

PROJECT MANUAL

2024 Cy Lakes HS Renovation
RFP# 24-02-5749-R-RFP

Cypress-Fairbanks Independent School District
11440 Matzke Road, Cypress, Texas 77429



Issue for Bids

November 17, 2024

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NATEX Corporation Architects/ Coleman Partners
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Houston, Texas 77007



Project Manual
for

2024 Cy Lakes HS Renovation

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Cypress-Fairbanks Independent School District

ISSUE FOR BIDS– November 17, 2024

NATEX Project No.: 24-05

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2024 Cy Lakes HS Renovation

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Cypress-Fairbanks Independent School District

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NOTICE TO GENERAL CONTRACTOR PROPOSERS

ELECTRONIC PROPOSAL DOCUMENTS REGISTRATION REQUIREMENTS AND DISCLAIMER

Project: Cypress Fairbanks ISD- 2023 2024 Cy Lakes HS Renovation
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Contract Documents have been released to Bidders and posted to ARC's digital website:
https://order.e-arc.com/arcEOC/PWELL_Main.asp?mem=95. Plans may also be obtained from ARC by
calling 713-785-8580.

All contractors who intend to submit a proposal, and acquire the proposal documents from any
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website for updates to addenda and other proposal documents.

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TABLE OF CONTENTS

<u>Page No.</u>	<u>Document</u>	<u>Number of Pages</u>
VOLUME 1		
00 01 01	TITLE PAGE & INSIDE COVER	4
00 01 05	TABLE OF CONTENTS	12
DIVISION 00 – BIDDING AND CONTRACT REQUIREMENTS		
AA	REQUEST FOR COMPETITIVE SEALED PROPOSALS	3
AB	INSTRUCTIONS TO OFFERORS	9
AC	COMPETITIVE SEALED PROPOSAL FORM – BASE PROPOSAL & ALTERNATES	12
AD	PROPOSAL BOND	1
AE	FELONY CONVICTION NOTIFICATION	1
AF	LIST OF SUBCONTRACTORS	1
AG	PROPOSAL EVALUATION WAIVER	1
AH	AFFIDAVIT OF NON-DISCRIMINATORY EMPLOYMENT	1
AI	FORM 1: CONDITIONAL WAIVER AND RELEASE ON PROGRESS PAYMENT	1
AI	FORM 2: UNCONDITIONAL WAIVER AND RELEASE ON PROGRESS PAYMENT	1
AI	FORM 3: CONDITIONAL WAIVER AND RELEASE ON FINAL PAYMENT	1
AI	FORM 4: UNCONDITIONAL WAIVER AND RELEASE ON FINAL PAYMENT	1
AJ	WARRANTY CERTIFICATE	1
AK	AFFIDAVIT OF NON-ASBESTOS, LEAD, AND PCB USE IN PROJECT	1
AL	CERTIFICATION OF PROJECT COMPLIANCE	2
AM	PROPOSAL CLARIFICATION FORM	1
AN	CONFLICT OF INTEREST QUESTIONNAIRE	1
AO	PROJECT CLOSE OUT CHECKLIST	4
AP	CERTIFICATION OF CRIMINAL HISTORY RECORD INFORMATION	5
AQ	CERTIFICATE OF FINAL COMPLETION	1
AR	FORM 1295 – DISCLOSURE OF INTERESTED PARTIES	2
BA	CONTRACT DOCUMENTS	1
A101-2017	STANDARD FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR - CFISD AS AMENDED	9
A201-2077	GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION - CFISD AS AMENDED	55
BB	TEXAS STATUTORY PERFORMANCE BOND	1
BC	TEXAS STATUTORY PAYMENT BOND	1
BD	INSURANCE AND BONDS REQUIREMENTS FOR CONTRACTORS	4
CA	APPLICATION AND CERTIFICATION FOR PAYMENT CHECKLIST AND TRANSMITTAL	1
CB	SUPPLEMENTARY CONDITIONS TO THE GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION AS AMENDED	5
CC	RIGHT OF AUDIT – EXAMINATION OF RECORDS	2

DIVISION 01 - GENERAL REQUIREMENTS

01 10 00	SUMMARY OF WORK	3
01 11 23	CODES, REGULATIONS, AND STANDARDS	9
01 11 26	OWNER/ARCHITECT PROVIDED DOCUMENTS	1
01 21 00	ALLOWANCES	2
01 22 00	MEASUREMENT AND PAYMENT (UNIT PRICES)	9
01 23 00	ALTERNATES	2
01 29 73	SCHEDULE OF VALUES	11
01 31 13	PROJECT COORDINATION	2
01 31 19	PROJECT MEETINGS	10
01 31 29	NOTIFICATION OF ARCHITECT REQUIREMENTS	2
01 32 16	CONSTRUCTION PROGRESS SCHEDULE	2
01 32 23	SURVEY AND LAYOUT DATA	2
01 33 00	SUBMITTALS	2
01 35 23	SPECIAL OWNER REQUIREMENTS	4
01 35 23.1	SPECIAL OWNER REQUIREMENTS – OVERTIME REQUESTS	3
01 35 23.2	SPECIAL OWNER REQUIREMENTS – BADGING PROCESS	2
01 36 13	RENOVATION PROJECT PROCEDURES	4
01 36 13.1	CUTTING AND PATCHING	2
01 45 00	QUALITY CONTROL	5
01 45 29	INSPECTION AND TESTING LABORATORY SERVICES	15
01 50 00	TEMPORARY FACILITIES	4
01 55 26	TRAFFIC CONTROL AND REGULATION	6
01 57 23	TEMPORARY STORM WATER POLLUTION CONTROL	10
01 57 23.10	TPDES REQUIREMENTS	4
01 57 23.11	STABILIZED CONSTRUCTION EXIT	4
01 57 23.12	CONTROL GROUND AND SURFACE WATER	8
01 71 23	FIELD ENGINEERING	4
01 71 50	PREVENTIVE HOUSEKEEPING AND FINAL CARPET CLEANING	5
01 77 00	GUARANTEES, CERTIFICATES, AND CLOSEOUT	9
01 91 00	GENERAL COMMISSIONING REQUIREMENTS	13

DIVISION 02 - EXISTING CONDITIONS

		59
02 30 00	SUBSURFACE INVESTIGATION	4
02 41 01	DEMOLITION	4
02 41 13.10	REMOVING EXISTING PAVEMENT AND STRUCTURES	4
02 41 19	SELECTIVE STRUCTURE DEMOLITION	
02 50 00	SITE RESTORATION	4

DIVISION 03 – CONCRETE

03 05 80	UNDER SLAB VAPOR BARRIER-RETARDER	3
03 10 00	CONCRETE FORMING AND ACCESSORIES	7
03 20 00	CONCRETE REINFORCING	6
03 30 00	CAST-IN-PLACE CONCRETE	18
03 35 11	CONCRETE FLOOR FINISHES	2
03 52 00	LIGHTWEIGHT CONCRETE ROOF INSULATION	6
03 54 16	HYDRAULIC CEMENT UNDERLAYMENT	4

DIVISION 04 – MASONRY

04 09 00	MASONRY RESTORATION	5
04 20 00	UNIT MASONRY	14

DIVISION 05 - STEEL

05 12 00	STRUCTURAL STEEL FRAMING	10
05 21 00	STEEL JOIST FRAMING	
05 31 23	STEEL ROOF DECKING	6
05 40 00	COLD FORMED METAL FRAMING	8
05 52 13	PIPE & TUBE RAILINGS	3

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

06 10 00	ROUGH CARPENTRY	5
06 10 55	ROOFING CARPENTRY	5
06 20 00	FINISH CARPENTRY	6
06 65 20	SOLID SURFACE FABRICATIONS	2

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

07 13 00	SHEET WATERPROOFING	2
07 21 00	THERMAL INSULATION	4
07 25 00	WEATHER BARRIERS	7
07 52 00	MODIFIED BITUMINOUS MEMBRANE ROOFING-	12
07 62 00	ROOFING RELATED SHEET METAL FLASHING & TRIM	7
07 64 00	THRU WALL FLASHING	4
07 65 00	FLEXIBLE FLASHING STAINLESS STEEL	4
07 72 00	ROOF ACCESSORIES	4
07 81 00	APPLIED FIREPROOFING	6
07 81 20	FIRESTOPPING, PENETRATION, SEALS	4
07 90 05	JOINT SEALANTS	4
07 95 13	EXPANSION JOINT COVER ASSEMBLIES	2

DIVISION 08 – OPENINGS

08 11 13	HOLLOW METAL DOORS & FRAMES	6
08 14 16	FLUSH WOOD DOOR	4
08 33 23	OVERHEAD COILING DOOR	4
08 34 73	SOUND CONTROL DOORS	6
08 51 00	ALUMINUM GLAZED SYSTEMS	6
08 71 00	DOOR HARDWARE	43
08 80 00	GLAZING	5
08 87 00	SECURITY GLAZING FILM	4
08 91 00	STATIONARY BLADE WALL LOUVERS	6

DIVISION 09 - FINISHES

09 01 60	GYM FLOOR RESTORATION	3
----------	-----------------------	---

09 21 16	GYPSUM BOARD ASSEMBLIES	6
09 24 00	PORTLAND CEMENT PLASTERING	6
09 30 00	TILING	6
09 51 00	ACOUSTICAL CEILING	4
09 52 00	ACOUSTICAL CEILING PANELS	4
09 64 55	RESILIENT WOOD STAGE FLOOR ASSEMBILES	4
09 65 00	RESILIENT FLOORING AND BASE	3
09 65 19.11	LUXURY VINYL TILE/PLANK FLOORING	5
09 65 66	RESILIENT ATHLETIC FLOORING	9
09 67 23	RESINOUS FLOORING	5
09 68 00	CARPET	3
09 72 00	WALLCOVERINGS	4
09 84 33	SOUND ABSORBING WALL PANELS	3
09 84 34	ACOUSTICAL WALL PANELS	5
09 90 00	PAINTING AND COATING	8

DIVISION 10 – SPECIALTIES

10 01 00	MISCELANEOUS SPECIALTIES	1
10 11 01	VISUAL DISPLAY BOARDS	3
10 12 00	DISPLAY CASE	2
10 14 00	SIGNAGE	5
10 21 13.19	PLASTIC TOILET COMPARTMENTS	3
10 22 13	WIRE MESH PARTITIONS	2
10 22 26.33	FOLDING PANEL PARTITIONS	4
10 26 01	CORNER GUARDS	2
10 28 00	TOILET ACCESSORIES	4
10 44 00	FIRE PROTECTION SPECIALTIES	2
10 50 50	METAL LOCKERS	3
10 56 13	INDUSTRIAL METAL SHELVING	2
10 73 13	AWNINGS	4

DIVISION 11 – EQUIPMENT

11 31 00	RESIDENTIAL APPLINACES	2
11 57 00	SHOP EQUIPMENT	9
11 61 00	THEATRICAL LIGHTING	17
11 61 33	RIGGING SYSTEMS AND CONTROLS	9

DIVISION 12 – FURNISHINGS

12 21 13	HORIZONTAL LOUVER BLINDS	2
----------	--------------------------	---

DIVISION 13 – SPECIAL CONSTRUCTION (NOT USED)

13 34 13	GREENHOUSE	6
13 34 19	PRE ENGINEERED BUILDING	20

DIVISION 14 - CONVEYING EQUIPMENT (NOT USED)

DIVISION 21 – FIRE PROTECTION

21 01 00	FIRE PROTECTION OPERATING AND MAINTENANCE MANUALS	4
21 05 00	FIRE PROTECTION GENERAL PROVISIONS	5
21 05 10	FIRE PROTECTION CONTRACT QUALITY CONTROL	2
21 05 12	FIRE PROTECTION SHOP DRAWINGS, COORDINATION DRAWINGS & PRODUCT DATA	4
21 05 13	ELECTRICAL PROVISIONS OF FIRE PROTECTION WORK	3

DIVISION 22 – PLUMBING

22 01 00	PLUMBING OPERATING AND MAINTENANCE MANUALS	3
22 05 00	PLUMBING GENERAL PROVISIONS	5
22 05 10	PLUMBING CONTRACT QUALITY CONTROL	2
22 05 12	PLUMBING SHOP DRAWINGS, COORDINATION DRAWINGS AND PRODUCT DATA	4
22 05 13	ELECTRICAL PROVISIONS OF PLUMBING WORK	3
22 05 14	PLUMBING ALTERATIONS PROJECT PROCEDURES	4
22 05 15	PLUMBING EARTHWORK	1
22 05 16	EXCAVATING, BACKFILLING & COMPACTING FOR UTILITIES	3
22 05 17	PLUMBING ACCESS DOORS	1
22 05 19	PRESSURE AND TEMPERATURE INSTRUMENTS	2
22 05 23	VALVES, STRAINERS AND VENTS	7
22 07 19	PLUMBING PIPING INSULATION	6
22 11 16	DOMESTIC WATER PIPING AND APPURTENANCES	6
22 11 19	PIPING AND PIPING APPURTENANCES FOR COLD WATER MAKEUP	2
22 11 23	DOMESTIC WATER PUMPS	7
22 15 00	SHOP COMPRESSED AIR SYSTEM	3
22 20 00	PLUMBING PIPE AND FITTINGS – GENERAL	9
22 33 33	ELECTRIC WATER HEATER (COMMERICAL ASME)	2
22 40 00	PLUMBING FIXTURES AND FIXTURE CARRIERS	4
22 63 11	GAS PIPING AND APPURTENANCES	4

DIVISION 23 – MECHANICAL

23 01 00	HVAC OPERATING AND MAINTENANCE MANUALS	4
23 05 00	MECHANICAL GENERAL PROVISIONS	6
23 05 10	HVAC CONTRACT QUALITY CONTROL	3
23 05 11	MECHANICAL ALTERATIONS PROJECT PROCEDURES	4
23 05 12	SHOP DRAWINGS, COORDINATION DRAWINGS AND PRODUCT DATA	4
23 05 13	ELECTRICAL PROVISIONS OF HVAC WORK	4
23 05 14	HVAC CONDENSATE DRAIN PIPING SYSTEM	1
23 05 17	HVAC ACCESS DOORS	1
23 05 18	VARIABLE FREQUENCY INVERTER	5
23 05 19	HVAC PRESSURE AND TEMPERATURE INSTRUMENTS	2
23 05 23	HVAC VALVES, STRAINERS AND VENTS	4
23 05 33	HVAC PIPE HEAT TRACING	2
23 05 48	VIBRATION ISOLATION	3
23 05 93	TESTING, BALANCING AND ADJUSTING (TAB) OF ENVIRONMENTAL SYSTEMS	12
23 05 94	COORDINATION OF TESTING AND BALANCING	4
23 07 13	EXTERNAL DUCT INSULATION	5
23 07 16	VESSEL INSUALTION	4
23 07 19	HVAC PIPING INSULATION	6
23 08 00	HVAC SYSTEMS TECHNICAL COMMISSIONING REQUIREMENTS	4
23 09 33	BUILDING MANAGEMENT AND CONTROL SYSTEM	31

