that the alignment will not be disturbed during placement of the concrete. No concrete shall be placed until all of the conduit ends have been capped and all box openings closed.

PVC conduit which is placed under existing pavement, sidewalks, and driveways shall be placed by first providing a void through which the PVC conduit shall be inserted. The void may be accomplished by either boring or jacking a mandrel. Metal conduit which is to be placed under existing pavement, sidewalks, and driveways shall be placed by jacking or boring (no boring or pushing will be allowed for conduits less than 1-1/2" in diameter).

Existing conduit which has been placed in position on the job site by others for this installation shall be checked to see that there are no obstructions in the conduit prior to threading the wire through. Any such obstructions shall be cleared without damage to the conduit, prior to installing cable.

Conduit runs shall be installed in such a manner as to minimize the accumulation of moisture at low points and pockets.

The component parts of conduit systems shall, in general, be of like material. Where dissimilar metals are used together, suitable provisions shall be made to prevent galvanic action.

The ends of all conduit runs shall be closed immediately after installation to prevent the accumulation of water, dirt and other foreign material. Conduit shall be swabbed out where necessary before conductors are pulled in. Bends may be either factory or field made.

618.4 MEASUREMENT AND PAYMENT.

Conduit shall not be paid for directly, but shall be incidental to other work.

There are no item code(s), description(s), and unit(s) for this Item.

END OF ITEM 618

ITEM 636

SIGNS

636.1 DESCRIPTION.

This Item shall govern for furnishing and/or installing signs which are of one piece construction, and which may or may not have the face side reflectorized.

636.2 REFERENCES.

- A. TxDOT Departmental Materials Specification – DMS-7110
“Aluminum Sign Blanks”
- B. TMUTCD

636.3 MATERIALS.

All traffic signs shall be in accordance with TMUTCD. Detailed drawings of the standard signs illustrated in the manual are available from the Texas Department of Transportation, Austin, Texas 78701-2483.

Sign blanks shall be aluminum 5052-H 38 alloy, 0.080 inches in thickness and in accordance with TxDOT DMS-7110. All sign face sheeting shall be in accordance with Item 860 “Sign Face Materials” unless otherwise specified.

636.4 FABRICATION.

Sign blanks shall be cut to the proper size and shape as specified in the Contract Documents or specifications and shall be free of buckles, warps, burrs, dents, cockles, and other defects resulting from fabrication and shall be essentially a plane surface.

The sign blanks shall not be handled except by device or clean canvas gloves between all cleaning operations and the application of the reflective material. There shall be no opportunity for the blanks to come in contact with grease, oils or contaminants prior to the application of reflective material. Sign blanks shall be pre-drilled, unless otherwise noted and "radiussed" prior to delivery.

Sheeting shall be applied to sign faces in conformance with the recommended procedures of the manufacturer of the sheeting. When splicing of sheeting is necessary, the number of splices shall be held to a

minimum consistent with the sheeting widths furnished by the manufacturer, and the minimum dimensions for any one piece of sheeting shall be 1 foot.

636.5 MEASUREMENT.

The majority of signs shall be measured by each unit, of the type specified in the Contract Documents. Some projects will require signs to be measured by the square foot.

636.6 PAYMENT.

Payment for aluminum signs shall be made of the unit price bid per each unit, which price shall be full compensation for furnishing sheet aluminum sign blanks, fabrication of the sign blanks, treatment of the sign blanks required by the specifications, furnishing and applying reflective sheeting to the sign faces, screening of messages as required, furnishing sign connections, and supports, washing and cleaning the sign after erection and all incidentals necessary to provide signs completed, erected, and attached to the sign support as specified. Signs installed temporarily as part of the traffic control plan during construction shall be paid in accordance with Item 694 "Temporary Traffic Control." Some projects will require aluminum signs paid for by the square foot.

There are item code(s), description(s), and unit(s) for this Item.

NOTE: This Item requires other Standard Specifications.

Item 694 "Temporary Traffic Control"

Item 860 "Sign Face Materials"

END OF ITEM 636

ITEM 682

TRAFFIC SIGNAL HEADS

682.1 DESCRIPTION.

This Item shall govern the minimum design and requirements for adjustable face aluminum or polycarbonate functional requirements for traffic control signal heads and signal heads hardware.

682.2 REFERENCES.

- A. ITE Technical Report No. 1
- B. TMUTCD

682.3 GENERAL.

The traffic control signal heads shall be in accordance with ITE's Technical Report No. 1, except as noted below. The Contractor shall supply written certification of compliance from the manufacturer.

Each traffic signal face shall consist of a number of signal sections rigidly fastened together in such a manner as to present a continuous pleasing appearance. Assembled signal sections shall not exhibit light leakage.

The traffic signal head shall consist of a system of one or more signal faces installed and illuminated in a definite sequence by a remote timing device, which shall indicate to traffic approaching the signal face the right of way at the intersection or giving warning of existence of a hazardous condition, thus facilitating an orderly movement of traffic through the intersection.

Structural requirements for aluminum and polycarbonate materials are described in Section "Housings."

Unless otherwise specified in the drawings, the material for the mounting attachments shall be cast aluminum alloy.

The signal, including one or more LED modules, shall be sectional in construction, requiring one section for each module.

The design of the signal shall be such, that with the aid of simple tools and addition of standard signal fittings; these signal assemblies with the addition of standard bracket assemblies will assemble into two-way, three-way, four-way and horizontal signal head configurations.

682.4 STANDARD SIGNAL FACE & HEADS.

Signal face and signal arrangement shall be as shown in the drawings; and conform to the TMUTCD.

The "Standard Signal Face" shall consist of three or more LED modules, each mounted in an individual housing case.

All housing cases of each of the multiple-way signal heads shall be rigidly attached, at top and bottom, to 1-1/2 inch (38mm) (inside diameter) tubular supporting arms radiating from hubs at the vertical central axis of the head and rigidly attached thereto in a manner that will assure permanent alignment of the separate housings. The hub shall be designed to conform to the type of mounting attachment specified in the drawings and provisions shall be made for carrying the leads from each housing enclosed in the supporting arms to a single outlet in the mounting attachment. All units of the assembled head shall be of adequate strength for the purpose intended and shall be constructed of materials not affected by continuous exposure to corrosive atmospheres, particularly salt air.

A metal spacer in place of the bottom pipe bracket will be acceptable for multiple-way span-wire and mast-arm mounted signal heads.

Signal Faces to be installed vertically or horizontally on mast arms shall be mounted by the appropriate and necessary hardware as approved by Harris County. Any signal heads to be installed vertically or horizontally on the signal pole shall likewise be mounted by hardware as approved by Harris County.

Unless otherwise called for in the drawings, all supporting arm assemblies shall have threaded connections, not welded, and shall be assembled with full threaded crosses, not elbows.

Housings. The Polycarbonate resin material with sides, top, and bottom integrally molded. The housing shall be injection molded from ultraviolet and heat stabilized flame retardant, permanently colored polycarbonate resins. The housing shall at least 0.125 inches (3.18 mm) thick anywhere on the housing and shall be internally ribbed so as to produce the strongest possible assembly consistent with light weight. The terminal block shall either be securely mounted or integrally molded into the housing (see Paragraph 11 of this Section).

The silicon aluminum alloy traffic signal housing cases, also designated herein as optical-unit housings, if required in the drawings, shall be die cast of a silicone aluminum alloy by a process imparting a smooth homogeneous

finish. Casting shall be accurately formed and free from pouring faults, sponginess, cracks, blowholes, or other defects affecting their strength and appearance.

All visors shall be of a silicon aluminum alloy and may be of cast material or of sheet metal having a minimum thickness of 1/16 inch (1.6 mm).

The signal housing cases, fittings, and accessories shall be of noncorrosive, rust resistant material capable of withstanding constant exposure to sunlight and corrosive atmospheres, including salt air, and shall provide adequate strength for the purpose of which it is utilized.

Provision shall be made for accommodation of the particular type of mounting specified and attachment of doors, optical units, and other such accessories as may be specified for the particular installation. All traffic signal housing cases, together with doors, lenses, and mounting attachments shall comprise a dust and moistureproof housing for the LED module, connecting wiring, and terminal block. The housing cases shall be of such construction as to assure permanent alignment of the lens in the traffic signal face. Design of door, housing, and visor shall be such that no light is visible in the profile view of the traffic signal face.

Traffic control signal housing cases shall be of the sectional adjustable expandable type. The assembled housings for each signal face shall consist of three or more individual sections, each designed for housing a single complete LED module. Individual signal sections shall be rigidly attached to form a single "Signal Face" either with at least four machine screws between each section or by the three bolt and two washer method. Complete signal faces shall provide positive locked positioning when used with serrated brackets, mast arm, or span wire fittings.

The top and bottom of each signal section shall be provided with a serrated ring surrounding a two inch diameter hole, such that positive locking of signal faces can be accomplished when mounted with serrated ring.

The serrated ring at the top of each signal shall be raised 0.128 inches above the surrounding body and rib plane to prevent water trapped between signal sections or falling on top of a signal from entering into the housing.

Portions of cases providing for attachment to supporting arms shall be molded with large bosses for the supporting arms. Each housing case shall be so attached to its supporting arm that it will be adjustable by rotation about its vertical axis in such a manner that any pair of adjacent cases may be adjusted individually to give indications in two directions as close as 15 degrees apart and may be rigidly clamped in any position throughout the

range of adjustment. Provision shall be made for carrying the traffic signal leads enclosed in the mounting attachment.

Both the top and bottom of each traffic signal housing case shall be provided with an opening of two inches (50 mm) in diameter to accommodate 1-1/2 inch (38 mm) pipe brackets. A locking ring shall be integrally cast or molded around the bottom opening. Around the top opening shall be either an integrally cast or molded locking ring or a separate splined locking ring designed to fit into notches. The locking rings shall have a minimum of 46 evenly spaced teeth and shall be so designed that the top and bottom rings will mate to provide a perfectly aligned signal head with flush connection between the outer circumference of the sections.