23 09 34	COORDINATION OF BUILDING MANAGEMENT AND CONTROL SYSTEM	1
23 20 00	HVAC PIPE AND PIPE FITTINGS – GENERAL	7
23 21 13	HOT WATER AND CHILLED WATER PIPING, VALVES AND APPURTENANCES	2
23 21 23	HVAC PUMPS	5
23 23 00	REFRIGERANT PIPING AND APPURTENANCES	2
23 25 13	CIRCULATING WATER SYSTEM CHEMICAL TREATMENT	4
23 31 13	DUCTWORK	12
23 34 16	FANS	4
23 35 13	WOOD CHIP EXHAUST SYSTEM	3
23 35 16	WELDING FUME EXHAUST SYSTEM	2
23 36 16	VARIABLE VOLUME TERMINAL UNITS	5
23 36 17	DUAL DUCT VARIABLE VOLUME TERMINAL UNITS	4
23 37 13	AIR DEVICES	2
23 41 00	AIR FILTRATION	1
23 57 20	HEAT EXCHANGER	2
23 65 27	AIR-COOLED ROTARY SCROLL CHILLER	8
23 73 13	AIR HANDLING UNITS	6
23 82 16	HEATING AND COOLING COILS	3
23 82 18	DUCTLESS MINI SPLIT DX UNITS	4

DIVISION 26 – ELECTRICAL

26 01 05	ELECTRICAL OPERATING AND MAINTENANCE MANUALS	4
26 05 00	ELECTRICAL GENERAL PROVISIONS	16
26 05 05	ELECTRICAL ALTERATIONS PROJECT PROCEDURES	6
26 05 10	CONTRACT QUALITY CONTROL	3
26 05 12	ELECTRICAL SHOP DRAWINGS, COORDINATION DRAWINGS, & PRODUCT DATA	6
26 05 19	CONDUCTORS AND CONNECTORS – 600 VOLT	6
26 05 26	ELECTRICAL GROUNDING	5
26 05 27	EXPANSION OF EXISTING ELECTRICAL GROUNDING SYSTEM	5
26 05 33	CONDUIT SYSTEMS	14
26 05 35	ELECTRICAL CONNECTIONS FOR EQUIPMENT	2
26 05 37	ELECTRICAL BOXES AND FITTINGS	5
26 05 40	ELECTRICAL GUTTERS AND WIREWAYS	2
26 05 50	FIRESTOPS	1
26 08 00	ELECTRICAL AND LIFE SAFETY TECHNICAL COMMISSIONING REQUIREMENTS	4
26 09 25	ELECTRICAL CONTACTORS	2
26 09 28	DIGITAL LIGHTING CONTROL SYSTEM	14
26 12 17	ULTRA HIGH EFFICIENCY K-RATED TRANSFORMERS	6
26 24 13	SWITCHBOARDS	6
26 24 14	TESTING, MAINTENANCE, AND MODIFICATIONS TO EXISTING SWITCHBOARDS AND FEEDER DISTRIBUTION PANELBOARDS	5
26 24 16	PANELBOARDS AND ENCLOSURES	4
26 24 25	ENCLOSED SWITCHES	4
26 24 30	FUSES	1
26 27 73	LINE VOLTAGE WIRING DEVICES	7
26 43 00	SURGE PROTECTION DEVICES	5
26 51 13	LIGHTING FIXTURES AND LAMPS	6
26 55 61	THEATRICAL LIGHTING AND RIGGING SYSTEM REFERENCE	1
26 56 67	SPORTS FIELD LIGHTING SYSTEM	8

DIVISION 27 – COMMUNICATIONS

27 01 00	OPERATION & MAINTENANCE (O&M) MANUALS OF COMMUNICATIONS SYSTEMS	4
27 05 00	COMMUNICATIONS BASIC MATERIALS, METHODS AND GENERAL PROVISIONS	22

27 05 07	COMMUNICATIONS SHOP DRAWINGS & PRODUCT DATA	5
27 05 09	CONTRACT QUALITY CONTROL	2
27 05 29	PATHWAYS FOR AV SYSTEMS	4
27 10 00	STRUCTURED CABLING SYSTEM	24
27 31 34	AV SYSTEMS	37
27 50 00	SCHOOL COMMUNICATION SYSTEM	22

DIVISION 28 – SAFETY/SECURITY

28 01 00	OPERATION AND MAINTENANCE (O&M) MANUALS OF ELECTRONIC SAFETY AND SECURITY SYSTEMS	4
28 05 00	ELECTRONIC SAFETY AND SECURITY BASIC MATERIALS, METHODS AND GENERAL PROVISIONS	19
28 05 07	SHOP DRAWINGS, COORDINATION DRAWINGS & PRODUCT DATA	5
28 05 10	CONTRACT QUALITY CONTROL	2
28 05 50	FIRESTOPS	1
28 10 00	ACCESS CONTROL SYSTEM (ACS)	19
28 10 00.05	DOOR INTERCOM SYSTEM	12
28 20 00	VIDEO SURVEILLANCE SYSTEM (VSS)	11
28 31 00	INTRUSION DETECTION	12
28 46 02	EXPANSION OF EXISTING FIRE DETECTION AND ALARM SYSTEM	23
28 55 00	RF SURVEY FOR IN-BUILDING EMERGENCY RESPONDER RADIO COVERAGE (ERRC) AND TESTING OF EXISTING ERRC ENHANCEMENT SYSTEMS (EERCES)	6
28 60 00	DISTRICT RADIO COMMUNICATION EQUIPMENT	3

DIVISION 31 - EARTHWORK

31 00 00	EARTHWORK UNDER BUILDING	4
31 00 01	EARTHWORK	6
31 06 20.15	CEMENT STABILIZED SAND	6
31 06 20.17	UTILITY BACKFILL MATERIALS	8
31 11 00	CLEARING AND GRUBBING	2
31 22 00	GRADING	4
31 23 00	EXCAVATION AND BACKFILL FOR STRUCTURES	8
31 23 16.14	TRENCH SAFETY SYSTEM	4
31 23 33	TRENCHING AND BACKFILLING	14
31 50 00	EXCAVATION SUPPORT AND PROTECTION	4
31 63 29	DRILLED CONCRETE PIERS AND SHAFTS	7

DIVISION 32 - EXTERIOR IMPROVEMENTS

32 11 13.13	LIME-TREATED SUBGRADES	6
32 11 29.13	LIME-FLY ASH-TREATED BASE COURSES	2
32 13 13	CONCRETE PAVING	10
32 13 13.10	CONCRETE PAVEMENT CURING	4
32 13 13.25	CONCRETE SIDEWALKS	4
32 13 73	CONCRETE PAVING JOINTING	4
32 16 13	CURBS AND GUTTERS	4
32 17 23	PAVEMENT MARKINGS	2
32 18 28	TENNIS COURTS	7
32 31 13	CHAIN LINK FENCES & GATES	4
32 31 19	ORNAMENTAL METAL FENCES AND GATES	4
32 84 10	LANDSCAPE IRRIGATION	9
32 91 13.13	TOPSOIL PLACEMENT AND GRADING	2
32 92 13	HYDRO-MULCHING	4

32 92 23	SODDING	4
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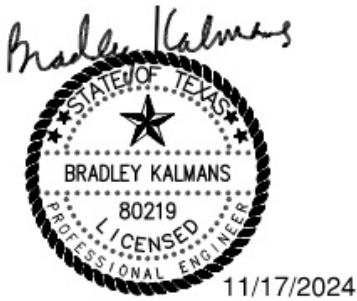
DIVISION 33 - UTILITIES

33 05 13	MANHOLES AND STRUCTURES	10
33 05 13.13	MANHOLE GRADE ADJUSTMENT	2
33 05 16.13	PRECAST CONCRETE UTILITY STRUCTURES	4
33 05 16.16	CONCRETE FOR UTILITY CONSTRUCTION	14
33 06 10.14	POLYVINYL CHLORIDE (PVC) PIPE	6
33 11 00	WATER UTILITY DISTRIBUTION PIPING	14
33 12 13.10	TAPPING SLEEVES AND VALVES	4
33 12 13.12	WET CONNECTIONS	2
33 12 16	WATER UTILITY DISTRIBUTION VALVES	4
33 12 40	VALVE BOXES, METER BOXES, AND METER VAULTS	6
33 13 00	DISINFECTING OF WATER UTILITY DISTRIBUTION	4
33 13 00.10	HYDROSTATIC TESTING OF PIPELINES	2
33 31 00	SANITARY UTILITY SEWERAGE PIPING	8
33 31 00.10	ACCEPTANCE TESTING FOR SANITARY SEWERS	10

SEALS: MEP SECTIONS

CIVIL SECTIONS STRUCTURAL

SECTIONS



ARCHITECTURAL SECTIONS



INDEX OF DRAWINGS

GENERAL

G0.01	DRAWING INDEX, SYMBOLS, ABBREVIATIONS
G1.01	LIFE SAFETY PLANS
G1.02	LIFE SAFETY PLANS - AREAS G & F
G1.03	UL FIRE RATED ASSEMBLIES
G1.10	HCED FIRE CODE REVIEW V8.0 - FINE ARTS / CTE ADDITION
G1.20	HCED FIRE CODE REVIEW V8.0 - GREENHOUSE
G1.30	HCED FIRE CODE REVIEW V8.0 - STORAGE BLDG
G2.00	ADA DETAILS
G2.01	ACCESSORIES MOUNTING REQUIREMENTS

CIVIL

SV.01	SURVEY
SV.02	SURVEY

CIVIL

C1.01	GENERAL NOTES
C1.02	OVERALL CIVIL SITE PLAN
C1.03	DEMOLITION PLAN
C1.04	DEMOLITION PLAN
C1.05	DEMOLITION PLAN
C1.06	FIRE ACCESS PLAN
C2.01	GRADING PLAN (SHEET 1 OF3)
C2.02	GRADING PLAN (SHEET 2 OF3)
C2.03	GRADING PLAN (SHEET 3 OF3)
C3.01	UTILITY PLAN (SHEET 1 OF 3)
C3.02	UTILITY PLAN (SHEET 2 OF 3)
C3.03	UTILITY PLAN (SHEET 3 OF 3)
C3.04	DETENTION POND PLAN
C3.05	STORM WATER POLLUTION PREVENTION PLAN
C5.01	PAVING AND JOINT PLAN
C5.02	PAVING AND JOINT PLAN
C7.01	PAVING DETAILS
C7.02	STORM SEWER DETAILS
C7.03	WATER LINE DETAILS
C7.04	SANITARY SEWER DETAILS
C7.05	STORM WATER POLLUTION PREVENTION DETAILS

LANDSCAPE

L1.00	IRRIGATION MODIFICATION TO SITE
L1.10	IRRIGATION MODIFICATION TO SITE

STRUCTURAL

S001	3D VIEW AND SHEET LIST
S101	GENERAL STRUCTURAL CRITERIA
S102	GENERAL STRUCTURAL CRITERIA
S201	FOUNDATION PLAN - OVERALL
S201F	FOUNDATION PLAN - AREA F
S201G	FOUNDATION PLAN - AREA G
S201H	FOUNDATION PLAN - GREENHOUSE
S201P	FOUNDATION PLAN - PEMB

S201T	TENNIS COURT PLAN AND DETAILS
S202	LOW ROOF FRAMING PLAN - OVERALL
S202F	LOW ROOF FRAMING PLAN - AREA F
S202G	LOW ROOF FRAMING PLAN - AREA G
S203	HIGH ROOF FRAMING PLAN - OVERALL
S203G	HIGH ROOF FRAMING PLAN - AREA G
S301	SCHEDULES
S302	COLUMN AND BASEPLATE SCHEDULE
S401	TYPICAL SLAB ON GRADE DETAILS
S402	TYPICAL GB AND CF DETAILS
S403	SOG @ GB
S404	SOG @ PEMB
S405	SITE DETAILS
S501	TYPICAL STEEL DETAILS
S502	TYPICAL COLD FORMED METAL FRAMING DETAILS
S503	TYPICAL CMU WALL DETAILS
S601	TYPICAL STEEL ROOF DETAILS
S602	STEEL ROOF (OVERFLOW & EJ)

DEMOLITION

D1.00	SITE DEMO
D2.01	1ST FLOOR DEMOLITION PLAN
D2.02	2ND FLOOR DEMOLITION PLAN
D2.10F	1ST FLOOR DEMOLITION PLAN - AREA 'F'
D2.10G	1ST FLOOR DEMOLITION PLAN - AREA 'G'

ARCHITECTURAL - BUILDING

A1.00	ARCHITECTURAL SITE PLAN
A1.01	ENLARGED SITE PLAN
A1.02	ATHLETIC STORAGE BLDG PLANS & DETAILS
A1.03	ATHLETIC OUT BUILDINGS PLANS & DETAILS
A1.04	ENLARGED CANOPY PLANS & DETAILS
A1.05	GREENHOUSE PLAN & DETAILS
A1.06	TENNIS COURT PLANS & DETAILS
A1.10	SITE DETAILS
A2.00	OVERALL FLOOR PLANS
A2.10A	1ST FLOOR PLAN - AREA 'A'
A2.10B	1ST FLOOR PLAN - AREA 'B'
A2.10C	1ST FLOOR PLAN - AREA 'C'
A2.10D	1ST FLOOR PLAN - AREA 'D'
A2.10E	1ST FLOOR PLAN - AREA 'E'
A2.10F	1ST FLOOR PLAN - AREA 'F'
A2.10G	1ST FLOOR PLAN - AREA 'G'
A2.10H	1ST FLOOR PLAN - AREA 'H'
A2.10I	1ST FLOOR PLAN - AREA 'I'
A2.10J	1ST FLOOR PLAN - AREA 'J'
A2.20E	2ND FLOOR PLAN - AREA EAST
A2.20W	2ND FLOOR PLAN - AREA WEST
A2.30	OVERALL & ENLARGED ROOF PLAN
A2.31	SIPLAST TYPICAL LWIC MEMBRANE ROOF DETAILS
A2.32	TYPICAL ROOF ACCESSORY DETAILS
A2.33	TYPICAL ROOF ACCESSORY DETAILS
A3.01	RECEPTION PLANS & DETAILS
A3.10	RESTROOM PLAN & ELEVATIONS
A4.01	DOOR SCHEDULES
A4.02	DOOR SCHEDULES