Threaded metal inserts shall be provided in a walled off portion of each signal for terminal block mounting. It shall be possible to place an insulating cover over the terminal block that will match the wall surrounding the terminal block.

Any open end of an assembled beacon face housing shall be plugged with an ornamental cap and gasket.

Housing Door. The housing door of each traffic signal housing shall be a one piece polycarbonate resin material or die cast in a silicon aluminum alloy with an approximate 12 inch (300 mm) diameter circular opening for the lens as specified. The door must be of the same material as the housing. The housing door shall be at least 0.125 inches (3.18 mm) thick anywhere on the housing door.

- A. Silicon Aluminum Alloy Door.** The door shall be provided with hinges and lugs for attachment to the main body casting, so spaced as to hold the door in perfect alignment when closed. The door shall be securely gasketed to the traffic signal housing with a weatherproof gasket.
- B. Polycarbonate Resin Door.** The door shall be attached to the housing by means of two stainless steel hinge pins.

Two stainless steel wing screws shall be installed on the side of the door to provide for opening and closing the door without the use of tools. Wing screws shall have a flat-bearing surface or stainless steel flat washer to prevent gouging of the housing door by the wing screws. Wing screws shall remain captive in the housing door when the door is open.

Visors. Each traffic signal housing door shall be equipped with an easily detachable standard tunnel or full circle visor (unless otherwise indicated). The visor shall be a polycarbonate resin or a silicon aluminum alloy to match

the housing and door. The visor shall be rigidly attached to the door with stainless steel screw type connections in a manner that will prevent the leakage of light and moisture throughout the periphery of attachment.

Unless otherwise called for in the drawings, the visor on the front of each door shall:

- A. Be circular in section;
- B. Have a downward tilt of 2 to 8 degrees;
- C. Encompass approximately 300 degrees of the lens;
- D. Extend outward from the face of the lens a minimum of 9-1/2 inches (240 mm) for 12 inch (300 mm) diameter lens (measured at its outer visible circumference);
- E. Be of such design that the encircled portion of the lens will not be visible in the profile view of the traffic signal face; and,
- F. Be open at the bottom so as to prevent the accumulation of snow and dirt

Visors shall be easily removed and replaced without damage to visor or signal head.

Terminal Blocks. Each optical unit shall be wired to a two-post terminal block located in that signal section. The terminal block in the top or red signal section shall have a six-post terminal block. All sections of the signal face assembly shall be wired to the six-post terminal ready for field installation. All terminal blocks shall be securely mounted in an accessible position and shall be of weatherproof molded construction, equipped with identified terminals. Binding screws shall be provided for the field and interior wires.

If specified, and/or shown in the drawings, a Terminal Compartment shall be provided for the side of pole-mounted signal heads in addition to the signal face assembly terminal block specified above. The terminal compartment shall be located as called for in the item description and drawings.

The Terminal Compartment shall be equipped with a readily accessible moistureproof cover and weatherproof molded-construction connector block with identified terminals for signal and field wires. Separate terminals shall be provided for the interior wires and the field wires. In addition to the interior wires required above, the supplier is also required to furnish and

install all other leads necessary to connect the terminal block of the multiple section face to the terminal block in the Terminal Compartment. Each lead shall be brought to a separate terminal in the Terminal Compartment except that the commons from one housing can all be brought to the same terminal in the Terminal Compartment. The color coding on leads from the individual optical units shall be maintained from the lamp holder to the individual terminals in the signal head Terminal Compartment except that the commons from each housing shall be grouped and carried to one terminal. The wiring shall be so arranged that any one optical unit can be individually illuminated through connections to terminals in the Terminal Compartment.

The Terminal Block installed in the Terminal Compartment shall be equipped with Pressure-Type Connectors having a minimum capacity of two No. 12 AWG solid-copper conductors per connector and shall be provided with barriers and rated for 25 amperes, 250-volt service. This multiple-connector terminal block is to be equipped with a minimum of twelve sets of connectors, with separate terminals for the interior and the fieldwire connections. Any variations from the above requirements will be covered in the Standard Traffic drawings.

Use of Terminal Compartments containing terminal blocks does not eliminate the requirement for terminal blocks specified above.

Mounting Attachments. All mounting attachments shall be cast aluminum specified in the drawings.

Provision shall be made for carrying the signal leads enclosed in the mounting attachment. The mounting attachment together with supporting arms and assembled housings, shall comprise a dust-and-moisture-proof enclosure for optical units and lead wiring.

Traffic Signal Hardware. Horizontal Signal Head Span Wire Hardware Kit. The hardware shall be in accordance with drawing number 1, which is part of this specification. All hardware shall be packaged in the same box.

Horizontal Signal Mid-Mast Arm Kit. The hardware shall be in accordance with drawing number 2, which is part of this specification. All hardware shall be packaged in the same box.

Horizontal Signal End Mast Arm Kit. The hardware shall be in accordance with drawing number 3, which is part of this specification. All hardware shall be packaged in the same box.

Vertical Signal Kit. The hardware shall be in accordance with drawing number 4, which is part of this specification. All hardware shall be packaged in the same box.

Material & Colors (Polycarbonate Signal Faces and/or Signal Heads Only). All material used in construction of major traffic signal components shall be polycarbonate resin. This material shall withstand 70 foot-pounds (95 Joules) of impact without fracture or permanent deformation.

Material for hardware shall be cast aluminum of adequate strength for the intended purpose.

The color of the completed traffic signals shall be Federal Yellow with the exception of the underside of the visors which shall be painted a flat black. The yellow color shall be completely impregnated in the resin material.

Paint & Painting (Metal Signal Faces and/or Signal Heads). Before shipment, all exposed metal surfaces except for the inside of the visors of the assembled traffic signal head shall be given two coats, separately baked on, of high grade highway yellow enamel. The inside of the visors shall be provided with two coats of high grade dull black finish paint.

Any variation in color of enamel will be covered in the Item Description.

Guarantee. The signal shall be guaranteed against imperfections in workmanship or material for a period of 2 years from date of completion.

682.5 MEASUREMENT.

This Item shall be measured by each traffic signal head assembly installed complete in place.

682.6 PAYMENT.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" shall be paid for at the unit price bid for "Traffic Signal Head." This price is full compensation for furnishing and/or installing; assembling the signal head; all mounting hardware and attachments; and materials, equipment, tools, labor, and incidentals necessary to complete the work.

There are item code(s), description(s), and unit(s) for this Item.

NOTE: This Item requires drawings that shall be incorporated into the contract documents.

END OF ITEM 682

ITEM 684

TRAFFIC SIGNAL CABLES

684.1 DESCRIPTION.

This Item shall govern for polyvinyl chloride compound jacketed polyethylene insulated cables, rated 600 volts, for use in signal systems in underground conduit, as aerial cable supported by a messenger, or for installation in buildings.

684.2 REFERENCES.

- A. ASTM B3 "Standard Specification for Soft or Annealed Copper Wire"
- B. ASTM D470 "Standard Test Methods for Crosslinked Insulations and Jackets for Wire and Cable"
- C. ASTM D1047 "Standard Specification for Poly(Vinyl Chloride) Jacket for Wire and Cable"
- D. ASTM D1248 "Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable"
- E. ASTM D1351 "Standard Specification for Thermoplastic Polyethylene Insulation for Electrical Wire and Cable"
- F. ICEA S-61-402 / NEMA WC5 "Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy"
- G. IMSA "Official Wire and Cable Specifications Manual"

684.3 MATERIALS.

Conductors. The copper conductors shall, before insulating, conform to the requirements of ASTM B3.

The conductors shall be stranded unless otherwise specified by the purchaser.

The number and size of the conductors shall be as specified by the purchaser, or sized according to the load per the National Electrical Code.

Insulation. The insulating compound before application to the conductors shall be heat stabilized polyethylene conforming to the requirements of

ASTM D1248, 63T, Type 1, Class B, Grade 4. The insulation shall be applied concentrically about the conductor. Insulation after the application to the conductors shall meet the following requirements when tested in accordance with the procedures given in ASTM D1351 and ASTM D470.

PHYSICAL PROPERTIES OF POLYETHYLENE INSULATION

INITIAL PROPERTIES	
Tensile Strength	1400 lbs./in. ² , minimum
Elongation at Rupture	350 %, minimum
AFTER 48 HOURS IN AIR OVEN AT 100° C	
Tensile Strength	75% of original, minimum
Elongation at Rupture	75% of original, minimum
COLD BEND TEST	
1 hour at -55° C ± 1°	no cracks (Mandrel diameter 2.5 times insulation diameter)

The nominal thickness of the insulation shall not be less than that specified in Table 1. The minimum thickness of the insulation shall be not less than 90 percent of the nominal value.

A. Moisture Absorption.

1. After a twenty-four hour immersion in tap water at 50° C plus or minus 1° C, the specific inductive capacity of the insulation shall be not more than 2.5. After a continued fourteen day immersion, the specific inductive capacity shall be not more than 1.5 percent higher than the value determined at the end of the first day, nor more than 1.0 percent higher than at the end of the seventh day.
2. The moisture absorption tests shall be conducted in accordance with methods specified in ICEA-S-61-402, NEMA WC5, Latest Edition.

B. Electrical Properties.

1. **Dielectric Strength.** Each processed length of insulated conductor before cabling shall withstand the test voltage specified in Table 1 for a period of 5 minutes after immersion in water for not less than 6 hours and while still immersed.

2. **Insulation Resistance.** Each processed length of insulated conductor, after withstanding the Dielectric Strength Test, and while still immersed, shall comply with the insulation resistance requirements of Table 1.

3. The Dielectric Strength and Insulation Resistance Tests shall be conducted in accordance with the requirements of ASTM D470.

TABLE 1

INSULATION RESISTANCE

CONDUCTOR SIZE AWG	INSULATION THICKNESS (Inch)	TEST VOLTAGE	INSULATION RESISTANCE AT 60°F. (Megohms-1,000 ft.)
20	0.025	2,500	15,000
19	0.025	2,500	15,000
18	0.025	2,500	15,000
17	0.025	2,500	15,000
16	0.025	2,500	14,800
15	0.025	2,500	13,700
14	0.025	2,500	12,600
13	0.030	3,000	13,200
12	0.030	3,000	12,100
11	0.030	3,000	11,000
10	0.030	3,000	10,100
9	0.030	3,000	9,200
8	0.030	3,000	8,300

- C. **Conductor Color Coding.** Standard color coding for cable shall be in accordance with Table 2. When permitted by the purchaser, the conductor coding may be numerals and words printed on the conductor insulation. Base colors shall be obtained by the use of colored insulation. Tracers shall be colored stripes or bands which are part of, or firmly adhered to, the surface of the insulation in such a manner as to afford distinctive circuit coding throughout the length of each wire. Tracers may be in continuous or broken lines, such as a series of dots or dashes, and shall be applied longitudinally, annularly, spirally, or in other distinctive patterns.

TABLE 2
CONDUCTORS COLORS AND SEQUENCE

CONDUCTOR NUMBER	BASE COLOR	FIRST TRACER
1	Black	
2	White	
3	Red	
4	Green	
5	Orange	
6	Blue	
7	White	Black
8	Red	Black
9	Green	Black
10	Orange	Black
11	Blue	Black
12	Black	White
13	Red	White
14	Green	White
15	Blue	White
16	Black	Red
17	White	Red
18	Orange	Red
19	Blue	Red
20	Red	Green
21	Orange	Green

The color sequence may be repeated as necessary. Color code sequence applies when cable is composed of mixed sizes.

Special color coding, when specified in unpaired conductor cables, shall consist of black for all conductors except that one conductor shall be identifiable conductor in each layer.

For combination cables consisting of pairs with single conductors, color code sequence given in Table 2, Specification No. 19 - 2 shall be used for pairs, repeated as necessary.

Conductor Assembly.

A. Two Conductor Cable. Two conductor cables shall have a maximum length of lay not more than 30 times the insulated conductor diameters.

Two conductor cables shall be of the round, twisted type.

Fillers shall be used where necessary to form a two conductor round twisted cable.

B. Multi-Conductor Cables Having More Than Two Conductors. In multi-conductor cables having more than two conductors, the single conductors shall be laid up symmetrically in layers with lay not exceeding the following:

NUMBER OF CONDUCTORS IN CABLE	MAXIMUM LENGTH OF LAY
3	35 times insulated conductor diameter
4	40 times insulated conductor diameter
5 or more	15 times assembled core diameter

Each layer of conductors in the cable shall be laid in a direction opposite to that of adjacent layers. When permitted by the purchaser, uni-directional lay may be used. The outer layer shall be left hand lay.

Fillers shall be used, where necessary, to secure a uniform assembly of conductors of a firm, compact cylindrical core.

Fillers. Fillers, when used, shall be of a non-metallic moisture-resistant material which shall have no injurious effect upon the component parts of the cable.

Identification. Each shipping length of cable shall have a tape showing the name of the manufacturer and the year in which the cable is manufactured, placed over or under the tape covering the conductor assembly before the application of outer coverings. As an alternative method of identification, the above information may be applied to the outer surface of the jacket.

Cable Tape. The conductor assembly shall be covered with a spiral wrapping of a moisture resistant tape applied so as to lap at least 10 percent of its width.

Jacket. Over the taped conductor assembly there shall be applied a tightly fitting polyvinyl chloride compound jacket which shall meet the following requirements when tested in accordance with ASTM D1047.

PHYSICAL PROPERTIES OF POLYVINYL CHLORIDE JACKET

INITIAL PROPERTIES	
Tensile Strength	1800 lbs./in. ² , minimum
Elongation at Rupture	250%, minimum
AFTER 5 DAYS IN AIR OVEN AT 100° C	
Tensile Strength	85% of original, minimum
Elongation at Rupture	60% of original, minimum
HEAT SHOCK TEST, AIR OVEN	
1 hour at 121° C	no cracks
HEAT DISTORTION TEST, AIR OVEN	
1 hour at 121° C	50% decrease in thickness, minimum
COLD BEND TEST	
1 hour at -40° C	no cracks
FLAME TEST	
Minutes Burning	1 minute
AFTER 4 HOURS IN AIR OVEN AT 70° C	
Tensile Strength	80% of original, minimum
Elongation of Rupture	60% of original, minimum

The nominal thickness of the jacket shall be as specified in Table 3. The average thickness shall be not less than 90 percent of the specified thickness. The minimum thickness shall be not less than 70 percent of the nominal thickness.

TABLE 3

CALCULATED DIAMETER OF CABLE UNDER JACKET (Inches)	JACKET THICKNESS (Mils)
0.425 and less	45
0.426 – 0.700	60
0.701 – 1.500	80

CALCULATED DIAMETER OF CABLE UNDER JACKET (Inches)	JACKET THICKNESS (Mils)
1.501 – 2.500	110
2.501 and larger	140

Sampling, Inspecting, and Acceptance. Inspection and tests shall be made prior to shipment and at the place of manufacture.

The manufacturer shall, when requested by the purchaser at time of placing the order, furnish the purchaser in suitable form, a certified report of the tests made on the cable to show compliance with this Item.

A. Tests on Entire Cable. The individual conductors of each length of completed cable shall meet the voltage and insulation resistance requirements of Section 679.5, except that the final electrical test on multiple conductor cables may be made without immersion in water. Each conductor of a multiple conductor cable shall be tested against all other conductors and shield if present.

B. Sample Tests. One sample for establishing conformity to this Item shall be taken from each 10,000 feet or fraction thereof, of each type and size of cable except that for the physical dimensions and the visual inspection a sample shall be taken from each reel. In case that these samples fail to meet the requirements of this Item, two additional samples shall be selected from new cable lengths and the lot shall be accepted if retests are both satisfactory. However, in case of any failure on the retest, the lot shall be rejected.

The manufacturer may re-examine rejected material and submit it for reinspection at his option.

Packing and Marking Shipment. Reels shall be substantially constructed and in good condition. The cables shall be suitably protected. Each end of the cable shall be available for testing, properly sealed, and protected against injury. Each reel shall be plainly and permanently marked with manufacturer's full description of the cable, giving the length of the cable on the reel, the number of conductors in the cable and the date of shipment from the factory.

Guarantee. If it is the normal trade practice for the manufacturer to furnish a guarantee for the work provided herein, the Contractor shall turn this guarantee over to HCED for potential dealing with the guarantor. The extent of such guarantee will not be a factor in selecting the successful bidder.

684.4 CONSTRUCTION.

Cable under this Item shall be composed of uncoated copper conductors individually insulated with heat stabilized polyethylene. The insulated conductors shall be laid up in a compact cable form and bound with suitable tape. The cable core shall be enclosed in a polyvinyl chloride compound jacket.

684.5 MEASUREMENT.

This Item shall be measured by the linear foot of traffic signal cable.

684.6 PAYMENT.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" shall be paid for at the unit price bid for "Traffic Signal Cable" of the designated cable size and International Municipal Signal Association (IMSA) cable specification. This price is full compensation for furnishing and installing materials, and for equipment, tools, labor, and incidentals necessary to complete the work.

There are item code(s), description(s), and unit(s) for this Item.

END OF ITEM 684

ITEM 863

TWELVE INCH LED TRAFFIC SIGNAL LAMP UNIT

863.1 DESCRIPTION.

This Item shall govern for the minimum acceptable design and performance requirements for a 12 inch (300 mm) light emitting diode (LED) traffic signal lamp unit for use in various Traffic Signal Head Assemblies.

863.2 REFERENCES.

- A.** ANSI/ASQ Z1.4 "Sampling Procedures and Tables for Inspection by Attributes"
- B.** ITE "Vehicle Traffic Control Signal Heads: Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement"
- C.** ITE "Vehicle Traffic Control Signal Heads: Light Emitting Diode (LED) Circular Signal Supplement"
- D.** NEMA TS 2-2003 "Traffic Controller Assemblies with NTCIP Requirements"

863.3 UNITS OF MEASUREMENTS.

The values given in parentheses (if provided) are not standard and may not be exact mathematical conversions. Use each system of units separately. Combining values from the two systems may result in nonconformance with the standard.

863.4 MATERIAL PRODUCER LIST.

HCED maintains the Material Producer List (MPL) of all materials conforming to the requirements of this Item. Materials appearing on the MPL, need no further sampling or testing unless deemed necessary by HCED.

863.5 BIDDERS' AND SUPPLIERS' REQUIREMENTS.

HCED will purchase or allow on projects only those products listed by manufacturer and product code or designation shown on the MPL.

Use of pre-qualified product does not relieve the Bidder of the responsibility to provide product that meets this Item. HCED may inspect or test material

at any time and reject any material that does not meet the specifications.

863.6 PRE-QUALIFICATION PROCEDURE.

Pre-Qualification Request. Prospective producers interested in submitting their product for evaluation must submit a written request to:

Harris County Engineering Department
1111 Fannin Street, 7th Floor, Houston, TX 77002
Attn: Traffic Signal Maintenance

Pre-Qualification Samples. Ship two samples of each color indication and type from a normal production run of each LED traffic signal lamp unit model requesting acceptance to:

Harris County Engineering Department
1111 Fannin Street, 7th Floor, Houston, TX 77002
Attn: Traffic Signal Maintenance

Provide additional samples when directed by HCED. All products submitted for pre-qualification tests must be at no cost to HCED.