A4.03	DOOR SCHEDULES
A4.04	DOOR SCHEDULES
A4.10	INTERIOR OPENING TYPES & DETAILS
A4.20	PARTITION TYPES & WALL DETAILS
A5.00	EXTERIOR OPENING TYPES
A6.00	EXTERIOR AERIAL PHOTOS
A6.01	JOINT SEALANT & IRF LOCATION FLOOR PLANS
A6.10	BUILDING ELEVATIONS - OVERALL
A6.11	BUILDING ELEVATIONS-SEALANT REPLACEMENT LOCATIONS
A6.12	BUILDING ELEVATION SEALANT REPLACEMENT
A6.13	BUILDING ELEVATIONS-SEALANT REPLACEMENT
A6.14	BUILDING ELEVATIONS-SEALANT REPLACEMENT
A6.15	BUILDING ELEVATIONS-SEALANT REPLACEMENT
A6.20	NEW FINE ARTS & CTE ADDITION ELEVATIONS
A6.30	BUILDING SEALANT DETAILS
A7.01	BUILDING SECTIONS
A7.02	BUILDING SECTIONS
A8.01	WALL SECTIONS & DETAILS
A8.02	WALL SECTIONS & DETAILS
A8.03	WALL SECTIONS & DETAILS
A8.04	WALL SECTIONS & DETAILS
A9.01	PLAN DETAILS
A10.01	FINE ARTS ELEVATIONS
A10.02	FINE ARTS ELEVATIONS
A10.03	WELDING LAB ELEVATIONS
A10.04	CORRIDOR ELEVATIONS
A10.10	CASEWORK ELEVATIONS
A10.20	CASEWORK SECTIONS & DETAILS
A11.01	1ST FLOOR REFLECTED CEILING PLAN
A11.02	2ND FLOOR REFLECTED CEILING PLAN
A11.10G	REFLECTED CEILING PLAN - AREA 'G'
A12.00	FINISH LEGEND & ROOM SIGNAGE
A12.10	OVERALL FINISH PLANS
A12.10A	FINISH PLAN - AREA 'A'
A12.10G	FINISH PLAN - AREA 'G'
A12.10J	FINISH PLAN - AREA 'J'

MECHANICAL

M0.01	MECHANICAL DEMOLITION FLOOR PLAN - AREA A
M0.02	MECHANICAL DEMOLITION FLOOR PLAN - AREA B
M0.03	MECHANICAL DEMOLITION FLOOR PLAN - AREA C
M0.04	MECHANICAL DEMOLITION FLOOR PLAN - AREA D
M0.05	MECHANICAL DEMOLITION FLOOR PLAN - AREA E
M0.06	MECHANICAL DEMOLITION FLOOR PLAN - AREA F
M0.07	MECHANICAL DEMOLITION FLOOR PLAN - AREA G
M0.08	MECHANICAL DEMOLITION FLOOR PLAN - AREA H
M0.09	MECHANICAL DEMOLITION FLOOR PLAN - AREA I
M0.10	MECHANICAL DEMOLITION SECOND FLOOR PLAN - AREA C
M0.11	MECHANICAL DEMOLITION SECOND FLOOR PLAN - AREA D
M0.12	MECHANICAL DEMOLITION SECOND FLOOR PLAN - AREA E
M0.13	MECHANICAL DEMOLITION SECOND FLOOR PLAN - AREA H
M0.14	MECHANICAL DEMOLITION SECOND FLOOR PLAN - AREA I
M1.01	MECHANICAL SITE PLAN
M1.02	MECHANICAL SITE PLAN - ENLARGED VIEWS
M2.01	MECHANICAL FIRST FLOOR PLAN - AREA A
M2.02	MECHANICAL FIRST FLOOR PLAN - AREA B

M2.03	MECHANICAL FIRST FLOOR PLAN - AREA C
M2.04	MECHANICAL FIRST FLOOR PLAN - AREA D
M2.05	MECHANICAL FIRST FLOOR PLAN - AREA E
M2.06	MECHANICAL FIRST FLOOR PLAN - AREA F
M2.07	MECHANICAL FIRST FLOOR PLAN - AREA G
M2.08	MECHANICAL FIRST FLOOR PLAN - AREA H
M2.09	MECHANICAL FIRST FLOOR PLAN - AREA I
M2.10	MECHANICAL FIRST FLOOR PLAN - AREA J
M2.11	MECHANICAL FIRST FLOOR PLAN - AREA P
M2.12	MECHANICAL SECOND FLOOR PLAN - AREA A
M2.13	MECHANICAL SECOND FLOOR PLAN - AREA B
M2.14	MECHANICAL SECOND FLOOR PLAN - AREA C
M2.15	MECHANICAL SECOND FLOOR PLAN - AREA D
M2.16	MECHANICAL SECOND FLOOR PLAN - AREA E
M2.17	MECHANICAL SECOND FLOOR PLAN - AREA F
M2.18	MECHANICAL SECOND FLOOR PLAN - AREA G
M2.19	MECHANICAL SECOND FLOOR PLAN - AREA H
M2.20	MECHANICAL SECOND FLOOR PLAN - AREA I
M2.21	MECHANICAL SECOND FLOOR PLAN - AREA J
M3.01	MECHANICAL ENLARGED PLANS
M3.02	MECHANICAL ENLARGED PLANS
M4.01	MECHANICAL PIPING DIAGRAM
M5.01	MECHANICAL DETAILS
M6.01	MECHANICAL LEGENDS & SCHEDULES
M6.02	MECHANICAL LEGENDS & NOTES
M7.01	MECHANICAL CONTROLS FIRST FLOOR PLAN - AREA A & J
M7.02	MECHANICAL CONTROLS FIRST FLOOR PLAN - AREA B & C
M7.03	MECHANICAL CONTROLS FIRST FLOOR PLAN - AREA D & I
M7.04	MECHANICAL CONTROLS FIRST FLOOR PLAN - AREA E,F,G & H
M7.05	MECHANICAL CONTROLS FIRST FLOOR PLAN - AREA P
M7.06	MECHANICAL CONTROLS SECOND FLOOR PLAN - AREA A & J
M7.07	MECHANICAL CONTROLS SECOND FLOOR PLAN - AREA B & C
M7.08	MECHANICAL CONTROLS SECOND FLOOR PLAN - AREA D & I
M7.09	MECHANICAL CONTROLS SECOND FLOOR PLAN - AREA E,F,G & H
M7.10	MECHANICAL CONTROLS SECOND FLOOR PLAN - AREA P
M7.11	MECHANICAL CONTROLS SCHEDULES
M7.12	MECHANICAL CONTROLS SCHEDULES

ELECTRICAL

E0.01	ELECTRICAL DEMOLITION FIRST FLOOR PLAN - AREA F
E0.02	ELECTRICAL DEMOLITION FIRST FLOOR PLAN - AREA G
E1.01	ELECTRICAL SITE PLAN
E1.02	ELECTRICAL SITE PLAN - ENLARGED VIEWS
E2.01	ELECTRICAL LIGHTING FIRST FLOOR PLAN - AREA F
E2.02	ELECTRICAL LIGHTING FIRST FLOOR PLAN - AREA G
E2.03	ELECTRICAL LIGHTING FIRST FLOOR PLAN - AREA F
E3.01	ELECTRICAL POWER FIRST FLOOR PLAN - AREA A
E3.02	ELECTRICAL POWER FIRST FLOOR PLAN - AREA B
E3.03	ELECTRICAL POWER FIRST FLOOR PLAN - AREA C
E3.04	ELECTRICAL POWER FIRST FLOOR PLAN - AREA D
E3.05	ELECTRICAL POWER FIRST FLOOR PLAN - AREA E
E3.06	ELECTRICAL POWER FIRST FLOOR PLAN - AREA F
E3.07	ELECTRICAL POWER FIRST FLOOR PLAN - AREA G
E3.08	ELECTRICAL POWER FIRST FLOOR PLAN - AREA H
E3.09	ELECTRICAL POWER FIRST FLOOR PLAN - AREA I
E3.10	ELECTRICAL POWER FIRST FLOOR PLAN - AREA J

E3.11	ELECTRICAL POWER FIRST FLOOR PLAN - NATATORIUM
E3.12	ELECTRICAL POWER SECOND FLOOR PLAN - AREA C
E3.13	ELECTRICAL POWER SECOND FLOOR PLAN - AREA D
E3.14	ELECTRICAL POWER SECOND FLOOR PLAN - AREA E
E3.15	ELECTRICAL POWER SECOND FLOOR PLAN - AREA H
E3.16	ELECTRICAL POWER SECOND FLOOR PLAN - AREA I
E3.17	ELECTRICAL POWER SECOND FLOOR PLAN - AREA J
E4.01	PARTIAL ELECTRICAL DEMOLITION ONE-LINE DIAGRAM
E4.02	PARTIAL ELECTRICAL ONE-LINE DIAGRAM
E5.01	ELECTRICAL PANEL SCHEDULE
E5.02	ELECTRICAL PANEL SCHEDULE
E5.03	ELECTRICAL PANEL SCHEDULE
E5.04	ELECTRICAL PANEL SCHEDULE
E5.05	ELECTRICAL PANEL SCHEDULE
E5.06	ELECTRICAL PANEL SCHEDULE
E5.07	ELECTRICAL PANEL SCHEDULE
E6.01	ELECTRICAL DETAILS, LEGENDS, AND SCHEDULES
E6.02	ELECTRICAL LIGHTING CONTROLS DETAILS

PLUMBING

P0.01	PLUMBING DEMOLITION FIRST FLOOR PLAN - AREA F
P0.02	PLUMBING DEMOLITION FIRST FLOOR PLAN - AREA G
P1.00	PLUMBING COMPOSITE FLOOR PLANS
P1.01	PLUMBING COMPOSITE ROOF PLANS
P1.02	PLUMBING SITE PLAN
P2.06	PLUMBING UNDERFLOOR PLAN - AREA F
P2.07	PLUMBING UNDERFLOOR PLAN - AREA G
P3.06	PLUMBING FIRST FLOOR PLAN - AREA F
P3.07	PLUMBING FIRST FLOOR PLAN - AREA G
P4.01	PLUMBING ROOF PLAN
P4.02	PLUMBING ROOF PLAN - NATURAL GAS
P5.01	PLUMBING ENLARGED PLANS
P5.02	PLUMBING ENLARGED PLAN - GREENHOUSE
P6.01	PLUMBING DETAILS
P6.02	PLUMBING DETAILS
P7.01	PLUMBING SCHEDULES
P7.02	PLUMBING SCHEDULES

TECHNOLOGY

T0.00	TECHNOLOGY LEGENDS AND SCHEDULES
T0.01	TECHNOLOGY DEMOLITION FIRST FLOOR PLAN - AREA D
T0.02	TECHNOLOGY DEMOLITION FIRST FLOOR PLAN - AREA F
T0.10	TECHNOLOGY DEMOLITION COMPOSITE PLAN
T1.01	TECHNOLOGY SITE PLAN
T1.02	TECHNOLOGY COMPOSITE FLOOR PLANS
T2.01	TECHNOLOGY FIRST FLOOR PLAN - AREA A
T2.02	TECHNOLOGY FIRST FLOOR PLAN - AREA B & BB
T2.03	TECHNOLOGY FIRST FLOOR PLAN - AREA C
T2.04	TECHNOLOGY FIRST FLOOR PLAN - AREA D
T2.05	TECHNOLOGY FIRST FLOOR PLAN - AREA E
T2.06	TECHNOLOGY FIRST FLOOR PLAN - AREA F
T2.07	TECHNOLOGY FIRST FLOOR PLAN - AREA G
T2.08	TECHNOLOGY FIRST FLOOR PLAN - AREA H
T2.09	TECHNOLOGY FIRST FLOOR PLAN - AREA I
T2.10	TECHNOLOGY FIRST FLOOR PLAN - AREA J
T2.11	TECHNOLOGY FIRST FLOOR PLAN - AREA P

T3.01	TECHNOLOGY ENLARGED PLANS
T5.01	TECHNOLOGY DETAILS
T5.02	TECHNOLOGY DETAILS
T5.03	TECHNOLOGY DETAILS
T5.04	TECHNOLOGY DETAILS
T5.05	TECHNOLOGY DETAILS
T5.06	TECHNOLOGY DETAILS

AV / THEATRICAL

AV0.01	AV - GENERAL NOTES & LEGENDS
AV0.02	AV - SYSTEMS ASCHEDULES
AV2.10F	AV - 1ST FLOOR PLAN - AREA 'F'
AV2.10T	AV - 1ST FLOOR PLAN - BLACK BOX
AV3.00	AV - SECTIONS & ELEVATIONS - AUDITORIUM
AV3.01	AV - SECTIONS & ELEVATIONS - BLACK BOX
AV4.10F	AV - 1ST FLOOR REFLECTED CEILING PLAN - AREA 'F'
AV4.10T	AV - 1ST FLOOR REFLECTED CEILING PLAN - BLACK BOX
AV5.00	AV - CONNECTOR DETAILS
AV5.01	AV - STANDARD DETAILS
AV5.02	AV - STANDARD DETAILS
AV5.20	AV - PANEL DETAILS
AV5.40	AV - RACK DETAILS
AV5.41	AV - RACK DETAILS
AV7.30	AV - SCHEMATICS
AV7.31	AV - SCHEMATICS
AV7.32	AV - SCHEMATICS
AV7.33	AV - SCHEMATICS
AV7.34	AV - SCHEMATICS
AVD2.10F	AV DEMO - FLOOR PLAN AREA "F"
TE0.00	TE - NOTES AND LEGENDS
TE2.10G	TE - 1ST FLOOR PLAN - AREA G
TE3.00	TE - SECTIONS & ELEVATION
TE4.10G	TE - 1ST FLOOR REFLECTED CEILING PLAN - AREA G
TL0.00	TL - GENERAL NOTES & LEGENDS
TL0.01	TL - SCHEDULES
TL0.02	TL - SCHEDULES
TL2.10F	TL - 1ST FLOOR PLAN - AREA F
TL2.10G	TL - 1ST FLOOR PLAN - AREA G
TL3.00	TL - SECTIONS & ELEVATIONS
TL4.10G	TL - 1ST FLOOR REFLECTED CEILING PLAN - AREA G
TL7.00F	TL - SCHEMATIC - AREA F
TL7.00G	TL - SCHEMATIC - AREA G

END OF TABLE OF CONTENTS

DOCUMENT AA

REQUEST FOR COMPETITIVE SEALED PROPOSALS

Competitive Sealed Proposals for the work described 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, Cypress-Fairbanks 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: Cypress-Fairbanks Independent School District
11440 Matzke Rd.
Cypress, Texas 77429
Representative: Mr. Jesse Clayburn, Assistant Supt. of Facilities and Construction

ARCHITECT: NATEX Corporation Architects
447 Heights Blvd.
Houston, TX 77007
713-975-9525

PROJECT: **2024 Cy Lakes HS Renovation**
CFISD Proposal Number 24-02-5749R-RFP

LOCATION: 5750 Greenhouse Road
Katy, Texas 77449

PROPOSED CONSTRUCTION BUDGET: **\$17,150,000.00**

PRE-PROPOSAL CONFERENCE: **Wednesday, November 20, 2024, at 2:00PM** at Cypress-Fairbanks Independent School District, Facilities & Construction Conference Room, 11430-B Perry Road, Houston, Texas 77064. Representatives of the Architect and Owner will be present at this meeting. All offerors are encouraged to attend.

PROPOSAL DATE AND TIME: **Thursday, December 19, 2024** Base Proposal: 2:00 PM
Alternate Proposal: 3:00 PM

LOCATION OF PROPOSAL OPENING: Cypress-Fairbanks Independent School District
Facilities and Construction
11430-B Perry Road
Houston, Texas 77064
(281) 897-4108

Proposal Documents will be available on/after **Monday, November 18, 2024**. General Contractor Offerors may obtain two (2) sets of drawings and specifications at the place identified below upon deposit of **\$200.00** per set with check made payable to **NATEX Architects**. The deposit will be returned when the Plans and Specifications are returned in good condition. Additionally, General Contractor Offerors must submit of a fully executed AIA Document A305, Contractor's Qualification Statement to the office of the Architect at the time proposal documents are obtained.

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

ARC Document Solutions

McGraw-Hill Construction/ Dodge Data & Analytics
www.dodgeplans.construction.com or contact Toni.Lawson@construction.com Ph: (281) 460-5730

Office of **NATEX Architects**

FULL REFUND: Deposits will be returned provided all Contract Documents and addenda are returned to the Architect complete with all sheets bound in their original order within ten (10) days of the opening of proposals.

FORFEIT OF DEPOSIT: When the Documents are not returned under the conditions specified, none of the deposit will be returned. However, the Documents shall remain the property of the Owner and must be returned.

All proposals must be in the hands of the Owner no later than the time specified above. Please seal all proposals in duplicate in an envelope with the following information on the face of the envelope.

Name of Offeror (General Contractor)
2024 Cy Lakes HS Renovation
Cypress Fairbanks Independent School District
Cypress-Fairbanks I.S.D. Proposal Number: **24-02-5749-R-RFP**
_____(Name of Bonding Company)
Attn: Mr. Jesse Clayburn, Assistant Supt. of Facilities and Construction

The Owner reserves the right to reject any and all proposals and to waive any informality in the Competitive Sealed Proposal process. No proposal shall be withdrawn within sixty (60) days after the proposal opening without the specific consent of the Owner. Refer to Offerors Section Document AB.

SELECTION CRITERIA: Selection criteria are included in Document AB of the Project Manual and Selection Criteria and are available on request by perspective Offerors from the office of the Architect.

PROPOSAL BOND: A Proposal Bond from a bonding company acceptable to the Owner or a certified check in an amount equal to 10% of the greatest amount proposed must 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. Refer to Section AB, Instructions to Offerors for detailed Bond requirements.

The prevailing rates of wages as stipulated in the Supplementary Conditions here within are the minimums that must be paid in conformance with all applicable laws of the State of Texas.

All Offerors (General Contractors) submitting proposals are encouraged to attend the proposal opening and visit the Project site.

Subcontractors and Suppliers intending to submit proposals to General Construction Offerors are required to prepare their proposals based on a complete set of proposal documents. If after reviewing the complete set of proposal documents, Subcontractors and Supplier Offerors desire to purchase individual drawings and specification sections for their proposal convenience, they may do so by ordering the specific drawings and specifications directly from the reproduction company. Each offeror purchasing a partial set of proposal documents is responsible for determining exactly which documents he requires and is responsible for all costs associated with printing and delivery. Subcontractors and Suppliers exercising this option must agree to do so on the basis that 1) all documents shall be returned to the Architect, without refund, after submitting a proposal and 2) documents shall not be used on other construction projects. Successful Subcontractors and Supplier Offerors may retain their Proposal Documents until completion of the construction. The subcontractor/supplier is responsible for all the associated work and coordination when not obtaining a complete set of drawings.

END OF DOCUMENT

DOCUMENT AB

INSTRUCTIONS TO OFFERORS

1. QUALIFIED OFFERORS

- A. Proposals will be accepted from qualified General Contractors only for the entire scope of work described in the Contract Documents. As a prerequisite to a Contractor's qualifying for the award of contract on this work, the Contractor must complete each item of the Contractor Information and Experience Statement (AIA Document A305™). The Statement forms may be obtained from the office of the Houston Chapter of the American Institute of Architects (A.I.A.), 315 Capitol, Suite 120; Houston, TX 77002. The Statement and 3 references of similar projects with current/verified phone numbers, email address and current/verified fax numbers for references of Owner and Architect (refer to Exhibit A on page 9), shall be submitted to the Architect by **5:00P.M. CST on Monday, December 2, 2024**, in digital format emailed to carolina@natexarchitects.com. Due to large size of files emailed please ensure receipt of confirmation email from NATEX that information has been received.
- B. Every interested Offeror shall be required to submit AIA Document A305™ (Contractor's Information and Experience Statement) to Architect. AIA Documents submitted by fax transmission will not be accepted.
- C. The primary purposes of the evaluation process will be to:
 1. Gather information for the Owner's evaluation procedure.
 2. Enable the Architect to evaluate the Contractor's qualifications and determine which Contractors the Architect could recommend to the Owner should such recommendation be requested by the Owner.
- D. After completion of the Contractor evaluation process, the Architect will notify the Owner and each Contractor who has submitted a Contractor's Qualification Statement as to the Architect's opinion. In the event the Owner chooses to determine the acceptability of Contractors prior to receipt of Proposals, the Contractors will be notified of the Owner's decision prior to the proposal date, otherwise the Owner will make his decision after receipt of proposals.
- E. In arriving at his opinion concerning the Contractor's qualifications, the Architect will use the same criteria that the Owner will use in determination of the successful Contractor as detailed hereinafter.
- F. In the event an Offeror fails to submit the specified Contractor's Qualification Statement in accordance with the schedule established, such noncompliance shall be considered by both the Owner and Architect as a negative factor in the determination of the successful Offeror.
- G. In the event the Architect notifies a Contractor that it is the Architect's opinion the Contractor has not sufficiently demonstrated his qualifications to perform the subject Contract, taking into consideration the items listed under Paragraph 19.A and the Contractor subsequently decides to submit a Proposal, the Contractor shall be doing so with the knowledge that the Architect will not recommend him as a qualified Offeror.

2. OFFEROR'S PRESENTATION

Each Offeror by making their Proposal represents that:

- A. The Offeror has read and understands the Proposal Documents and their Proposal is made in accordance therewith.

- B. The Offeror has visited the site, has familiarized themselves with the local conditions under which the work is to be performed and has correlated their observations with the requirements of the proposed Contract Documents.
- C. The Offeror agrees to comply with the requirements of the following paragraph. These requirements are absolute, and any Offeror who subsequently does not agree to comply with these requirements will automatically disqualify himself from proposing or receiving award of the contract.
- D. The Offeror agrees that:
 - 1. Work on the project will begin immediately upon the General Contractor's receipt of CFISD's Notice to Proceed. The NTP will be accompanied by CFISD's purchase order.
 - 2. On-site mobilization will not begin until after the Bonds and Certificate of Insurance have been reviewed and approved by the Owner and that timely submittal of correct Bonds and Certificate of Insurance is solely the responsibility of Offeror.
 - 3. Offeror will participate as a team member in cooperation with the Owner and Architect.
 - 4. The Offeror will assign competent full-time superintendents and that these superintendents shall be maintained on the project for the duration of the project including completion of all punch list items, subject only to their continuous employment.
 - 5. The Offeror will furnish and pay for a proposal bond in the amount of ten percent (10%) of the greatest amount proposed.
 - 6. If awarded, the Offeror shall furnish and pay for a Performance Bond and a Payment Bond each in the full contract amount.
 - 7. Offeror and its subcontractors shall comply with requirements listed in Document BD, Insurance and Bonds Requirements for Contractors and Facility Renters.
 - 8. Each Offeror by making their Proposal represents that their Proposal includes only material and equipment specified in the Proposal Documents and supplemented, if necessary, for a complete and operating system.
 - 9. Each Offeror by making their Proposal represents that their Proposal includes the employment of Subcontractors that meet or exceed the Installer Qualifications described in the Project Manual.
 - 10. Each Offeror (and sub-Offeror or supplier submitting a proposal to an Offeror) shall submit an affidavit stating that no asbestos, PCBs or lead building materials will be incorporated into the Work.

3. PROPOSAL DOCUMENTS

- A. Proposal Documents include the Proposal Forms, Contract Forms, Specifications, Drawings, Addenda and documentation as noted in AIA Document A201TM-2017, as amended.

4. INTERPRETATION OF PROPOSAL DOCUMENTS

- A. Offerors and sub-Offerors requiring clarification or interpretation of the Proposal Documents shall make a written request using the form bound in the Project Manual, which shall reach the Architect at least ten (10) days prior to the date for receipt of proposals.
- 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.

5. 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 ten (10) 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. No substitutions will be considered after the Contract award.

6. ASBESTOS, LEAD AND PCB CONTAINING MATERIALS, PRODUCTS AND SYSTEMS

- A. The use of asbestos or PCB's in any construction process is strictly prohibited
- B. Prior to submitting a proposal, Offerors shall notify the Architect, in writing, of any materials, products and systems in these specifications which are known to contain or are likely to contain asbestos, lead or PCBs. The Architect will promptly explore possibilities for selecting other materials, products and systems which would circumvent the problem and notify Offerors of any changes in an addendum, otherwise it will be understood that only specified materials, products and systems that are asbestos, lead, and PCB free are included in the proposals.
- C. Prior to payment of Retainage and Final Payment, the Contractor and all subcontractors shall furnish a notarized statement certifying that no asbestos/PCB's, or asbestos/PCB-containing materials have been used in this Project.

7. INSURANCE

- A. Each Offeror shall include in his proposal the complete cost for insurance required under the Amended General Conditions, Supplementary Conditions and Specification Document BD, Insurance and Bond Requirements for Contractors and Facility Renters. Coverage shall remain in full force for the duration of the Project.

8. PERFORMANCE BOND AND PAYMENT BOND

- A. Each Offeror shall include in his base proposal, the premium costs for 100% Performance Bond and 100% Payment Bond. Bonds shall be written by a Surety Company included in the latest State Board of Insurance, Bond Department's "List of Insurance Companies Licensed to Write Fidelity and Surety Bonds in Texas, and the latest United States Department of the Treasury's Listing of Approved Sureties (Department Circular 570). The Owner reserves the right to make inquiries about the current financial stability of the Surety, including demands for proof of sound reinsurance, proof that claims are being met, and current financial information. The Owner reserves the right to reject Bonds written by a Surety that, in the Owner's judgment, does not provide proof of sound reinsurance and or does not provide proof that claims are being met.

9. 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 "No Change".
- C. Prior to the receipt of Proposals, Addenda will be transmitted to each person or firm recorded by the Architect as having received the proposal documents in accordance with the Request for Competitive Sealed Proposals, and will be available for inspection wherever the proposal documents are available for that purpose.
- D. Proposals must be submitted in duplicate and only on the Proposal Forms included in the Project Manual, in sealed envelopes addressed as follows:

Name of Offeror (General Contractor)
Competitive Sealed proposal for:
2024 Cy Lakes HS Renovations
Cypress-Fairbanks Independent School District
Cypress-Fairbanks ISD Proposal Number: **24-02-5749-R-RFP**

Name of Bonding Company
Attn: Mr. Jesse Clayburn, Assistant Supt. of Facilities and Construction
Facilities, Planning & Construction
11430-B Perry Road
Houston, Texas 77064

- E. All proposals must be delivered sealed to the above address stipulated in the Request for Competitive Sealed Proposals at or before the time and date set. Proposals will be received at no other place. If Proposal is sent by U.S. Mail, it must be sent Registered Mail.
- F. 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. Conditional proposals will not be accepted. Award may be made to other than the low-dollar Offeror and given to 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.
- G. A proposal may be withdrawn only upon request by the Offeror or his duly authorized representative, provided such written request is received by the Owner at the place designated for receipt of proposals and prior at least forty-eight (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 sixty (60) days.

10. SUBMISSION OF ADDITIONAL PROPOSAL INFORMATION

- A. The Offeror shall submit with his Alternate Proposals:
 - 01 Proposal Form AC Alternates
 - 02 An experience profile (resume) of the proposed superintendent(s) and project manager(s). These experience profiles will be considered by the Selection Committee in the evaluation of the Offeror's proposal.
 - 03 The firm names of the major subcontractors and/or suppliers requested on the Alternate Proposal Form AF.
 - 04 Signed and Notarized Special Owner Requirements Sections 01 35 23 and 01 35 23.1.
 - 05 An experience profile (resume) of the Offeror, including a list of projects completed of similar size and scope. These experience profiles will be considered by the Selection Committee in the evaluation of the Offeror's proposal.

11. FELONY CONVICTION NOTIFICATION

- A. Each Offeror shall execute and submit Form AE, Statement of Affirmation within the sealed envelope containing the Base Proposal.
- B. 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”.

12. PROPOSAL EVALUATION WAIVER

- A. Each Offeror shall execute and submit Form AG, Proposal Evaluation Waiver within the sealed envelope containing the Base Proposal.
- B. All Offerors shall agree to waive any claim it has or may have against the Owner, Architect, Engineers, Consultants and their respective employees, arising out of or in connection with the administration, evaluation, or recommendation of any proposal. The Offeror further agrees the Owner reserves the right to waive any requirements under the proposal documents or the Contract Documents, with regards to acceptance or rejection of any proposals, and recommendation or award of the contract.

13. AFFIDAVIT OF NON-DISCRIMINATORY EMPLOYMENT

- A. Each Offeror shall execute and submit Form AH, Affidavit of Non-Discriminatory Employment within the sealed envelope containing the Base Proposal.
- B. All Offerors, Contractor and subcontractors 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.

14. CONFLICT OF INTEREST QUESTIONNAIRE

- A. Each Offeror shall execute an on-line Conflict of Interest Questionnaire and submit Form AN within the sealed envelope containing the Base Proposal.

15. PROPOSAL SECURITY

- A. No proposal will be considered unless it is accompanied by a Certified or Cashier's Check or Proposal Bond executed on the form attached. In either case the amount shall be **not less than ten percent (10%) of the greatest amount proposed (considering alternates, if any)**. The proposal security shall insure the execution of the contract and the furnishing of acceptable Performance Bond, Payment Bond and Certificates of Insurance by the successful Offeror within ten (10) days after notification of award to such Offeror and that this proposal will not be withdrawn within sixty (60) days after date of opening of proposals without the consent of the Owner. Proposal Bond shall be submitted on AIA Document A310™-2010 or on Form AD included in the Project Manual.
- B. Proposal Security shall be submitted within the sealed envelope containing Alternate Proposals.

- C. Withdrawal of a proposal by an Offeror, or refusal to enter into negotiations and/or acceptance of a contract for construction by an Offeror after the opening of proposals and within and including the sixtieth day after proposals shall subject the Offeror to the forfeiture of his proposal security to the Owner.