Provide the following with pre-qualification samples:

- A.** Manufacturer name and contact information
- B.** Brand and model number of LED traffic signal lamp unit
- C.** LED Manufacturer's recommended drive current and degradation curves
- D.** One schematic diagram for each LED traffic signal lamp unit model being evaluated, along with any necessary installation instructions
- E.** Copy of the manufacturer's International Organization for Standardization ISO 9000 certification, or Latest Edition, (including date)
- F.** Copy of the manufacturer's quality assurance (QA) testing procedures
- G.** Letter from the manufacturer confirming compliance to this Item
- H.** Testing procedures explaining compliance to this Item, in addition to the ITE tests

- I. Letter confirming participation from ETL/INTERTEK LED Traffic Signal Modules Certification Program; confirming each LED traffic signal lamp unit model's compliance with this Item, including Article 863.8 as well as the latest pertinent ITE standards.
- J. Manufacturer's written warranty against defects in materials, design and workmanship for LED traffic signal lamp units for a period of 180 months after installation

Sampling and Testing. HCED will connect all samples submitted to HCED's ITS Traffic Signal Control Cabinet and will test to ITE "Vehicle Traffic Control Signal Heads (VTCSH)" environmental standards. All LED units must be operational at the conclusion of the test and must not cause Conflict Monitor (MMU/CMU) trip conditions in the controller/cabinet during testing.

During the environmental testing, HCED may evaluate the samples for chromaticity and intensity after 8 hours of soaking at -40°F (-40°C) and 165°F (74°C), at low (80 VAC) and high (135 VAC) voltages.

HCED will conduct destructive testing to determine that the units are in conformance with the catastrophic LED failure clause.

Evaluation. HCED will return to the submitting party a letter of confirmation or rejection for each model submitted. For each rejected model, TSM will issue a test report along with the letter of rejection.

- A. **Qualification.** If approved for use by HCED, the product will be included in the MPL.

Any deviation in product design after testing and approval from HCED constitutes a new model which must be resubmitted for acceptance.

If a manufacturer determines there is reason to remove a model from the MPL, they must submit a letter to HCED identifying the problem in writing. HCED will remove the model without prejudice. Once the problem has been resolved to HCED's satisfaction, the manufacturer may apply for re-qualification for the new model.

All submitted materials become the property of the County.

- B. **Failure.** Products not qualified under this Item may not be furnished on County projects and must be corrected of all deficiencies before reconsideration for qualification.

If products fail to meet any of the specification requirements, the producer may not resubmit for pre-qualification until one year from original evaluation date. HCED may waive this time limit if provided with documentation from an independent testing facility stating the product meets all requirements. HCED will enforce the one year time limit if, after retesting, the product again fails any of the specification requirements.

Costs of sampling and testing are normally borne by the County; however, the costs of sampling and testing products failing to conform to the requirements of this Item are borne by the contractor or supplier. This cost will be assessed at the rate established by HCED and in effect at the time of testing for each recurring non-compliant submittal.

Amounts due to the County will be deducted from monthly or final estimates on contracts or from partial or final payments on direct purchases by the County.

Disqualification. The following conditions are cause for immediate removal from the MPL:

- A. A problem is found to exist with a LED traffic signal lamp unit (e.g. unsafe failure condition or excessive failure rate)
- B. Excessive complaints about a manufacturer's compliance to Article 863.9
- C. Manufacturer deviates LED traffic signal lamp units from pre-qualified units without prior testing and approval from HCED.

If HCED removes a model from the MPL for cause other than manufacturer's recommendation, the manufacturer may not resubmit for approval for a minimum of one year.

HCED may reinstate a model on the MPL under a different model number, if all problems identified have been corrected, and the new model no longer exhibits the same. HCED must approve of the new model as a successful replacement.

Periodic Evaluation. HCED may perform random sample testing on shipments, to be completed within 30 days after delivery.

HCED will perform optical testing with the module mounted in a standard traffic signal section, but without a visor or hood attached to the section or housing. The quantity of each model in the shipment will determine the

number of modules tested. The sample size will conform to ANSI/ASQ Z1.4. HCED will determine the sampling parameters used for the random sample testing. All parameters of the specification may be tested on the modules. Acceptance or rejection of the shipment will conform to ANSI/ASQ Z1.4 for randomly sampled shipments.

863.7 MATERIAL REQUIREMENTS.

General Requirements. All LED traffic signal lamp units must conform to ITE “VTCSH: Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement”, ITE “VTCSH: Light Emitting Diode (LED) Circular Signal Supplement”, and this Item. In the case of conflicts between standards and specifications, the latest County specifications will govern.

The LED traffic signal lamp unit must be designed as a retrofit replacement for existing signal lamps and will not require any special tools for installation. The 12 inch retrofit replacement LED traffic signal lamp unit must fit into existing traffic signal housings without modifications.

Installation of a retrofit replacement LED traffic signal lamp unit into existing signal housing must only require removal of the existing lens, reflector, and incandescent lamp; fitting of the new unit securely in the housing door; and connecting to existing electrical wiring or terminal block by means of simple connectors.

For proper orientation of the LED traffic signal circular lamp unit prominent and permanent directional marking(s), i.e. an “UP arrow” or equivalent, for correct indexing and orientation must exist on the unit. LED traffic signal arrow lamp units when required shall be omni-directional only with permanent markings, i.e. “Suitable for mounting in any direction” or equivalent.

Each LED traffic signal lamp unit shall have the manufacturer's name, trademark, model number, serial number, lot number, month and year of manufacture, and required operating characteristics, including rated voltage, power consumption, and volt-ampere, permanently marked on the back of the module. Serial Number schemes that clearly identify the date of manufacture will be considered.

Each LED traffic signal lamp unit shall have a symbol indicating module type and color. Symbol must be an inch in diameter. Color must be written out in 0.50 inch high letters next to the symbol.

Each LED traffic signal lamp unit shall have a label certifying compliance to ITE “VTCSH: Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement” or ITE “VTCSH: Light Emitting Diode (LED) Circular Signal Supplement”.

Supplement” standards, including standard title and date.

Each LED traffic signal lamp unit shall have a certification label from ETL/INTERTEK LED, which provides ongoing verification of production to pertinent standards.

Any deviation to product design after testing and approval from HCED will constitute a new model and must have a new model number. The new model must be submitted for acceptance. Failure to adhere to this requirement will be grounds for automatic removal from the MPL until HCED approves an alternative solution. Random testing of average production LED traffic signal lamp units will be conducted to ensure compliance with this Item.

Physical and Mechanical Requirements. The LED traffic signal lamp unit must be a single, self-contained device, not requiring on-site assembly for installation into existing traffic signal housing.

The assembly and manufacturing process for the LED traffic signal lamp unit must ensure that all internal LEDs and electronic components are adequately supported to withstand mechanical shock and vibration from high winds and other sources.

Each LED traffic signal lamp unit must be comprised of a UV stabilized polymeric outer shell, multiple LED light sources, and a regulated power supply. LEDs must be mounted on a printed circuit board/heat sink assembly.

Optical and Light Output Requirements. The LEDs must be manufactured using AlInGaP (Aluminum-Indium-Gallium-Phosphide) technology and/or InGaN (Indium-Gallium-Nitride) LEDs. The AlGaAs (Aluminum-Gallium-Arsenic) LEDs will not be allowed.

Designs that require the LEDs to be operated at currents greater than the LED manufacturer’s published recommended drive current will not be allowed.

Each LED traffic signal lamp unit must meet minimum laboratory light intensity values and light output distribution as described in I.T.E. Vehicle Traffic Control Signal Heads (VTCSH) - LED Supplements for a minimum period of 180 months, based on normal use in traffic signal operation over an operating temperature range of -40°F (-40°C) to 165°F (74°C).

Measured chromaticity coordinates of LED traffic signal lamp units must conform to the chromaticity requirements detailed in the I.T.E. VTCSH LED Circular Signal Supplement, Section 4.2: Chromaticity, or in the I.T.E.

VTCSH LED Vehicle Arrow Traffic Signal Supplement, Section 4.2: Chromaticity, for circular or arrow indications respectively for a minimum period of 180 months.

LED lamp units shall be non-tinted, with an incandescent appearance and meeting the criteria of this Item.

LED traffic signal lamp units tested or submitted for testing must be representative of typical production units. Perform optical testing with LED units mounted in standard traffic signal sections without visors or hoods attached to the signal sections.

A copy of the lab test report from a Nationally Recognized Testing Laboratory (NRTL) for each LED traffic signal lamp model must include light intensity values at each ITE specific distribution test point (balls supplement Table 1 or 2, for arrow supplement Table 4). The lab report must document current, voltage, and total harmonic distortion (THD) for each test point. The power factor (PF) associated with each model must be documented.

Electrical Requirements. Each LED traffic signal lamp unit must incorporate a regulated power supply engineered to electrically protect the LEDs and maintain a safe and reliable operation. The power supply must provide capacitor filtered DC regulated current to the LEDs per the LED manufacturer specification. The power supply must be designed so that the failure of an individual component or any combination of components cannot cause the signal to be illuminated after source power is removed.

LED traffic signal lamp units must be operationally compatible with all cabinet designs.

Under normal operating conditions, the LED lamp unit must operate without inhibiting any Conflict Monitor (MMU/CMU) monitoring features.

If a 20 mA alternating current or less is applied to the unit, the voltage read across the 2 leads must be 15 VAC or less.

Arrow and circular LED traffic signal lamp units must be designed to sense a loss of light output due to catastrophic LED failure and react in compliance with the failed state impedance provision of the ITE "VTCSH: Light Emitting Diode (LED) Circular Signal Supplement," Section 5.7. LED Arrow indications must trip the Conflict Monitor (MMU/CMU) after no more than 15 percent to 25 percent LED loss occurs. The LED unit must always be recognizable as an arrow indication for any loss less than this trip condition.

Two, captive, color coded, 600 V, 18 AWG minimum jacketed wires, 3 feet or 1 meter long, conforming to the National Electric Code, rated for service at 22°F (105°C), are to be provided for an electrical connection.

The LED traffic signal lamp units must have on-board circuitry including voltage surge protection, to withstand high-repetition noise transients and low-repetition high-energy transients as stated in NEMA TS 2, Section 2.1.8, except voltage must be 2000 V instead of 1000 V. The circuitry must also be able to withstand high-repetition low-energy transients as stated in NEMA TS 2, Section 2.1.6.

Environmental Requirements. Environmental requirements must meet or exceed ITE VTCSH: Light Emitting Diode (LED) Standard Supplements.

The LED traffic signal lamp units must be rated for use in the ambient operating temperature range of -40°F (-40°C) to 165°F (74°C).

The LED traffic signal lamp units must be dust and moisture tight to protect all internal LED and electrical components.

The LED traffic signal lamp units must consist of a housing that is a sealed, watertight enclosure to eliminate dirt contamination and allow for safe handling in all weather conditions. Perform moisture resistance testing on LED signal modules in conformance with the requirements in the ITE VTCSH: Light Emitting Diode (LED) Standard Supplements. Evidence of internal moisture after testing will be cause for rejection.

Production Testing Requirements. A quality assurance (QA) program must be in place at the manufacturer's facility to ensure product reliability.

Each new LED traffic signal lamp unit must be energized at the manufacturer's facility for a minimum of 24 hours at nominal operating voltage (120 VAC RMS) at room temperature in order to ensure electronic component reliability prior to shipment.

863.8 DOCUMENTATION REQUIREMENTS.

Provide each LED traffic signal lamp unit with, as a minimum, the following documentation:

- A.** Complete and accurate installation wiring guide
- B.** Contact name, address, telephone number and email address or webpage for the representative, manufacturer, or distributor for warranty repair
- C.** If requested by the purchaser, the bidders must supply schematics for all electronics

- D. LED Manufacturer's recommended drive current and degradation curves
- E. Compliance letter specified in Article 863.9
- F. Certification document specified in Article 863.9
- G. Bidders must submit a copy of a test report, certified by a NRTL, stating that the LED traffic signal lamp model submitted meets or exceeds ITE VTCSH: Light Emitting Diode (LED) Supplemental Standards. The NRTL report must include documentation of tests and verification of compliance to the additional provisions of this standard. Tests performed by the independent lab must follow all the instructions documented in ITE "VTCSH: Light Emitting Diode (LED) Circular Signal Supplement" or ITE "VTCSH: Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Supplement" as it pertains to the product being tested. The ITE criteria in Section 6 Quality Assurance must be documented in the submitted test report.

Manufacturers must be certified to International Organization for Standardization ISO 9000, or Latest Edition.

863.9 WARRANTY REQUIREMENTS.

Manufacturer must comply with all requirements of the following warranty. Failure to comply with the requirements of this warranty is cause for the manufacturer/supplier to be removed from the MPL.

The manufacturer/provider must submit a letter of compliance indicating understanding and willingness to abide by the provisions of this Item. The manufacturer/provider must provide name and telephone number of the person to contact regarding potential claims under the provisions of this warranty. Address the compliance letter to:

Harris County Engineering Department
1111 Fannin Street, 7th Floor, Houston, TX 77002
Attn: Traffic Signal Maintenance

The LED traffic signal lamp units must be warranted against any failure due to design, workmanship, material defects, and loss of intensity for 180 months of field operation. Units must meet or exceed minimum requirements of this Item for a minimum of 180 months of field operation. Repair or full replacement will be required if a LED traffic signal lamp unit fails to operate as specified under normal operating conditions. Provide repaired or replaced units at no cost to HCED. Repaired units will inherit the remainder of the failed unit's warranty. Replaced units will be warranted for

180 months of field operation.

Should a lamp unit fail with no visible damage to electronic/electrical components, (not including fuses or components designed to act as a fuse) or wiring, the unit is considered to have failed under normal operating conditions. A blown fuse or a component acting as a fuse, without any other permanent failure to electrical, electronic components will be considered to have failed under normal operating conditions. Natural phenomena (e.g. lightning) are not acceptable as excusable unit failures without visible damage.

Repair or replace LED traffic signal lamp units within 15 business days after receipt of failed LED units. All shipping costs will be borne by the vendor or manufacturer.

The manufacturer/provider must submit a certification document with each lot or shipment stating that the LED lamp units provided meet all the requirements of this Item.

The certification document must show individual lot numbers and manufacturer dates.

HCED reserves the right to select a sample from the field during the warranty period and perform evaluation tests to determine extended compliance and/or deterioration of the LED traffic signal lamp unit. Any model that shows deterioration of unit causing the unit to fail the evaluation tests during the warranty period will be automatically removed from the MPL, and the submitting party may be held legally responsible for all damages.

863.10 MEASUREMENT AND PAYMENT.

LED traffic signal lamp units when supplied as part of a traffic signal head assembly, will not be paid for directly, but shall be incidental to assemblies defined by Item 682 "Traffic Signal Heads" and/or Item 691 "Twelve- Inch Signal Head with Programmable Visibility of Signal Faces," any pertinent Special Provisions and Standard Drawings (if applicable).

LED traffic signal lamp units when supplied individually shall be paid for by each type and color required.

There are item code(s), description(s), and unit(s) for this Item (equipment procurement contracts only).

NOTE: This Item requires other Standard Specifications

Item 682 "Traffic Signal Heads"

Item 691 "Twelve- Inch Signal Head with Programmable Visibility of Signal
Faces"

END OF ITEM 863

END OF SECTION 34 41 13

SECTION 34 41 14 SCHOOL ZONE FLASHER ASSEMBLIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Refer to Harris County Engineering Department (HCED) Specifications, dated October 10, 2023 or City of Humble specifications when working in public right of way.
- C. This section contains HCED items:
 - 1. 685 – Roadside Flasher Assemblies
 - 2. 687 – Pedestal Pole Assemblies
 - 3. 865 – Flasher Assemblies

ITEM 685

ROADSIDE FLASHING ASSEMBLIES

685.1 DESCRIPTION.

This Item shall govern for the furnishing of all labor, materials, tools, equipment, tests, adjustments and all other incidentals necessary to install school zone flasher assemblies and warning flasher assemblies.

685.2 REFERENCES.

- A. Harris County "General Conditions for Roads, Bridges and Related Work"
 - 1. Section 3.01 "Indemnification"
 - 2. Section 4.01 "Laws to be Observed"
 - 3. Section 4.04 "Barricades, Warning Lights and Signs, On Projects Involving Public Roads"
- B. ITE
- C. NEC
- D. NEMA
- E. TMUTCD

685.3 GENERAL.

All bidders shall visit the job site prior to bidding, only if drawings are made available, in order to acquaint themselves with all jobsite conditions and problems, if any, and all other factors that may affect the bid. Any discrepancy between drawings and specifications shall be resolved prior to bidding.

The Contractor shall clean the job site of all debris, loose excess excavated material, etc. accumulated as a result of work performed under this contract. The Contractor shall exercise care in working around the area not to infringe on or mutilate property. The Contractor shall be responsible for any such infringement or mutilation. It is the Contractor's responsibility to restore the construction area to its original condition prior to final acceptance and

payment. The Contractor shall remove any excess excavated material from the jobsite.

All trades are to work in cooperation with one another, and all trades, when necessary and/or as standard procedure, shall construct preliminary grounds for work to be performed by succeeding trades. It is the General Contractor's responsibility to see that all work is properly coordinated and executed.

Any Contractor having any questions concerning this project should contact Harris County (713) 881-3210.

685.4 MATERIALS AND EQUIPMENT.

All materials and equipment furnished for installation under this contract shall be new and unused, unless otherwise specified. The Contractor shall install all school zone flashing signals in accordance with this Item, any and all applicable special specifications or special provisions associated with this project, and in accordance with referenced Harris County specifications and details as indicated below.

- A. Solar School Zone Flasher Systems.** Reference Harris County Specification Items 636, 682, 687, 860, 863, and 865 (Polycarbonate).
- B. AC School Zone Flasher Systems.** Reference Harris County Specification Items 618, 636, 682, 684, 687, 860, 863, and 865 (Polycarbonate).

All control equipment shall conform to appropriate ITE and NEMA Specifications and shall be furnished and installed in accordance with the drawings and specifications.

685.5 PERMITS, CODES, ETC.

The Contractor shall be responsible for obtaining permits and inspections by regulatory bodies and shall work with Harris County in obtaining power to the system from the local power utility company and notify Harris County 48 hours prior to connecting the system to the local power utility company lines.

All required meter service assemblies shall be installed by the Contractor as required by the local power utility company at the Contractor's expense, unless otherwise specified and/or shown on the construction drawings.

All wiring throughout this system shall be in strict accordance with the NEC, all local applicable codes and shall also comply with all requirements of CenterPoint Energy, in order that service may be obtained from them. All costs for code compliance are to be included in the bid for this contract.

All construction will be in accordance with the TMUTCD, and in accordance with the specifications and drawings.

All items installed under this Item, having a manufacturer's guarantee shall be installed by or under the direction of the manufacturer or his certified agent. The Contractor shall follow the manufacturer's installation procedures for all equipment. It is the Contractor's responsibility to procure the installation procedures before bidding the project.

Barricades and Construction Signs. The Contractor shall furnish and install permanent and/or portable construction signs on all approaches to the project as shown on the drawings and as required by TMUTCD and Harris County Specification Items 694 and 696. All required construction signs shall be installed and in place when the Contractor is on the jobsite.

Closing of lanes for construction shall be done in strict accordance with the TMUTCD and as shown on the drawings. Prior to closing any section of roadway to traffic, the Contractor shall furnish and install barricades and warning signs in accordance with the TMUTCD, and in accordance with Harris County Specification Items 694 and 696.

All of the above does not preclude the requirements of Item 4.04 of the "Harris County General Conditions for Roads, Bridges and Related Work."

Responsibility for Damage or Claims. (Also see Paragraphs 3.01 and 4.01 of "Harris County General Conditions for Roads, Bridges and Related Work".)

The Contractor shall hold harmless the County and its representatives from all suits, actions, or claims of any character filed as a result of injuries or damages sustained by any person or property due to neglect in safeguarding the work, the use of unacceptable materials in the execution of the contract, or any act of omission by the Contractor or his Sub-Contractors. The Contractor shall not be released from responsibility until the contract has been completed and all work accepted. Money due the Contractor under and by virtue of his contract may be retained by the County or his surety may be held until such claims have been settled and suitable evidence to that effect furnished to the County.

Unless otherwise set forth in these Standard Specifications, the Contractor shall receive no direct compensation for furnishing, erecting, and

maintaining the necessary barricades, lights, flares, signs, or for any other incidentals necessary for the good and proper safety, convenience, and direction of traffic during the period prior to final inspection and acceptance by the County.