16. SUBMISSION OF POST PROPOSAL INFORMATION

- A. Each Offeror shall submit, by **5:00P.M. on Friday, December 20, 2024**, following documentation to the office of the Architect. Information can also be sent via digital format by email to carolina@natexarchitects.com. Due to large size of files emailed please ensure receipt of confirmation email from NATEX that information has been received. The post proposal information submitted by the Offeror will be considered by the Selection Committee in the evaluation of the Offeror's proposal:
 - 1. A bar-chart construction schedule delineating construction phasing including major construction milestone dates.
 - 2. A statement describing the Offeror's proposed management concept for the Project.
 - 3. A statement of all Work to be self-performed by the Offeror.
 - 4. Complete and fully executed Contractor Qualification Statement Form, AIA Document A305, for each of the subcontractors named on the Offeror's Alternate Proposal Form. Qualification statements must include a listing of past projects performed by the subcontractor that are of similar size and scope to the Project. Past project information must include the names and telephone numbers of the respective Owner's and Architect's representatives for those projects.
 - 5. Any voluntary Value Engineering items that the proposer would believe to be of interest to the Owner. (This VE list will not be considered part of the evaluation process and is entirely voluntary.)
 - 6. As part of post proposal negotiations the Owner may desire to discuss a voluntary option that would establish the amount to be added to the owner's contingency allowance as an incentive amount offered by the general contractor and identified sub-contractors for early payments made by the owner to the general contractor on or before the 15th day of each month following the specified billing period. In addition, General Contractor agrees to maintain timely payments to subcontractors upon payment to the general contractor by the owner. This incentive is made to the owner as a lump sum for each trade contract participating, the proposed amount offered is for the duration of the contract and shall be allocated on a percentage complete of total contract value per month per contractor or subcontractor offering the incentive for early payment. The amount of the incentive each month shall be the proposed value by trade for the incentive multiplied by the percentage completed that month of that trade or generals total contract, if the owner makes payment to the general contractor on or before the 15th day of the month following the billing period then the incentive would be recognized as a credit to the owners contingency allowance, if the payment is not made on or before the 15th by the owner then the incentive credit to the Owner that month would not be applied.

A value for this incentive for the general contractor and the proposed list of subcontractors and values proposed for each that want to participate in this option will be submitted by the highest ranked proposer during post proposal negotiations.
- B. The selected Offeror shall execute From AL, Certification of Project Compliance, and submit at Project Closeout.
- C. The selected Offeror shall execute and submit Form AP, Certification of Criminal History Record Information within 10 days after receipt of Notice to Proceed and prior to commencement of Work.

17. 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, irregular, or not submitted by the published date and time as specified.

18. EVALUATION OF PROPOSALS

- A. The Owner may discuss proposals with Offerors after the proposal opening, to allow for clarification.
- B. The Owner shall endeavor to prevent non-monetary information from competing proposals being disclosed to other Offerors.
- C. The Owner will, within forty-five (45) days after the proposal opening, evaluate and rank each proposal submitted relative to the selection criteria.
- D. The Owner’s Selection Committee will select the Offeror that offers the best value based on the selection criteria and the Selection Committee’s ranking of the proposals.
- E. The Owner and Architect may discuss options with the selected Offeror for cost reduction and/or other Contract terms. If the Owner is unable to come to terms with the first ranked Offeror, discussions are to terminate and the Owner will proceed to the next ranked Offeror and repeat the process until a contract agreement is reached or all proposals are rejected.

19. DETERMINATION OF SUCCESSFUL RESPONDENT AND AWARD OF CONTRACT

- A. In determining the Selected Offeror, the Owner will evaluate the information derived from the Offeror's (Contractor’s) Qualification Statement, information received from completed Offeror’s reference surveys, direct experience with the Offeror by Selection Committee members, the Offeror’s proposal including information requested with the proposals and post proposal information submitted by the Offeror relative to the following Selection Criteria. A maximum of **one hundred twenty (120) points** may be scored to each proposal.

1.	Purchase Price – The purchase price will be scored mathematically as a weighted percentile score utilizing the proposal submitted and the weighted value of the criterion	40
2.	Reputation – Offeror and the Offeror’s goods and services for projects of similar size and scope	10
3.	Quality – Offeror and the Offeror’s goods and services for projects of similar size and scope	10
4.	Completion – Offerors past record of completing projects of similar size and scope on time and within budget	10
5.	Warranty – Offeror’s response to warranty work requests, the quality of the warranty work, and the Offeror’s record of monitoring and reporting back to the Owner on the progress of warranty work	10
6.	Close Out – Offeror’s record of closing out projects expeditiously	10
7.	Project Team – The qualifications of the Offeror’s proposed project manager(s) and project superintendent(s)	10
8.	Subcontractors – The qualifications of the Offeror’s proposed subcontractors	20
	Total:	120

The Selection Committee consisting of Cypress-Fairbanks ISD administrators, architects, consultants and other staff will make an initial evaluation of the proposals. Its recommendation will be considered by the Cypress-Fairbanks ISD Board of Trustees ("Board"). The District reserves the right to review the recommendation with the Asst. Supt. of Facilities & Construction, the Director of Construction Field Services, the Director of Design and Facilities Planning, and the Director of Project Management and others deemed appropriate by the District prior to review by the entire Board. The final decision-making authority on the proposals rests with the full Board. Decision-making authority has not been delegated to any person or entity other than the Board.

20. AWARD OF CONTRACT

- A. The Owner's Selection Committee's recommendation based on an evaluation and ranking of each proposal submitted in relation to the selection criteria will be presented to the Board of Trustees for approval and award of the contract for construction. Presentation of the Selection Committee's recommendation is anticipated to occur during the Board of Trustees' meeting on **January 16, 2025**.
- B. The Owner or the Architect, on behalf of the Owner, will issue a written Notice to Proceed after award of the contract for construction by the Board of Trustees.
- C. The selected Offeror shall submit to the Owner, for review and acceptance, a Performance Bond, a Payment Bond and Certificates of Insurance within ten (10) calendar days after receipt of a written Notice to Proceed.
- D. All Offerors shall hold pricing of all alternates open for consideration and acceptance by the District/Owner as noted on Alternates proposal form.

21. ON SITE MOBILIZATION

- A. The selected Offeror shall not commence on-site work under this Contract until he receives a written confirmation from the Owner approving the Performance Bond, Payment Bond and Certificates of Insurance. Timely submittal of correct Bonds and Certificate of Insurance is solely the responsibility of Offeror. Additional review time by the Owner due to Contractor's failure to do so will not constitute grounds for delay claims.

22. CONTRACT TIME AND LIQUIDATED DAMAGES

- A. Refer to the AIA Document A201™-2017, as Amended for Contract Time and Liquidated Damages provisions of the Contract.

23. AVAILABILITY OF MATERIALS AND SYSTEMS

- A. A serious effort has been made to select only materials that are asbestos free and 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 or if they contain asbestos, 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 asbestos free are included in the proposals.
- B. Decisions regarding allowance items will endeavor to be made in a timely manner to avoid construction delays.

EXHIBIT A
REFERENCE LISTING FOR Cy-Fair ISD
2024 Cy Lakes HS Renovations

OFFEROR NAME: _____

PROJECT No. 1	
Project Name: _____	Completion Date: _____
Contract Amount: \$ _____	Square Footage: _____
OWNER	ARCHITECT
Contact Name: _____	Contact Name: _____
Phone Number: _____	Phone Number: _____
or Email: _____	or Email: _____

PROJECT No. 2	
Project Name: _____	Completion Date: _____
Contract Amount: \$ _____	Square Footage: _____
OWNER	ARCHITECT
Contact Name: _____	Contact Name: _____
Phone Number: _____	Phone Number: _____
or Email: _____	or Email: _____

PROJECT No. 3	
Project Name: _____	Completion Date: _____
Contract Amount: \$ _____	Square Footage: _____
OWNER	ARCHITECT
Contact Name: _____	Contact Name: _____
Phone Number: _____	Phone Number: _____
or Email: _____	Or Email: _____

END OF SECTION

FORM AC
COMPETITIVE SEALED PROPOSAL FORM - BASE PROPOSAL

2024 Cy Lakes HS Renovation
Cypress-Fairbanks Independent School District
Cypress-Fairbanks I.S.D. Proposal Number: 24-02-5749-R-RFP
Attn: Mr. Jesse Clayburn, Asst. Superintendent of Facilities & Construction

Submitted by: _____

Date: _____ Phone No.: _____

To: Board of Trustees
Cypress-Fairbanks Independent School District
Facilities and Construction
11430-B Perry Road
Houston, Texas 77064

Having examined Proposal and Contract Documents prepared by **NATEX Architects** dated **November 17, 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. Hold Base Proposal open for acceptance sixty (60) days.
2. Accept right of Owner to reject any or all proposals, to waive formalities and to accept proposal which Owner considers most advantageous.
3. Enter into and execute the contract, if awarded, for the Base Proposal and accepted Alternate Proposals.
4. Complete work in accordance with the Contract Documents within the stipulated contract time.
5. 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

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

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

II. ALLOWANCES

Undersigned certifies that the allowances specified in Section 01 21 00 are included in the Base Proposal and agrees that unexpended balance of allowance sums will revert to Owner in the final settlement of the contract.

III. CONTRACT TIME

By submittal of this proposal, the undersigned stipulates that the Base Proposal includes all costs necessary to attain Substantial Completion of the Work on or before the date stipulated in AIA Document A101™-2017.

THIS PAGE OF PROPOSAL FORM MUST BE SUBMITTED BY 2:00 PM, DECEMBER 19, 2024
COMPETITIVE SEALED PROPOSAL FORM - BASE PROPOSAL

IV. ADDENDA

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

V. CHANGES IN THE WORK

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

VI. LIQUIDATED DAMAGES

By submittal of this proposal, the undersigned stipulates an agreement that if Substantial Completion of the Work is not attained on or before the date stipulated in AIA Document A101™-2017, the undersigned and his Surety shall be liable for and shall pay the Owner the sums stipulated as Liquidated Damages as defined in AIA Document A201™-2017.

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

Printed Name

Title

Name of Contracting Firm

Address

Telephone

Date

THIS PAGE OF PROPOSAL FORM MUST BE SUBMITTED BY 2:00 PM, DECEMBER 19, 2024
COMPETITIVE SEALED PROPOSAL FORM - BASE PROPOSAL

FORM AC
COMPETITIVE SEALED PROPOSAL FORM - ALTERNATE PROPOSALS

2024 Cy Lakes HS Renovation
Cypress-Fairbanks Independent School District
Cypress-Fairbanks I.S.D. Proposal Number: 24-02-5749-R-RFP
Attn: Mr. Jesse Clayburn, Asst. Superintendent of Facilities & Construction

Submitted by: _____

Date: _____ Phone No.: _____

To: Board of Trustees
Cypress-Fairbanks Independent School District
Facilities and Construction
11430-B Perry Road
Houston, Texas 77064

Having examined Proposal and Contract Documents prepared by **NATEX Architects** dated **November 17, 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. Hold Alternate Proposal open for acceptance one hundred twenty (120) days.
2. Accept right of Owner to reject any or all proposals, to waive formalities and to accept proposal which Owner considers most advantageous.
3. Enter into and execute the contract, if awarded, for the Base Proposal and accepted Alternate Proposals.
4. Complete work in accordance with the Contract Documents within the stipulated contract time.
5. 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. ALTERNATES

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

A. Alternate Number 1 – **Base Bid Adjustment**

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

B. Alternate Number 2 – **Fire Alarm Replacement**

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

C. Alternate Number 3 – **Chiller by Carrier**

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

THIS PAGE OF PROPOSAL FORM MUST BE SUBMITTED BY 3:00 PM, DECEMBER 19, 2024
COMPETITIVE SEALED PROPOSAL FORM - ALTERNATE PROPOSAL

D. Alternate Number 4 – *Chiller by Daikin*

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

E. Alternate Number 5 – *Chiller by Trane*

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

II. UNIT PRICES

If the Owner accepts any or all of the Alternates, the undersigned agrees to add or subtract the following units of work:

UNIT PRICE 1: ELECTRICAL DUPLEX RECEPTACLE

Provide unit price for a new 20A, 120V duplex electrical receptacle and cover plate, flush mounted in a CMU, metal stud, or demountable wall construction, circuited to an existing electrical panel within 150 feet of the outlet using a branch circuit consisting of 2 #10 AWG and 1 #10 AWG ground in 3/4 inch EMT conduit. All conduits to be concealed in wall construction. Unit price shall include a 20 amp circuit breaker to be installed in existing panel space. \$ _____/ea

UNIT PRICE 2: DATA DROP

Provide unit price for a data drop, flush mounted in a CMU, metal stud or demountable wall construction., wired to an IDF/MDF Room. The data drop shall consist of a single gang wall box, cabling wiring device, cover plate, 3/4 inch conduit from outlet to above accessible ceiling, plenum-rated cabling routed above accessible ceiling to the nearest MDF or IDF location within 250 feet of the outlet. Termination and testing to be included in the unit price. . \$ _____/ea

UNIT PRICE 3: 4” CONDUIT WITH PULL STRING

Provide unit price per LF, Schedule 40 conduit with pull string installed underground at a depth of five feet below finish floor elevation. \$ _____/LF

UNIT PRICE 4: DATA CABLING TO TEACHER STATION

Provide one data drop, including data jack, faceplate, and CAT 6 cable home run to nearest IDF or MDF data rack. Assume length less than 300 FT. Include J-box and conduit from data outlet to ceiling cavity in this unit price. . \$ _____/ea

UNIT PRICE 5: 4 ½” THICK CONCRETEWALK PER SQUARE FOOT

This unit cost shall establish the amount to the contract price for the Contractor to add or deduct 4 ½” thick concrete walk (minimum 100 SF) per Square Foot. \$ _____/SF

UNIT PRICE 6: 7” THICK CONCRETE DRIVE PER SQUARE FOOT

This unit cost shall establish the amount to the contract price for the Contractor to add or deduct 7” thick concrete drive (minimum 100 SF) per Square Foot. \$ _____/SF

UNIT PRICE 7: CHAIN LINK FENCE

This unit cost shall establish the amount to be added or deducted from the contract price for the Contractor to add/deduct chain link fence.

- | | |
|-----------------------------------|-----------------------|
| 1. 4-foot-high fence | \$ _____/ linear foot |
| 2. 4-foot-high x 3-foot-wide gate | \$ _____/ linear foot |
| 3. 4-foot-high x 6-foot-wide gate | \$ _____/ linear foot |
| 4. 6-foot-high fence | \$ _____/ linear foot |
| 5. 6-foot-high x 3-foot-wide gate | \$ _____/ linear foot |
| 6. 6-foot-high x 6-foot-wide gate | \$ _____/ linear foot |

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COMPETITIVE SEALED PROPOSAL FORM - ALTERNATE PROPOSAL

UNIT PRICE 8: LIFE SAFETY DEVICES (including all associated cabling and programming)

This unit cost shall establish the amount to be added or deducted from the contract price for the Contractor to add /deduct Fire Alarm devices.

- | | |
|-------------------------------------|-----------------|
| 1. Exterior Horn to Speaker | \$ _____ / each |
| 2. Interior Horn to Speaker | \$ _____ / each |
| 3. Interior Visual Strobe | \$ _____ / each |
| 4. Interior Speaker / Visual Strobe | \$ _____ / each |
| 5. Smoke Detector | \$ _____ / each |
| 6. Heat Detector | \$ _____ / each |
| 7. Manual Pull Station | \$ _____ / each |
| 8. Stopper 2 Pull Station Cover | \$ _____ / each |
| 9. Annunciator Panel | \$ _____ / each |
| 10. Duct Detector | \$ _____ / each |
| 11. Relay | \$ _____ / each |
| 12. Supervisory | \$ _____ / each |
| 13. Waterflow | \$ _____ / each |
| 14. Amplifier | \$ _____ / each |
| 15. Remote Power Supply | \$ _____ / each |

UNIT PRICE 9: 4" RESILIENT BASE 100 LINEAR FEET

This unit cost shall establish the amount to be added or deducted to the contract price for the Contractor to properly remove existing base and install 4" resilient base. \$ _____ /LF

UNIT PRICE 10: GRAPHIC SIGNS

This unit cost shall establish the amount to be added or deducted to the contract price for the Contractor to remove existing signage and install new as described below:

- | | |
|---------------------------------------|-----------------|
| 1. Sign Type A | \$ _____ / each |
| 2. Sign Type B | \$ _____ / each |
| 3. Sign Type C | \$ _____ / each |
| 4. Sign Type D | \$ _____ / each |
| 5. Sign Type E | \$ _____ / each |
| 6. Sign Type F | \$ _____ / each |
| 7. Max Occupancy Signage | \$ _____ / each |
| 8. FDC Connection Signage | \$ _____ / each |
| 9. Wayfinding Signage (2 lines text) | \$ _____ / each |
| 10. Wayfinding Signage (3 lines text) | \$ _____ / each |
| 11. Wayfinding Signage (4 lines text) | \$ _____ / each |

UNIT PRICE 11: PAINTING

This unit cost shall establish the amount to be added or deducted to the contract price for the Contractor to paint 100 square feet of wall (minimum 400 square feet of wall). \$ _____ /SF

UNIT PRICE 12: EXIT SIGN

This unit cost shall establish the amount to be added to the contract price to provide and install one (1) exit sign. Price shall include wiring to nearest available emergency circuit, up to 200 feet.

UNIT PRICE 13: ORNAMENTAL FENCE

This unit cost shall establish the amount to be added or deducted from the contract price for the Contractor to add/deduct ornamental fence.

- | | |
|-----------------------------------|------------------------|
| 1. 6 foot high fence | \$ _____ / linear foot |
| 2. 6 foot high x 4 foot wide gate | \$ _____ / per leaf |
| 3. 6 foot high x 6 foot wide gate | \$ _____ / per leaf |

THIS PAGE OF PROPOSAL FORM MUST BE SUBMITTED BY 3:00 PM, DECEMBER 19, 2024
COMPETITIVE SEALED PROPOSAL FORM - ALTERNATE PROPOSAL

UNIT PRICE 14: SECURITY FILM

This unit cost shall establish the amount to provide and install Security Film per specification 08 87 00 Security Glazing Film \$_____/square foot

III. CONTRACTOR'S PROJECT TEAM MEMBERS

The undersigned proposes the following project team members (include resumes):

Project Manager _____

Superintendent _____

Asst. Superintendent(s) _____

Project Engineer _____

THIS PAGE OF PROPOSAL FORM MUST BE SUBMITTED BY 3:00 PM, DECEMBER 19, 2024
COMPETITIVE SEALED PROPOSAL FORM - ALTERNATE PROPOSAL

III. PROPOSED SUBCONTRACTORS

The undersigned proposes the following subcontractors. Note – Not all trades listed below will apply to every project.

Paving: _____

Abatement: _____

Dampproofing/insulator: _____

Masonry: _____

Roofing: _____

Drywall: _____

Casework: _____

Concrete: _____

Plumbing: _____

Mechanical: _____

Electrical: _____

Fire Alarm: _____

Sprinkler: _____

Low Voltage/Security: _____

Site Utilities: _____

Earthwork/Site Prep: _____

Fencing: _____

Pre-Engineered Metal Building: _____

Glazing: _____

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COMPETITIVE SEALED PROPOSAL FORM - ALTERNATE PROPOSAL

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

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

Authorized Signature

Printed Name

Title

Name of Contracting Firm

Address

Telephone

Date

END OF FORM

THIS PAGE OF PROPOSAL FORM MUST BE SUBMITTED BY 3:00 PM, DECEMBER 19, 2024
COMPETITIVE SEALED PROPOSAL FORM - ALTERNATE PROPOSAL

FORM AD

PROPOSAL BOND

KNOW ALL MEN BY THESE PRESENTS, that we _____,
as Principal, and _____, as Surety, are held and firmly
bound unto the Cypress-Fairbanks Independent School District, Harris County, Texas, 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 _____, _____, being for the _____, Cypress-Fairbanks
I.S.D. Proposal Number **24-02-5749-R-RFP** for the Cypress-Fairbanks Independent School District, the kind and extent
of work involved being set forth in detail in the proposed Contract Documents cited herein.

NOW, THEREFORE, if the Principal shall not withdraw the accompanying proposal within 60 days after the date set
for opening thereof, and shall within ten (10) days after the prescribed forms are presented to him 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 such contract including payment of all persons supplying
labor or materials therefor, or in the event of the withdrawal of said proposal within the period specified, or the failure to
enter into such contract and give such 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 several seals this _____
day of _____, _____, 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: Signature and Printed Name

Business Address

Individual Principal: Signature and Printed Name

ATTEST:

Secretary President

BY: _____

Business Address

Corporate Surety

ATTEST: _____

BY: _____

END OF FORM

NOTE: THIS FORM MUST BE EXECUTED AND SUBMITTED WITH ALTERNATE PROPOSAL.

FORM AE

FELONY CONVICTION NOTIFICATION

Note: The Statement of Affirmation Must Be Notarized

STATEMENT OF AFFIRMATION

“The undersigned affirms that he/she is duly authorized to provide this information by the person(s) or business entity making the proposal, and the information provided below concerning felony convictions has been personally and thoroughly reviewed, and verified, and is, therefore, current, true and accurate to the best of my knowledge.”

Firm’s Name: _____ Address: _____

“a. ___ My firm is a publicly held corporation, therefore, this reporting requirement is not applicable.”

“b. ___ My firm is not owned nor operated by anyone who has been convicted of a felony.”

“c. ___ My firm is owned or operated by the following individual(s) who has/have been convicted of a felony:”

Name of Felon(s)

Details of Conviction(s)

PLEASE CHECK a, b, or c ABOVE AND SIGN BELOW

Offeror’s Printed

Name _____ Position/Title _____

Offeror’s

Signature _____ Date _____

Subscribed and sworn to me on this _____ day of _____, 20__.

Notary Public

My Commission expires _____

NOTE: THIS FORM MUST BE EXECUTED AND SUBMITTED WITH BASE PROPOSAL

END OF FORM

FORM AF

LIST OF SUBCONTRACTORS

PROJECT: **2024 Cy Lakes HS Renovation**
ARCHITECT: NATEX Architects

(Name, address) Cypress-Fairbanks Independent School District
Cy-Fair I.S.D. Proposal Number: **24-02-5749R-RFP**
Houston, Harris County, Texas

TO: (General Contractor)

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
-------------------	------	---------	-------	-----	--------	----------------

FORM AG

PROPOSAL EVALUATION WAIVER

By submitting a Proposal, the proposer indicated below agrees to waive any claim it has or may have against the Owner, Architect, Engineers, Consultants and their respective employees, arising out of or in connection with the administration, evaluation, or recommendation of any proposal. The proposer further agrees the Owner reserves the right to waive any requirements under the proposal documents or the Contract Documents, with regards to acceptance or rejection of any proposals, and recommendation or award of the contract.

NOTE: The Statement of Affirmation Must Be Notarized.

STATEMENT OF AFFIRMATION

“The undersigned affirms that he/she is duly authorized to execute this waiver by the person(s) or business entity making the proposal.”

Firm’s Name _____ Address: _____

Proposer’s Printed Name _____ Position/Title _____

Proposer’s Signature _____ Date _____

Subscribed and sworn to me on this _____ day of _____, _____.

Notary Public

My Commission expires _____

NOTE: THIS FORM MUST BE EXECUTED AND SUBMITTED WITH BASE PROPOSAL.

END OF FORM

FORM AH

AFFIDAVIT OF NON-DISCRIMINATORY EMPLOYMENT

STATE OF TEXAS)
)
COUNTY OF HARRIS)

AFFIDAVIT

This Company, Contractor, or Subcontractor agrees 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 pursuant thereto in order to maintain and insure non-discriminatory employment practices.

SIGNED: _____ DATE: _____

PRINTED NAME: _____

TITLE: _____

COMPANY: _____

The person signing above hereby certifies that he or she is fully authorized and empowered to execute this instrument and to bind the person or entity named hereto and does in fact so execute this instrument.

STATE OF TEXAS

COUNTY OF _____)

Subscribed and sworn before me on this _____ day of _____, _____.

Notary Public

My Commission expires _____

NOTE: THIS FORM MUST BE EXECUTED AND SUBMITTED WITH BASE PROPOSAL

END OF FORM

FORM AI

FORM 1: CONDITIONAL WAIVER FOR PROGRESS PAYMENT

CONDITIONAL WAIVER AND RELEASE ON PROGRESS PAYMENT

Cypress-Fairbanks Independent School District

2024 CY LAKES HS RENOVATION

Cypress-Fairbanks ISD Proposal Number: 24-02-5749R-RFP

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 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 lay 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 **Cypress-Fairbanks Independent School District** (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 paying 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)
_____ (Printed/Typed name)
_____ (Title)

SWORN AND SUBSCRIBED before me at _____, this ____ day of _____, 20__.

Notary Public in and for the state of _____.

FORM AI

FORM 2: UNCONDITIONAL WAIVER FOR PROGRESS PAYMENT

UNCONDITIONAL WAIVER AND RELEASE ON PROGRESS PAYMENT

Cypress-Fairbanks Independent School District

2024 CY LAKES HS RENOVATION

Cypress-Fairbanks ISD Proposal Number: 24-02-5749R-RFP

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

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 Cypress-Fairbanks Independent School District (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 statements(s) or progress payment request(s).

Date _____

_____ (Company name)

By _____ (Signature)

_____ (Printed/Typed name)

_____ (Title)

SWORN AND SUBSCRIBED before me at _____, this ____ day of _____, 20__.

_____ Notary Public in and for the state of _____.

FORM AI

FORM 3: CONDITIONAL WAIVER FOR FINAL PAYMENT

CONDITIONAL WAIVER AND RELEASE ON FINAL PAYMENT

Cypress-Fairbanks Independent School District

2024 CY LAKES HS RENOVATION

Cypress-Fairbanks ISD Proposal Number: 24-02-5749R-RFP

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 **Cypress-Fairbanks Independent School District** (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), inclusive of all modifications and changes therein.

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)

_____ (Printed/Typed name)

_____ (Title)

SWORN AND SUBSCRIBED before me at _____, this ____ day of _____, 20__.

_____ Notary Public in and for the state of _____.

FORM AI

FORM 4: UNCONDITIONAL WAIVER FOR FINAL PAYMENT

UNCONDITIONAL WAIVER AND RELEASE ON FINAL PAYMENT

Cypress-Fairbanks Independent School District

2024 CY LAKES HS RENOVATION

Cypress-Fairbanks ISD Proposal Number: 24-02-5749R-RFP

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

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 **Cypress-Fairbanks Independent School District** (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)

_____ (Printed/Typed name)

_____ (Title)

SWORN AND SUBSCRIBED before me at _____, this ____ day of _____, 20__.

_____ Notary Public in and for the state of _____.

FORM AJ
WARRANTY CERTIFICATE

PROJECT NAME: 2024 Cy Lakes HS Renovation
Cypress-Fairbanks I.S.D. Proposal Number: 24-02-5749R-RFP
Architect's Project Number: 24-05
Address: _____

OWNER NAME: *Cypress-Fairbanks Independent School District* **Phone No. (281) 897-4108**

_____ Warrants _____
(Name of Company) (Description of Work/Products/ Division Number)

_____ against defective materials, workmanship, machinery, hardware, and equipment. The above-mentioned company agrees to repair or replace such defective items at its own expense for a period of _____ year/s from the Date of Substantial Completion.

FIRM ISSUING WARRANTY: _____ **Phone No.** _____

Address: _____ **City** _____ **State** _____ **Zip** _____

IN WITNESS WHEREOF, the above bonded parties have executed this instrument under their several seals this _____ day of _____, _____, 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.

(Printed Name) (Signature) (Title)

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

Subscribed and sworn before me on this _____ day of _____, _____.

Notary Public

My Commission expires _____

FORM AK

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

Complete this form and return to the Architect upon close-out of the project.

PROJECT NAME: 2024 Cy Lakes HS Renovation

Cypress-Fairbanks I.S.D. Proposal Number: 24-02-5749R-RFP

Architect's Project Numbers: 24-05

OWNER NAME: Cypress-Fairbanks Independent School District

Phone No. (281) 897-4108

Address: 11440 Matzke Rd., Cypress, Texas 77429

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 bibs, as applicable to the project. Lead sheet flashing used in through roof plumbing penetration applications is the only permissible lead-containing material on the Project.

SIGNED: _____

DATE: _____

PRINTED NAME: _____

TITLE: _____

COMPANY: _____

The person signing above hereby certifies that he or she is fully authorized and empowered to execute this instrument and to bind the person or entity named hereto and does in fact so execute this instrument.

STATE OF TEXAS

COUNTY OF _____)

Subscribed and sworn before me on this _____ day of _____, _____.

Notary Public

My Commission expires _____

END OF FORM

CERTIFICATION OF PROJECT COMPLIANCE

Completion of this form is required under the provisions of §61.1036(c)(3)(F) TAC for all public school district construction projects. Instructions for completion of this form can be found on page 2.

1. PROJECT INFORMATION

DISTRICT: Cypress-Fairbanks I.S.D.

Facility: 2024 Cy Lakes HS Renovation

ARCHITECT/ENGINEER: Natex Corporation Architects

Address: 5750 Greenhouse

CONTRACTOR/CM: TBD

City: Katy, TX 77449

CONTRACT DATE: TBD

DATE DISTRICT AUTHORIZED PROJECT: 2019 Bond authorized 5/4/19, Phase 6 authorized 11/1/23

BRIEF DESCRIPTION OF PROJECT:

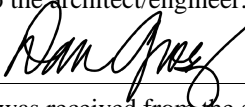
CFISD Project Number: 24-02-5749-R-RFP

Various renovations, program additions, mechanical/electrical/plumbing upgrades and security enhancements to an existing high school.

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 that the educational program and the educational specifications of this facility along with the identified building code to be used have been provided to the architect/engineer.

DISTRICT: Cypress-Fairbanks I.S.D. **BY:**  **DATE:** 2/29/2024

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 facility has been designed to meet or exceed the design criteria relating to space (minimum square footage), educational adequacy, and construction quality as contained in the School Facilities Standards as adopted by the Commissioner of Education, June 9, 2003, and as provided by the district.

ARCHITECT/ENGINEER: Arcadis **BY:** **DATE:**

5. The Contractor/CM certifies that this project has been constructed in general conformance with the construction documents as prepared by the architect/engineer listed above.

CONTRACTOR/CM: TBD **BY:** **DATE:**

6. The District certifies completion of the project (as defined by the architect/engineer and contractor).

DISTRICT: Cypress-Fairbanks I.S.D. **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 §61.1033 or §61.1036, 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.

FORM AM

REQUEST FOR CLARIFICATION DURING PROPOSAL PROCESS

All clarifications requested during the proposal process must be submitted in written form using the form provided. Fax form to the attention of Architect. All pertinent responses to clarification requests will be made by addenda to the Contract Documents.