Operation and Maintenance Responsibilities. The Contractor shall accept responsibility for operation and maintenance of the flasher system beginning on the date work commences on the project through the date of final acceptance and payment of the project. Operation and maintenance responsibilities shall include, as a minimum, initiating emergency response for evaluation and, if necessary, for emergency repair operations, on the job site a maximum of 4 hours after notification by Harris County of a reported system failure or malfunction. The Contractor shall pursue emergency response and repair operations with all haste in order that flashers down time will be kept to absolute minimum. In the event the Contractor fails to respond within 4 hours, Harris County reserves the right to pursue the repair operations and forward all associated bills for providing this service to the Contractor for reimbursement. Harris County will also inform the Contractor's bonding company of these incidents.

Guarantee. Excluding lamps, the Contractor's acceptance of this contract guarantees all workmanship performed and/or materials and/or equipment furnished and installed shall be warranted for a period of two year from date of final acceptance and payment for the project. All LED lamps furnished and installed by the Contractor shall be guaranteed for workmanship and performance for a period of no less than five years from the date of final acceptance and payment for the project. All incandescent lamps furnished and installed by the Contractor shall be guaranteed for workmanship and performance for a period of no less than 180 days from the date of final acceptance and payment for the project, excluding lamps. When warranty repairs are required, the Contractor shall initiate emergency repair service operations on the job site a maximum of 4 hours after notification by Harris County of system failure or malfunction. The Contractor shall pursue repair operations with all haste in order that signal down time will be kept to absolute minimum. In the event the Contractor fails to respond to a request for warranty repairs within 4 hours, Harris County will pursue the repair operations and forward the bills to the Contractor for reimbursement and inform his bonding company. Vandal damage and damage due to automobile accidents or acts of nature shall not be included under Contractor's guarantee. The Contractor shall sign the inspection sheet on all warranty calls.

685.6 SUBSTITUTE MATERIALS.

Set forth in these specifications are definite models, materials, etc.; however, items of equal appearance, durability, performance and design

will be accepted upon approval of Harris County. The successful bidder is required to submit to the HCED, Traffic Signal Maintenance, engineering brochures and information on all materials he desires to furnish and install which are of different manufacturer or model number than specified herein. The submittal is for approval or disapproval by HCED. In the event approval is not obtained, the specified items shall not be furnished and installed. The submittals shall be furnished not later than 2 days after bid opening.

It is the Contractor's responsibility to verify these locations prior to commencing work and to ensure that these locations do not result in conflicts with and/or damage to existing utilities. To this end, the Contractor shall, as a minimum, contact the Lone Star Notification Center at (713) 223-4567 in Houston and 1-800-669-8344 outside of Houston and Texas One Call at 1-800-245-4545 a minimum of 72 hours before commencing any work in the construction area. It is the Contractor's responsibility to physically locate any electrical, communications, sewer, water, gas, or other utilities and to adjust the location of any foundations(s) as necessary to avoid damage to any existing utilities.

Field Test. All flasher assemblies installed by the Contractor shall be field tested. The contract shall not be considered complete until all the flasher assemblies have been field tested for 10 consecutive days without failure and/or malfunction, and to the satisfaction of Harris County. Should a failure and/or malfunction occur within the 10 day test period, the test period shall be extended until the flasher assemblies have operated successfully for 10 consecutive days.

Special Notes.

- A.** A pre-construction meeting shall be scheduled by the County after award of contract, and prior to commencement of construction. The Contractor or his authorized representative will be required to attend.
- B.** All work in this contract shall be performed between the hours of 9:00 a.m. and 4:00 p.m., Monday through Friday, unless prior authorization has been obtained from HCED.
- C.** Contractor shall notify Harris County at (713) 881-3210 a minimum of 24 hours prior to commencement of work so that an inspector may be assigned.
- D.** The "Service Outlet Location and Data Statement" for these flashers will be supplied to the Contractor upon receipt from local power utility company.

- E. All flashing beacon heads shall be wrapped with burlap or an approved equal cover so that signal faces cannot be seen from the time of installation until placed into operation.
- F. The Contractor shall inform the Harris County at (713-881-3210) a minimum of 48 hours prior to placing a flasher into operation. Turn-ons shall be scheduled for Monday through Thursday during off-peak traffic periods only.

685.7 MISCELLANEOUS.

Submittals. HCED, Traffic Signal Maintenance Section will supply the Contractor with the drawings of the proposed improvements. Upon receipt of the drawings, the Contractor shall within two calendar days furnish the County with a copy of purchase orders, invoices, etc., with the estimated date of delivery.

Time for Installation. The Contractor will have five calendar days to install flashers from the time they receive their materials.

Contract Duration. This contract shall be completed when the maximum expenditure is met. It is anticipated that this will occur within the designated period from the date of the purchase order.

Units Assemblage. The Contractor shall be required to assemble the items that are supplied to manufacturer's specifications or inspector's satisfaction.

Lane Closure(s). Lane Closure(s) shall be addressed with lane closure details, which will be provided to the declared winning bid.

Sign Removal. Sign removal is incidental to the installation of flashers and new signs.

Pedestal Pole. Poles shall be installed in accordance with drawings and Item 687 "Pedestal Pole Assemblies."

685.8 MEASUREMENT.

Roadside flashing assemblies shall be measured by the lump sum furnished and/or installed complete in-place.

685.9 PAYMENT.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" shall be paid for at the

unit price bid for "Roadside Flasher Assemblies" of the type specified. This price is full compensation for all costs of labor, furnishing and/or installing materials including flasher assemblies, tools, equipment, test, adjustments, and all other incidentals necessary to construct the complete traffic signal system, excluding all other items shown in the bid sheets in accordance with the Contract Documents and to the satisfaction of HCED.

There are item code(s), description(s), and unit(s) for this Item.

NOTE: This Item requires drawings that shall be incorporated into the contract documents.

NOTE: This Item requires other Standard Specifications

Item 618 "Conduit"

Item 636 "Signs"

Item 682 "Traffic Signal Heads"

Item 684 "Traffic Signal Cables"

Item 687 "Pedestal Pole Assemblies"

Item 694 "Temporary Traffic Control"

Item 696 "Barricades"

Item 860 "Sign Face Materials"

Item 863 "Twelve Inch LED Traffic Signal Lamp Unit"

Item 865 "Flasher Assemblies"

END OF ITEM 685

ITEM 687

PEDESTAL POLE ASSEMBLIES

687.1 DESCRIPTION.

This Item shall govern for furnishing and/or installing pedestal pole assemblies for traffic signal supports.

687.2 REFERENCES.

- A. AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals"
- B. ASTM A123 "Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products"
- C. ASTM A153 "Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware"
- D. AWS "Structural Welding Code"

687.3 MATERIALS.

Design. Pedestal pole assemblies shall be the "Pedestal pole shaft extending through bases" as indicated on the drawings or mentioned in the specifications.

All pedestal pole assemblies as supplied must conform to the Standard Traffic Drawings and/or requirements in the drawings as to height, general design and finish. All assembly parts of the same type shall be interchangeable.

The pole assembly shall be designed to support a 150 pound axial load with 11 square feet of signal head area rigidly mounted at the top of the shaft.

In addition to dead load, each assembly shall be designed to withstand wind and ice loads on the specified pedestrian signal head and sign area and on all surfaces of the support in accordance with AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals" and other specifications of this body as may be pertinent. Unless otherwise shown on the drawings, 100 mph wind speeds shall be used for design.

Allowable unit stresses in each component of the assembly shall be as provided in the AASHTO Specification.

Hydraulic Cement Concrete. Hydraulic cement concrete for pedestal pole foundations shall meet the requirements of Item 421 “Hydraulic Cement Concrete” and shall be Class C concrete with Grade No. 5 coarse aggregate or as indicated on the Contract Documents.

Pedestal Pole. The pedestal pole shall be fabricated from one piece of new 4-1/2 inch diameter schedule 40 steel pipe or tubing, aluminum pipe (alloy 6061 T6), or rigid metal conduit. Do not use aluminum conduit.

Galvanizing. Pedestal pole assemblies shall be hot-dip galvanized in accordance with ASTM A123 and shall provide proper filling, venting and draining during the cleaning and galvanizing operations.

687.4 CONSTRUCTION.

Foundation.

Option 1. Concrete foundation for pedestal poles shall, as a minimum, include:

- A. Concrete Foundation.** 5 foot deep by 24 inch diameter foundation, with 24 inch x 36 inch concrete head for the extended type shaft as shown on the drawings.
- B. Ground Rod.** Shall be a minimum 5/8 inch x 8 foot long copper weld rod.

Option 2. Screw anchor foundation for pedestal poles shall, as a minimum, include:

- A. Screw Anchor Foundation.** 8 inch schedule 40 pipe shaft length of 5 foot, with a 13 inch diameter helix (3/8 inch plate).
- B. Ground Rod.** Shall be a minimum 5/8 inch x 8 foot long copper weld rod.

Fabrication. The height of the pedestal pole shall be as indicated on the drawings. The pole shall have a cap and a bell bottom base, and the pole shall be extended through the bases, set in an excavated hole as shown on the drawings.

A 2-1/2 inch x 1/4 inch steel strap shall be welded in accordance with the AWS “Structural Welding Code” on the bottom pipe-end to provide extra

support of the pole when set. The steel strap shall not extend beyond the outside diameter of the pipe and shall have a continuous weld to the pipe on the contacted surfaces.

Installation. Install pedestal pole assemblies as shown on the Contract Documents, or as directed. Pedestal pole assemblies include foundation, pole shaft, pole cap, base, anchor bolts, anchor bolt nuts, anchor bolt template, shims, and miscellaneous components. Watertight breakaway electrical disconnects are required for pedestal pole assemblies used in conjunction with pedestrian heads and components.

687.5 SUBMITTAL.

Hydraulic Cement Concrete. The Contractor shall submit the concrete mix design and certification that the concrete used meets the requirements of this Item.