PROJECT: _____

CONTRACTOR: _____

SUBMITTED BY: _____

PRINTED NAME: _____

TITLE: _____

TELEPHONE: _____

FAX: _____

EMAIL: _____

CLARIFICATION REQUESTED	ARCHITECT USE
-------------------------	------------------

END OF FORM

SECTION AN

Conflict of Interest Questionnaire

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 Cypress-Fairbanks Independent School District must file a completed Conflict of Interest Questionnaire with the Purchasing Department 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.

Each Proposer must complete the on-line version of the Conflict Of Interest Questionnaire at the following website:

<https://app.cfsd.net/ciq/index.aspx>

Full instructions for completing the Questionnaire are included at this website.

CERTIFICATION OF PROPOSER'S COMPLETION OF CONFLICT OF INTEREST QUESTIONNAIRE

The undersigned certifies that he has completed the Conflict of Interest Questionnaire per the above information.

Authorized Signature

Printed Name

Title

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

Name of Contracting Firm

Address

Telephone

Date

TO BE INITIALED BY ARCHITECT AND CONTRACTOR PRIOR TO OWNER'S FINAL CLOSEOUT REVIEW

PROJECT NAME:

NOTE: SUBMIT ALL DOCUMENTS RELATED TO SUBCONTRACTORS AND SUPPLIERS IN ALPHABETICAL ORDER BY NAME OF COMPANY UNLESS NOTED OTHERWISE

	<u>Contractor's</u> <u>Initials</u>	<u>Architect's</u> <u>Initials</u>	<u>CFISD PM</u> <u>Initials</u>
CFISD Close Out Log - with Subcontractors Filled Out	_____	_____	_____
List of Project Team	_____	_____	_____
List of Final Subcontractor/Suppliers/Local Representatives (Form AF)	_____	_____	_____
"Consent of Surety to Final Payment" AIA G707	_____	_____	_____
<input type="checkbox"/> 1. Check for Corporate Seal			
<input type="checkbox"/> 2. Check for Original Signature			
<input type="checkbox"/> 3. Check for Project Name			
"Contractor's Affidavit of Payment of Debts and Claims" AIA G706	_____	_____	_____
<input type="checkbox"/> 1. Check for Notary			
<input type="checkbox"/> 2. Check for Original Signature			
<input type="checkbox"/> 3. Check for Project Name			
"Contractor's Affidavit of Release of Liens" AIA G706A	_____	_____	_____
<input type="checkbox"/> 1. Check for Notary			
<input type="checkbox"/> 2. Check for Original Signature			
<input type="checkbox"/> 3. Check for Project Name			
Subcontractors' Waiver of Lien (Subcontractors/Major Suppliers) (Conditional or Unconditional) (Form AI)	_____	_____	_____
<input type="checkbox"/> 1. Check against Subcontractor List			
<input type="checkbox"/> 2. Check for Notary			
<input type="checkbox"/> 3. Check for Original Signature			
<input type="checkbox"/> 4. Check for Project Name			
"Certificate of Substantial Completion" AIA G704	_____	_____	_____
Allowances	_____	_____	_____
<input type="checkbox"/> 1. <i>CPR Execution Complete (Owner)</i>			
<input type="checkbox"/> 2. <i>Account Balance Review (Owner)</i>			
<input type="checkbox"/> 3. Executed Final Change Order			
Architect letter confirming all punch list items complete (Architect)	_____	_____	_____
<input type="checkbox"/> 1. Final Signed Off Punch list			
List of All Permits during Job and a Copy of All Permits	_____	_____	_____
Storm Water Quality Permit (As-Built Certificate)	_____	_____	_____
<input type="checkbox"/> 1. Check for Original Signature			
<input type="checkbox"/> 2. Check for Project Name			
<input type="checkbox"/> 3. Check for Permit Number			
<input type="checkbox"/> 4. Check for Engineer License Seal			

PROJECT CLOSE OUT – FORM AO

	<u>Contractor's</u> Initials	<u>Architect's</u> Initials	<u>CFISD PM</u> Initials
Utilities (Owner)	_____	_____	_____
<input type="checkbox"/> Invoice/Check for Electricity			
<input type="checkbox"/> Invoice/Check for Gas			
<input type="checkbox"/> Invoice/Check for Water/Sewer/Irrigation			
Contractor's Overtime	_____	_____	_____
<input type="checkbox"/> Invoices Sent to Contractor (Owner)			
<input type="checkbox"/> Payment Received by Contractor (Owner)			
Copy of Certificate of Compliance/Occupancy from local governmental Authorities	_____	_____	_____
Project Compliance Certificate (Owner Form AL)	_____	_____	_____
<input type="checkbox"/> 1. Check for Original Signature			
<input type="checkbox"/> 2. Check for Project Name			
Hazardous Material Certificate (Architect, General Contractor/Contractor, Subcontractors, and Material/Equipment Suppliers) Each shall be notarized. (Form AK)	_____	_____	_____
<input type="checkbox"/> 1. Check against Subcontractor List			
<input type="checkbox"/> 2. Check for Notary			
<input type="checkbox"/> 3. Check for Project Name			
<input type="checkbox"/> 4. Check for Original Signature			
Asbestos Manifest	_____	_____	_____
<input type="checkbox"/> Signed by all appropriate parties			
Report from Asbestos Consultant confirming abatement observations and air monitoring	_____	_____	_____
<input type="checkbox"/> 1. Asbestos Reports			
<input type="checkbox"/> 2. <i>Transmit Originals to Maintenance, Keep Copies for File. (Owner)</i>			
Letter from Building Envelope Consultant confirming all deficiency items complete	_____	_____	_____
Roofing Warranty & Documentation	_____	_____	_____
<input type="checkbox"/> <i>Send Copies to Director of Maintenance (Owner)</i>			
<input type="checkbox"/> Compliance letter on Roofing from Roofing Consultant			
<input type="checkbox"/> Roofing Manufacturer Letter confirming Warranty			
<input type="checkbox"/> Copy to Roof Warranty Binder (Owner)			
<input type="checkbox"/> Place Original in Roof Warranties Binder (Owner)			
TDLR Inspection	_____	_____	_____
<input type="checkbox"/> Inspection Report			
<input type="checkbox"/> Deficiencies documented and corrected (if applicable)			
<input type="checkbox"/> Approval letter from TDLR			
Letter from Test & Balance Consultant confirming all deficiency items complete	_____	_____	_____
Letter from Commissioning Consultant confirming all deficiency items complete	_____	_____	_____
Letter from Structural Engineer confirming conformance with design (provided by Architect)	_____	_____	_____
Letter from Civil Engineer confirming conformance with design (provided by Architect)	_____	_____	_____

PROJECT CLOSE OUT – FORM AO

	<u>Contractor's</u> Initials	<u>Architect's</u> Initials	<u>CFISD PM</u> Initials
Letter from Mechanical Engineer confirming conformance with design (provided by Architect)	_____	_____	_____
Letter from Materials Testing Consultant confirming all deficiency items complete	_____	_____	_____
Letter from Consultants confirming conformance with design if applicable (<i>Provided by Consultant, FDP, C-H, etc.</i>)	_____	_____	_____
Copy of all Gas Pipe Test Results Form	_____	_____	_____
Elevators	_____	_____	_____
<input type="checkbox"/> Maintenance Service Agreement			
<input type="checkbox"/> Send Copy to Maintenance (Owner)			
General Contractor's Written Guarantee (Form AJ)	_____	_____	_____
<input type="checkbox"/> 1. Check for Notary			
<input type="checkbox"/> 2. Check for Original Signature			
<input type="checkbox"/> 3. Check for Project Name			
Subcontractors' Written Guarantee (Form AJ)	_____	_____	_____
<input type="checkbox"/> 1. Check against Subcontractor List			
<input type="checkbox"/> 2. Check for Original Signature			
<input type="checkbox"/> 3. Check for Project Name			
<input type="checkbox"/> 4. Check for Notary			
<input type="checkbox"/> 5. State date to be date of Substantial Completion of final phase of project			
Extended Warranties & Maintenance List	_____	_____	_____
Insurance Certificate documenting continuing coverage after Final Payment (see AIA Document A201™-2017, as amended, Article 11.1.3)	_____	_____	_____
Workers' Compensation Certificates	_____	_____	_____
<input type="checkbox"/> General Contractor			
<input type="checkbox"/> <u>ALL</u> Subcontractors			
All Extra Stock Transmittals by Division	_____	_____	_____
<input type="checkbox"/> Divisions 0 – 21			
<input type="checkbox"/> Division 22 Plumbing			
<input type="checkbox"/> Division 23 HVAC			
<input type="checkbox"/> Division 26 Electrical			
<input type="checkbox"/> Division 27, 28 and beyond as applicable			
CFISD Master Keys Returned	_____	_____	_____
Paint Mix Cards	_____	_____	_____
List of Finishes used in Project	_____	_____	_____
Demonstration and Training Sign In Sheets by Division with Digital Video if applicable	_____	_____	_____

PROJECT CLOSE OUT – FORM AO

	<u>Architect's</u>	<u>CFISD PM</u>
Contractor's Initials	<u>Initials</u>	<u>Initials</u>

Maintenance/Operations Manuals (2 hard copies, 1 digital copy)
(Reviewed/Approved by Architect)

- Divisions 0 – 21
- Division 22 Plumbing
- Division 23 HVAC
- Division 26 Electrical
- Division 27, 28 and beyond as applicable

Record Drawings / As-Builts

- 1. Record CAD Files
- 2. Record PDF Files

The undersigned Contractor certifies that to the best of the Contractor’s knowledge, information and belief the close out documentation attached has been accurately completed in accordance with the Contract Documents, and requests permission to submit the FINAL Application and Certification for Payment AIA G702 Document for the outstanding retainage owed under the contract.

Contractor:

By: _____

Print Name: _____

In accordance with the Contract Documents, based on data comprising the attached, the Architect certifies to the Owner that to the best of the Architect’s knowledge, information and belief the Project Close Out Documents have been completed as indicated, the accuracy of the documents is in accordance with the Contract Documents.

Architect:

By: _____

Print Name: _____

CFISD Project Manager Signature: _____ Date: _____

CFISD Director of Project Management Signature: _____ Date: _____

CFISD Director of Contract Management Signature: _____ Date: _____

CFISD Assistant Superintendent Signature: _____ Date: _____

FORM AP – Contractor SB 9 Public Works Contractor Certification

Introduction: Texas Education Code Chapter 22 requires entities that contract with school district contractors to obtain criminal history record information regarding covered employees. Covered employees with disqualifying criminal histories are prohibited from serving at a school district. Contractors must certify to the District that they have complied.

The District may not obtain criminal histories for contractors: The law requires each contractor to obtain the criminal histories of its covered employees.

Definitions:

Covered employees: Employees of a contractor who have or will have continuing duties related to the service to be performed at the District and have or will have the opportunity for direct contact with students in connection with the person's continuing duties. The District will be the final arbiter of what constitutes *continuing duties* or *direct contact* with students. *Disqualifying criminal history:* (1) a conviction or other criminal history information designated by the District or (2) a conviction for one of the following offenses during the preceding 30 years, if at the time of the offense, the victim was under 18 or enrolled in a public school: (a) a felony offense under Title 5, Texas Penal Code; (b) an offense for which a defendant is required to register as a sex offender under Chapter 62, Texas Code of Criminal Procedure; (c) an equivalent offense under federal law or the laws of another state. Title 5 felony offenses include criminal homicide; kidnapping, unlawful restraint, and smuggling of persons; trafficking of persons; sexual offenses; and assaultive offenses.

On behalf of _____ ("Contractor"), I, the undersigned authorized signatory for Contractor, certify to Cypress-Fairbanks Independent School District ("District") and Contractor that [check one]:

None of Contractor's employees are *covered employees*, as defined above. If this box is checked, I further certify that Contractor has taken precautions or imposed conditions to ensure that its employees will not become *covered employees*. Contractor will maintain these precautions or conditions throughout the time the contracted services are provided.

Or

Some or all of Contractor's employees are *covered employees*. If this box is checked, I further certify that:

- 1) Contractor has obtained all required criminal history record information regarding its covered employees. None of the covered employees has a disqualifying criminal history.
- 2) If Contractor receives information that a covered employee subsequently has a reported criminal history, Contractor will immediately remove the covered employee from contract duties and notify the District in writing with 3 business days.
- 3) Upon request, Contractor will provide the District with the name and any other requested information of covered employees so that the District may obtain criminal history record information on the covered employees.

All company employees must have a CFISD badge prior to working on district property.

There is a processing fee of \$7 per badge requested, for which an invoice will be submitted. This fee is a processing fee per individual submitted on the Employee List Form and is charged regardless of whether the individual is approved to receive a badge.

If the District objects to the assignment of a covered employee based on the covered employee's criminal history record information, Contractor agrees to discontinue using that covered employee to provide services at the District.

I also certify to the District on behalf of Contractor that Contractor has obtained certifications from its subcontractors of compliance with Education Code, Chapter 22.

Noncompliance or misrepresentation regarding this certification may be grounds for contract termination.

Signature

Date

Title

Submit completed form to: Cypress-Fairbanks ISD, Facilities & Construction Office: contractor_badges@cfisd.net

Notes

Public works contractor employees must have opportunity for *direct contact with students* in order to be subject to a mandatory criminal history review. Tex. Educ. Code § .08341(b)(2). Direct contact with students is contact that results from activities that provide substantial opportunity for verbal or physical interaction with students and that is not supervised by a certified educator or other professional district employee.

For public works contractor employees, a person does not have the opportunity for direct contact with students if:

- the public work does not involve the construction, alteration, or repair of an instructional facility;
- if the public work involves construction of a *new* instructional facility, the person's duties related to the contracted services will be completed not later than the seventh day before the first date the facility will be used for instructional purposes; *or*
- if the public work involves an existing instructional facility:
 - the public work area contains sanitary facilities and is separated from all areas used by students by a secure barrier fence that is not less than six feet in height; *and*
 - the contractor adopts a policy prohibiting employees, including subcontractor employees, from interacting with students or entering areas used by students, informs employees of the policy, and enforces the policy at the public work area.

"Instructional facility" means real property, an improvement to real property, or a necessary fixture of an improvement to real property that is used predominantly for teaching the curriculum required under Texas Education Code section 28.002.

FORM AP - Subcontractor SB 9 Public Works Contractor Certification

Introduction: Texas Education Code Chapter 22 requires entities that contract with school district contractors to obtain criminal history record information regarding covered employees. Covered employees with disqualifying criminal histories are prohibited from serving at a school district. Subcontractors must certify to the District and to the contractor that they have complied.

The District may not obtain criminal histories for subcontractors: The law requires each subcontractor to obtain the criminal histories of its covered employees.