687.6 MEASUREMENT.

This Item shall be measured by each pedestal pole assembly furnished and/or installed.

687.7 PAYMENT.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" shall be paid for at the unit price bid for "Pedestal Pole Assemblies" of the size specified. This price is full compensation for furnishing and/or installing of pedestal pole assembly including foundation, pole shaft extended through the base, ground rod, pole cap, bell bottom, all other wire outlet, conduit, access door; and all other equipment, labor, tools, and incidentals necessary to complete the work.

There are item code(s), description(s), and unit(s) for this Item.

NOTE: This Item requires other Standard Specifications.

Item 421 "Hydraulic Cement Concrete"

END OF ITEM 687

ITEM 865

FLASHER ASSEMBLIES

865.1 DESCRIPTION.

This Item shall govern for furnishing materials, equipment and all other incidentals necessary to assemble complete school zone flasher assemblies (school zone pager flasher assemblies) and warning flasher assemblies.

All materials and equipment furnished for installation under this contract shall be new and unused, unless otherwise specified.

Any Contractor having any questions concerning this project should contact Harris County at (713) 881-3210.

865.2 REFERENCES.

- A. ASTM A153 "Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware"
- B. ITE
- C. NEC
- D. TMUTCD

865.3 GUARANTEE.

The Contractor, by accepting this contract, guarantees all workmanship, materials and equipment performed or furnished and installed under this Item for a period of two year from date of completion and shall, at his entire expense and within said term of guarantee, repair, replace or adjust all faulty, broken, or maladjusted materials and/or equipment furnished and installed under this Item. All L.E.D. lamps shall be warranted for 5 years. The Contractor shall initiate emergency repair service operations on the job site a maximum of 4 hours after notification by Harris County of system failure or malfunction, and the Contractor shall pursue repair operations with all haste in order that signal down time will be kept to absolute minimum. In the event the Contractor fails to respond within 4 hours, Harris County will pursue the repair operations and forward the bills to the Contractor for reimbursement and inform his bonding company. Vandal damage and damage due to automobile accidents or acts of nature shall not be included

under Contractor's guarantee. **Contractor shall sign inspection sheet on all warranty calls.**

865.4 EQUIPMENT AND MATERIAL REQUIREMENTS.

The AC Operation. Units shall include the following components for the AC School Zone Pager Flashing Signals per flasher assembly:

PARTS FOR ELECTRICAL FLASHER - AC OPERATION		
QTY (UNIT 1)	UNIT	DESCRIPTION
1	Each	4 1/2" OD x 19' Galvanized Steel Pole
2	Each	12" Yellow Polycarbonate Single Section Housing (Less Lenses and gasket)
2	Each	12" Yellow LED Optical Assemblies, AC Voltage
1	Each	1 1/4" Weatherhead
10	LF	1 1/4" x 10' Rigid Galvanized Conduit
25	Each	3/4" Stainless Steel Strap
13	Each	3/4" Stainless Steel Strap Buckles
1	Each	1 1/4" Offset Nipple
5	Each	1 1/4" Locknut
5	Each	1 1/4" Fiber Bushing
1	Each	1 1/4" Hub (For Service Disconnect)
1	Each	Service Disconnect
1	Each	20 Amp Single Pole Breaker
1	Each	Lightning Arrestor
3	Each	1 1/4" x Close Nipple
2	Each	Cabinet Mount assembly. (PELCO SE-1100)
1	Each	Flasher Cabinet Assembly, Complete (NO TIME CLOCK FOR WARNING FLASHERS)
13	Each	3/4" Single Hole Mount for Strapping, with Bolt
4	Each	1 1/2" x 12" Aluminum Nipple
4	Each	1 1/2" Aluminum Cross
4	Each	1 1/2" Aluminum Collared Nipple
4	Each	1 1/2" Locking Ring
8	Each	1 1/2" Short Rosette Cap
4	Each	1 1/2" Hub Plate

PARTS FOR ELECTRICAL FLASHER - AC OPERATION		
QTY (UNIT 1)	UNIT	DESCRIPTION
50	LF	#4 Wire
15	LF	#12, 2-conductor
10	LF	#8, Bare Copper Grounding Wire
1	Each	Sign- See Attached Drawing
1	Each	Ground Rod (8ft)
1	Each	Ground Rod Clamp
1	Each	Split Bell Base
1	Each	Pole Cap

- A. Controller Cabinet.** The battery cabinet shall be manufactured of sheet aluminum with a minimum thickness of 0.125 inches, or cast aluminum alloy. The cabinet shall be sized to provide adequate space for two group 29 batteries. The cabinet shall have louvers for ventilation and to prevent the accumulation of gasses. There shall also be rubber mats installed on the bottom of the cabinets and two 1/8 inch drain holes located in the bottom at opposite corners.

The door and its opening shall encompass and constitute the entire area of the face of the cabinet. It shall be hinged via a continuous hinge, which shall be riveted to the door and to the cabinet. The door shall be tightly secured via a latching device, which pulls the door snugly against a neoprene gasket affixed to the cabinet body forming a weather-tight seal. The latching device shall be equipped with a standard police door-locking device.

The cabinet shall be equipped with the necessary hardware to provide right top and bottom mountings to a pole with band on post hubs, or 4-1/2 inch O.D. pole clamps as specified in the invitation for bids.

The DC Operation. Units shall include the following components for the DC Flashing Signals per flasher assembly:

PARTS FOR SOLAR FLASHER - DC OPERATION		
QTY (UNIT 1)	UNIT	DESCRIPTION
1	Each	4 1/2" OD x 19' Galvanized Steel Pole

PARTS FOR SOLAR FLASHER - DC OPERATION		
QTY (UNIT 1)	UNIT	DESCRIPTION
2	Each	12" Yellow Polycarbonate Single Section Housing (Less Lenses and gasket)
2	Each	12" Yellow LED Optical Assemblies, DC Voltage
25	LF	3/4" Stainless Steel Strap
12	Each	3/4" Stainless Steel Strap Buckles
2	Each	1 1/2" x 20" Offset Nipple
1	Each	1 1/4" Hub (For Service Disconnect)
2	Each	1 1/2" Aluminum Ell (SE-0457)
2	Each	1 1/2" Threaded Tee's(SE-0458)
1	Each	1 1/2" Sign Clamp (SH-0208) Comes in pairs
2	Each	Cabinet Mount assembly. (PELCO SE-1100)
1	Each	Flasher Cabinet Assembly, Complete (NO TIME CLOCK FOR WARNING FLASHERS)
13	Each	3/4" Single Hole Mount for Strapping, with Bolt
6	Each	1 1/2" x 12" Aluminum Nipple
4	Each	1 1/2" Aluminum Cross
4	Each	1 1/2" Aluminum Collared Nipple
4	Each	1 1/2" Locking Ring
8	Each	1 1/2" Short Rosette Cap
4	Each	1 1/2" Hub Plate
15	LF	#12, 2-conductor
10	LF	#8, Bare Copper Grounding Wire
1	Each	Sign – See Attached Drawing
1	Each	Ground Rod (8ft)
1	Each	Ground Rod Clamp
1	Each	Split Bell Base
2	Each	55 Watt Solar Panel
1	Each	Charging Regulator, 12 VDC
2	Each	Batteries, Gel filled 12 VDC
1	Each	Solar Array Cap Mounting Assembly" Top of Pole Kit"

- A. Regulator/Charger.** The Regulator/Charger unit is a solid state device, which shall regulate the photovoltaic (PV) module electrical

output to prevent battery overcharge. It shall be encapsulated for environmental protection. LED or LCD indicators shall be provided so that battery condition and/or amount of charge/discharge to or from the battery can be quickly determined.

The unit shall be supplied with a color-coded harness and a complete wiring diagram. Wires shall be a minimum 16 gauge stranded. Termination of the harness wiring to components mounted to pedestal poles, photovoltaic module, and signal beacons shall be accomplished via connectors. Female connectors shall be terminated for ease of installation and male connectors are to be supplied with each harness.

Battery terminals shall be 3/8 inch diameter round crimp terminals. Flasher termination shall be spade terminals. Regulator/charger terminations shall be spade terminals. The harness shall be installed in the controller cabinet using chassis tie downs and riveted to the harness bracket. The harness shall have spiral tubing to protect wires from the control cabinet to the door.

The flashing operation of the unit shall be initiated and terminated by relay contact closure of the solid state time clock.

The flasher shall be:

1. 12 volts D.C.
2. Solid-state with no relays or electro-mechanical devices.
3. 2-circuit with 50% duty cycle (per circuit) and shall provide 55 flashes per minute (± 5 flashes per minute) to each circuit in accordance with M.U.T.C.D. standards.

- B. Photovoltaic Modules.** The photovoltaic module shall provide 12 VDC and be capable of recharging the system to full capacity, after 6 hours of continuous operation, in 3 hours \pm 0.5 hours during optimum sun conditions in December. The crystalline silicon solar module shall consist of cells that are permanently encapsulated between a tempered glass cover and layers of ethylene vinyl acetate (EVA) pottant with a polyvinyl fluoride (PVF) and aluminum foil back sheet to provide a moisture free environment. The module frame shall be made from extruded aluminum alloy and adequately sized to attach the desired number and size of solar panels. The mounting bracket shall have no less than (4) 3/4 inch stainless steel bolts, lock washers, and hex head c, nuts to secure the PV module to the frame. An ultra violet (UV) resistant, weatherproof junction box providing

wire termination for up to #8 A WG wiring shall be provided with the PV module.

The photovoltaic module mounting assembly shall be constructed of galvanized steel (ASTM A153, Class A) or aluminum, of adequate design and strength to provide a means of securely attaching the PV module frame to a pole at a permanent angle of 45 to 50 degrees. The pole mounting hardware shall accommodate poles ranging from a minimum 4-1/2 inch O.D. steel pole to a wood pole. The bracket shall be capable of 360 degree horizontal orientation with a means of locking the bracket at an inscribed angular position about the pole. Contractor shall supply proper equipment to ensure due south positioning and angle of tilt of solar panels.

C. Battery. The manufacturer shall furnish the required number of batteries to meet this Item. The batteries shall be group 29, sealed, gel lead acid batteries. The batteries shall be 12-volt D.C. nominal and have minimum storage capacity of 105 ampere-hours. The deep cycle marine battery shall be maintenance free with internal venting. The batteries shall be sized to allow twelve (12) days autonomy.

D. Battery Cabinet. The battery cabinet shall be manufactured of sheet aluminum with a minimum thickness of 0.125 inches, or cast aluminum alloy. The cabinet shall be sized to provide adequate space for two group 29 batteries. The cabinet shall have louvers for ventilation and to prevent the accumulation of gasses. There shall also be rubber mats installed on the bottom of the cabinets and two 1/8 inch drain holes located in the bottom at opposite corners.

The door and its opening shall encompass and constitute the entire area of the face of the cabinet. It shall be hinged via a continuous hinge, which shall be riveted to the door and to the cabinet. The door shall be tightly secured via a three point latching device, which pulls the door snugly against a neoprene gasket affixed to the cabinet body forming a weather-tight seal. The three point latching device shall be equipped with a locking device that is operated by a number two Carbon Key.

The cabinet shall be equipped with the necessary hardware to provide right top and bottom mountings to a pole with band on post hubs, or 4-1/2 inch O.D. pole clamps as specified in the invitation for bids.

A Harris County approved single battery/control cabinet may be used in place of the separate battery and control cabinets.

All cabinets supplied must be equipped with Heavy Duty SPST, Off/Momentary On Door Open Switch with mounting bracket as required). Switch shall be equipped with two linear feet of twisted 18 AWG black terminated on inside to supplied switch and the other side with crimped #8 forked terminal lugs.

All cabinets shall be supplied with back panel assemblies that are compatible with solid state time clocks currently in use by Harris County and as described elsewhere in this specification. Back panel assemblies will be provided with appropriate wire termination blocks, and mounting space for assemblies and parts needed to provide fully functioning unit.

- E. Warranty.** Photovoltaic modules shall have a limited warranty for a minimum period of 10 years. The balance of the equipment described herein shall be warranted for 3 years from the date of completion.
- F. Testing.** Solar-powered flasher assemblies shall meet or exceed all applicable TMUTCD and/or ITE Standards and this Item. In addition to testing or pre-shipment samples, complete testing of school zone flasher assemblies may be required at any time prior to acceptance.
- G. Documentation Requirements.** Each solar-powered flasher assembly shall be provided with two each of the following documentation.
 - 1. Complete accurate schematic diagrams.
 - 2. Complete parts list including names of vendors for parts not identified by universal part numbers.
 - 3. Complete set of operator manuals.

865.5 SPECIAL EQUIPMENT AND MATERIALS.

Lightning Arrestor. Shall be 2 pole, 3 wire, 175v per pole for 120/240 service. Lightning arrestor shall be installed on the main disconnect box (Joslyn J9200-10, General Electric 9L15ECB001, or approved equal).

Main Breaker. Shall be a minimum 20 amp breaker for the flasher.

Hardware. All hardware used in this construction shall be galvanized; all conduits shall be galvanized rigid steel conduits in accordance with Item 618 "Conduit." All junction boxes and/or condulets shall have a cover and

gasket and shall be located approximately 24 inches above natural ground for accessibility as shown on the drawings.

Signal Cables. All traffic signal cable shall be copper insulated jacketed cable in accordance with Item 684 "Traffic Signal Cables." The number and size of conductors shall be as directed by the manufacturer to service the required signals and according to the NEC or as shown on the drawings.

Signal Heads. All flashing beacons (2 per sign) shall be 12 inch Yellow Polycarbonate amber lenses with visor hood, band-on mounting or approved equal, designed according to Item 682 "Traffic Signal Heads." Beacons to flash alternately (bouncing ball type).

The number and size of conductors shall be as directed by the manufacturer to service the required signals and according to the NEC or as shown on the drawings.

Pedestal Pole. Poles shall be 19 feet x 4-1/2 inch O.D. pedestal poles and shall be designed in accordance with the drawings.

School Zone Signs. Shall be school zone signs (24 inches x 48 inches) as shown on drawings.

Warning Signs. Shall be "Slow When Flashing" signs (48 inches x 48 inches) or as shown on drawing sheet(s).

Signs. All required construction signs and regulatory signs shall be in accordance with the TMUTCD as shown on the drawings.

Other Specifications Requirements. Harris County with mutual Contractor approval reserves the right to extend the quantity by up to 100 percent within 18 months from the date of Purchase Order, at the same price, terms and conditions. For additional quantities Harris County will issue a work order to the Contractor with the number of School Zone Pager System Flasher Assembly (not less than 4 School Zone Pager System Flasher Assembly per shipment) and the delivery schedule shall be 45 calendar days from work order date for 4 School Zone Pager System Flasher Assembly and 60 calendar days. The School Zone Pager System Flasher Assembly shall be shipped with all components contained within the assembly.

865.6 SUBSTITUTE MATERIALS.

Set forth in this Item are definite models, materials, etc. of particular manufacturer; however, items of equal appearance, durability, performance and design will be accepted upon approval of HCED. The successful bidder is required to submit to the County Engineer's Office, Traffic Signal

Maintenance Section, engineering brochures and information on all materials he desires to furnish and install which are of different manufacturer or model number specified herein. The submittal is for approval or disapproval by HCED. In the event approval is not obtained, the specified items shall not be furnished and installed. The submittals shall be furnished not later than 2 days after bid opening.

Control Components. All electronic components within the cabinet shall be mounted to the back panel. The electronic components shall be easily installed or removed with simple hand tools.

Constructed so that each component may be readily replaced if needed.

The Operation units shall include the following components for all the School Zone Flasher Assemblies per system: a low profile disc antenna, a three-point latch for Cabinet Door Assembly (solar), and a 19 foot pole.

Solid State Time Clock. This section of the Item describes the minimum acceptable requirements for an electronic time clock that can automatically change the operation of a school zone flasher at predetermined times.

Time clock must be compatible with existing school zone flasher management system in use by HCED.

Consist of a field controller that includes an integrated cell modem, GPS and all other inputs and outputs required for the correct operation of the system.

The same unit should be able to operate with either AC or DC power.

Provide for Local Scheduling via a laptop using an internet browser. The unit shall include an Ethernet port to locally program the beacon schedules.

Provide a local override switch to place the beacon in on, off, or schedule control, and provide input to system for switch status. Monitors the door status of the cabinet. Installation of Door Open Switch required (Heavy Duty SPST, Off/Momentary On with mounting bracket as required).

Monitoring signals such as AC, battery voltage, solar charge voltage and integrated battery backup voltage.

Monitor load current to determine if both lamps are working, only one lamp is working or none are working.

The unit shall include 2 relay outputs so that 2 flasher controller units can be controlled. The relay outputs should be rated at 16A.

Function correctly between -34 degrees C and +74 degrees C.

Be provided with appropriately rated and keyed connectors that allows the solid state time clock to be exchanged by unplugging connectors, without tools.

Capable of using 3rd party SIM cards provided at the option of Harris County.

Be configured by accessing the internal web server with a browser. It shall be possible to configure the solid state time clock without any special software.

Utilize field initiated communications. This allows for low cost cellular data plans to be used, with infrequent polling. However, when an abnormal event occurs and is detected by the solid state time clock, then the solid state time clock will immediately initiate the transfer of a data packet to the solid state time clock to enable real-time alerting of response personnel to take place.

Include a backup battery and battery charging/monitoring circuit, to allow the solid state time clock to function correctly even when all power to the school beacon has failed. The battery shall continue to power the solid state time clock and cell modem for a minimum of 5 hours after all power has failed to the school beacon. Incorporate an integrated GPS which will allow the solid state time clock to geo-locate itself on the map, without configuration.

Operate without requiring a static IP address. The only configuration required at the solid state time clock is to enter the URL of where the school zone beacon central management software is hosted.

In the event that the cell service is interrupted or is not available, the solid state time clock shall store any events that occur in internal memory and forward these events automatically to the solid state time clock when the cell service is restored. In this way, a complete record of events at the device can be maintained even if cell service is interrupted for a period.

Utilize HTTP and HTTPS protocols, and XML data structures, for communications with the solid state time clock. In this way the data will be open for future expansion and competition. The use of proprietary protocols is not permitted.

Support Ethernet and cellular communications. The primary communication shall be Ethernet, and in the event of the Ethernet communication not being successful then the solid state time clock shall switch over to the back-up cellular communications.

865.7 WARRANTY.

Photovoltaic modules shall have a limited warranty for a minimum period of 10 years. The balance of the equipment described herein shall be warranted for 3 years from the date of completion.

865.8 TESTING.

Flasher and school zone flasher assemblies shall meet or exceed all applicable TMUTCD and/or ITE Standards and this Item. In addition to testing or pre-shipment samples, complete testing of school zone flasher or flasher assemblies may be required at any time prior to acceptance.

865.9 DOCUMENTATION REQUIREMENTS.

Each flasher assembly shall be provided with two each of the following documentation.

- A. Complete accurate schematic diagrams.
- B. Complete parts list including names of vendors for parts not identified by universal part numbers.
- C. Complete set of operator manuals.

865.10 QUALITY ASSURANCE AND ACCEPTANCE.

The Contractor shall setup and demonstrate to Harris County the system 5 calendar days from the date of award. A Factory Representative shall be present with Harris County to inspect and test the system.

865.11 MEASUREMENT AND PAYMENT.

No direct measurement or compensation shall be made for this Item. The work performed, materials furnished, equipment, labor, tools, and incidentals shall be subsidiary to pertinent Items.

There are no item code(s), description(s), and unit(s) for this Item.

NOTE: This Item requires Standard Traffic Drawings that shall be incorporated into the Contract Documents.

NOTE: This Item requires other Standard Specifications

Item 618 "Conduit"
Item 682 "Traffic Signal Heads"
Item 684 "Traffic Signal Cables"

END OF ITEM 865

END OF SECTION 34 41 14