Definitions:

Covered employees: Employees of a subcontractor who have or will have continuing duties related to the service to be performed at the District and have or will have the opportunity for direct contact with students in connection with the person's continuing duties. The District will be the final arbiter of what constitutes *continuing duties* or *direct contact* with students. *Disqualifying criminal history:* (1) a conviction or other criminal history information designated by the District or (2) a conviction for one of the following offenses during the preceding 30 years, if at the time of the offense, the victim was under 18 or enrolled in a public school: (a) a felony offense under Title 5, Texas Penal Code; (b) an offense for which a defendant is required to register as a sex offender under Chapter 62, Texas Code of Criminal Procedure; (c) an equivalent offense under federal law or the laws of another state. Title 5 felony offenses include criminal homicide; kidnapping, unlawful restraint, and smuggling of persons; trafficking of persons; sexual offenses; and assaultive offenses.

Subcontractor has entered a contract with _____ ("Contractor") to provide services in connection with contract between Cypress-Fairbanks Independent School District ("District") and Contractor. On behalf of _____ ("Subcontractor"), I, the undersigned authorized signatory for Subcontractor, certify to the District and Contractor that [check one]:

None of Subcontractor's employees are *covered employees*, as defined above. If this box is checked, I further certify that Subcontractor has taken precautions or imposed conditions to ensure that its employees will not become *covered employees*. Subcontractor will maintain these precautions or conditions throughout the time the contracted services are provided.

Or

Some or all of Subcontractor's employees are *covered employees*. If this box is checked, I further certify that:

- 1) Subcontractor has obtained all required criminal history record information regarding its covered employees. None of the covered employees has a disqualifying criminal history.
- 2) If Subcontractor receives information that a covered employee subsequently has a reported criminal history, Subcontractor will immediately remove the covered employee from contract duties and notify the District in writing with 3 business days.
- 3) Upon request, Subcontractor will provide the District with the name and any other requested information of covered employees so that the District may obtain criminal history record information on the covered employees.

All company employees must have a CFISD badge prior to working on district property.

There is a processing fee of \$7 per badge requested, for which an invoice will be submitted. This fee is a processing fee per individual submitted on the Employee List Form and is charged regardless of whether the individual is approved to receive a badge.

If the District objects to the assignment of a covered employee based on the covered employee's criminal history record information, Subcontractor agrees to discontinue using that covered employee to provide services at the District.

I also certify to the District and Contractor on behalf of Subcontractor that Subcontractor has obtained certifications from its subcontractors of compliance with Education Code, Chapter 22.

Noncompliance or misrepresentation regarding this certification may be grounds for contract termination.

Signature

Date

Title

Submit completed form to: Cypress-Fairbanks ISD, Facilities & Construction Office: contractor_badges@cfisd.net

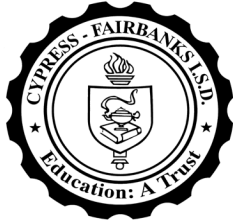
Notes

Public work subcontractor employees must have opportunity for *direct contact with students* in order to be subject to a mandatory criminal history review. Tex. Educ. Code § .08341(b)(2). Direct contact with students is contact that results from activities that provide substantial opportunity for verbal or physical interaction with students and that is not supervised by a certified educator or other professional district employee.

For public works subcontractor employees, a person does not have the opportunity for direct contact with students if:

- the public work does not involve the construction, alteration, or repair of an instructional facility;
- if the public work involves construction of a *new* instructional facility, the person's duties related to the contracted services will be completed not later than the seventh day before the first date the facility will be used for instructional purposes; *or*
- if the public work involves an existing instructional facility:
 - the public work area contains sanitary facilities and is separated from all areas used by students by a secure barrier fence that is not less than six feet in height; *and*
 - the contractor adopts a policy prohibiting employees, including subcontractor employees, from interacting with students or entering areas used by students, informs employees of the policy, and enforces the policy at the public work area.

"Instructional facility" means real property, an improvement to real property, or a necessary fixture of an improvement to real property that is used predominantly for teaching the curriculum required under Texas Education Code section 28.002.



Cypress-Fairbanks Independent School District

Employee List Form

FORM AP - CERTIFICATION OF CRIMINAL HISTORY RECORD INFORMATION
For Contractors, Sub-Contractors, Service Providers, & Vendors

Project Name: _____

Date: _____

Project Number: _____

CFISD Project Manager: _____

Company Name: _____

Mailing Address: _____

Phone: _____

PLEASE TYPE OR PRINT CLEARLY

Filled out by Service Provider					For CFISD Use	
Employee Name <i>(Last Name, First Name)</i>	Gender <i>(Male, Female)</i>	Birth Date <i>(Month, Day, Year)</i>	Race	U.S Government Issued Picture ID Number and Type	V-Soft Cleared <i>(Sign & Date)</i>	Badge Issued <i>(Sign & Date)</i>

FACILITIES PLANNING AND CONSTRUCTION

CERTIFICATE OF FINAL COMPLETION (AQ)

Project Name:	2024 Cy Lakes HS Renovation	Project No.:	24-02-5749R-RFP
Contractor:			
Contract No.:	24-05	Contract Date:	
Architect/Engineer:	NATEX Architects		
Date of Final Completion:		Time of Final Completion (include Time Zone CT):	

DATE OF FINAL COMPLETION

The work performed under this contract has been inspected and found to be complete. This constitutes the Owner's acceptance for final completion for the **ENTIRE** contract amount. The date of final completion of the project is hereby established as set forth above.

In accordance with the General Conditions and Supplementary Conditions of the contract, this is to confirm the results of the final completion inspection(s). The Contractor has completed the list of items identified on the pre-final and final punch list(s) that the inspection team required corrected or completed before final acceptance of the work in accordance with the contract. Work accepted with incomplete punch list items or failure of the Owner or other parties to identify work that does not comply with the contract documents or is defective in operation or workmanship does not constitute a waiver of the Owner's rights under the contract or relieve the Contractor of its responsibility for performance or warranties.

In accordance with the contract, the date of final completion is that date jointly certified by the Contractor, Architect/Engineer and Owner that the work is completed and the contract is fully satisfied according the contract documents. Completion of all work is a condition precedent to the Contractor's right to receive final payment.

The **CONTRACTOR** has completed/corrected the items identified on all referenced punch list(s) and the requirements of the contract are fully satisfied according to the contract documents.

_____	_____	_____
<i>Project Manager</i>	<i>(Print Name)</i>	<i>(Date)</i>

The **ARCHITECT** agrees that the work noted in this Certificate of Final Completion is completed in accordance with the contract documents.

_____	_____	_____
<i>Project Architect</i>	<i>(Print Name)</i>	<i>(Date)</i>

The **OWNER** accepts the work designated herein to be in accordance with the requirements for final completion, except as provided in the contract documents.

_____	_____	_____
<i>Project Manager</i>	<i>(Print Name)</i>	<i>(Date)</i>

_____	_____	_____
<i>Director of Construction Field Services</i>	<i>(Print Name)</i>	<i>(Date)</i>

_____	_____	_____
<i>Director of Project Management</i>	<i>(Print Name)</i>	<i>(Date)</i>

_____	_____	_____
<i>Director of Contract Management</i>	<i>(Print Name)</i>	<i>(Date)</i>

_____	_____	_____
<i>Assistant Supt. of Facilities & Construction</i>	<i>(Print Name)</i>	<i>(Date)</i>

_____	_____	_____
<i>Chief Operations Officer</i>	<i>(Print Name)</i>	<i>(Date)</i>

Associate Supt. of Facilities, Construction & Support Services

SECTION AR

DISCLOSURE OF INTERESTED PARTIES

Section 2252.908 of the Texas Government Code requires a business entity that enters into a contract with a school district must submit a disclosure of interested parties (Form 1295) to the school district and state agency and applies to contracts with a value of \$1,000,000.00 or greater and applies to all contracts entered into on or after January 01, 2016.

An example of the Form 1295 is included in this section; however the form shall be required to be filled out online, printed and signed, and submitted with the contract of which it is applicable.

Filing Process:

By January 01, 2016, the Texas Ethics Commission will make available on its website a new filing application that must be used to file Form 1295. A business entity must use the application to enter the required information on Form 1295 and print a copy of the form and a separate certification of filing that will contain a unique certification number. An authorized agent of the business entity must sign the printed copy of the form and have the form notarized. The completed Form 1295 and certification of filing must be filed with the governmental body or state agency with which the business entity is entering into the contract.

The governmental entity or state agency must notify the commission, using the commission's filing application, of the receipt of the filed Form 1295 and certification of filing not later than the 30th day after the date the contract binds all parties to the contract. The commission will post the completed Form 1295 to its website within seven business days after receiving notice from the governmental entity or state agency.

Information regarding how to use the filing application will be available on the Texas Ethics Commissions site by January 01, 2016 at www.ethics.state.tx.us.

CERTIFICATE OF INTERESTED PARTIES		FORM 1295	
Complete Nos. 1 - 4 and 6 if there are interested parties. Complete Nos. 1, 2, 3, 5, and 6 if there are no interested parties.		OFFICE USE ONLY	
1 Name of business entity filing form, and the city, state and country of the business entity's place of business.		Must file online at www.ethics.state.tx.us/File	
2 Name of governmental entity or state agency that is a party to the contract for which the form is being filed.			
3 Provide the identification number used by the governmental entity or state agency to track or identify the contract, and provide a description of the services, goods, or other property to be provided under the contract.			
4		Nature of Interest (check applicable)	
Name of Interested Party	City, State, Country (place of business)	Controlling	Intermediary
5 Check only if there is NO Interested Party. <input type="checkbox"/>			
6 UNSWORN DECLARATION My name is _____, and my date of birth is _____. My address _____ (street) _____ (city) _____ (state) _____ (zip code) _____ (country). I declare under penalty of perjury that the foregoing is true and correct. Executed in _____ County, State of _____, on the _____ day of _____, 20_____. (month) (year)			
_____ Signature of authorized agent of contracting business entity (Declarant)			
ADD ADDITIONAL PAGES AS NECESSARY			

DOCUMENT BA
CONTRACT DOCUMENTS

I. CONSTRUCTION CONTRACT AGREEMENT

- A. The contract for the construction of the project shall be executed by the successful Offeror on the AIA Document A101™-2017, as amended "Standard Form of Agreement between Owner and Contractor." A Notice to Proceed shall be issued 10 days following Board Award.
- B. A sample of this AIA Document A101™-2017, as amended is attached here within.

II. CONDITIONS OF THE CONTRACT

- A. General Conditions:
 - 1. The General Conditions of the Contract for Construction AIA Document A201™-2017, as supplemented and amended herein, constitutes the General Conditions and is hereby specifically made part of the Contract Documents.
- B. Supplementary Conditions:
 - 1. For modifications to the General Conditions of the Contract for Construction AIA Document A201™-2017, as amended refer to Section CB for the Supplementary Conditions.

END OF DOCUMENT



AIA® Document A201® – 2017

General Conditions of the Contract for Construction

for the following PROJECT:

(Name and location or address)

2024 CY LAKES HS RENOVATION
CFISD Project Number: 24-02-5749R-RFP
Architect Project No. 24-05

CAMPUS ADDRESS:

5750 Greenhouse Road
Katy, Texas 77449

THE OWNER:

(Name, legal status and address)

Cypress-Fairbanks Independent School District
11430-B Perry Road
Houston, Texas 77064
Telephone Number: 281-897-4108
Fax Number: 281-897-3806

THE ARCHITECT:

(Name, legal status and address)

NATEX Corporation Architects
447 Heights Blvd.
Houston, TX 77007
713-975-9525

ADDITIONS AND DELETIONS:

The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as 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 necessary information and 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™, Guide for Supplementary Conditions.

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

Init.

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User Notes:

- 11 INSURANCE AND BONDS
- 12 UNCOVERING AND CORRECTION OF WORK
- 13 MISCELLANEOUS PROVISIONS
- 14 TERMINATION OR SUSPENSION OF THE CONTRACT
- | 15 LABOR STANDARDS



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User Notes:

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, 13.4.2, 13.7, 14.1, 15.2

Addenda

1.1.1, 3.11.1

Additional Costs, Claims for

3.7.4, 3.7.5, 6.1.1, 7.3.7.5, 10.3, 15.1.4

Additional Inspections and Testing

9.4.2, 9.8.3, 12.2.1, **13.5**

Additional Insured

11.1.4

Additional Time, Claims for

3.2.4, 3.7.4, 3.7.5, 3.10.2, 8.3.2, **15.1.5**

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, 7.3.8

All-risk Insurance

11.3.1, 11.3.1.1

Applications for Payment

4.2.5, 7.3.9, 9.2, **9.3**, 9.4, 9.5.1, 9.6.3, 9.7, 9.10, 11.1.3

Approvals

2.1.1, 2.2.2, 2.4, 3.1.3, 3.10.2, 3.12.8, 3.12.9, 3.12.10,

4.2.7, 9.3.2, 13.5.1

Arbitration

8.3.1, 11.3.10, 13.1.1, 15.3.2, **15.4**

ARCHITECT

4

Architect, Definition of

4.1.1

Architect, Extent of Authority

2.4.1, 3.12.7, 4.1, 4.2, 5.2, 6.3, 7.1.2, 7.3.7, 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,
13.5.1, 13.5.2, 14.2.2, 14.2.4, 15.1.3, 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,
9.5.3, 9.6.4, 15.1.3, 15.2

Architect's Additional Services and Expenses

2.4.1, 11.3.1.1, 12.2.1, 13.5.2, 13.5.3, 14.2.4

Architect's Administration of the Contract

3.1.3, 4.2, 3.7.4, 15.2, 9.4.1, 9.5

Architect's Approvals

2.4.1, 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,
7.3.7, 7.3.9, 8.1.3, 8.3.1, 9.2, 9.4.1, 9.5, 9.8.4, 9.9.1,
13.5.2, 15.2, 15.3

Architect's Inspections

3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.8.3, 9.9.2, 9.10.1, 13.5

Architect's Instructions

3.2.4, 3.3.1, 4.2.6, 4.2.7, 13.5.2

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, 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, 4.1.3, 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, 11.3.7, 12, 13.4.2, 13.5, 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, 11.3.7

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, 13.5

Asbestos

10.3.1

Attorneys' Fees

3.18.1, 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, 5.2.1, 11.4.1

Binding Dispute Resolution

9.7, 11.3.9, 11.3.10, 13.1.1, 15.2.5, 15.2.6.1, 15.3.1,
15.3.2, 15.4.1

Boiler and Machinery Insurance

11.3.2

Bonds, Lien

7.3.7.4, 9.10.2, 9.10.3

Bonds, Performance, and Payment

(Paragraphs deleted)

7.3.7.4, 9.6.7, 9.10.3, 11.3.9, **11.4**

Building Permit

3.7.1

Init.

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User Notes:

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, 15.1.3

Certificates of Inspection, Testing or Approval

13.5.4

Certificates of Insurance

9.10.2, 11.1.3

Change Orders

1.1.1, 2.4.1, 3.4.2, 3.7.4, 3.8.2.3, 3.11.1, 3.12.8, 4.2.8,

5.2.3, 7.1.2, 7.1.3, 7.2, 7.3.2, 7.3.6, 7.3.9, 7.3.10, 8.3.1,

9.3.1.1, 9.10.3, 10.3.2, 11.3.1.2, 11.3.4, 11.3.9, 12.1.2,

15.1.3

Change Orders, Definition of

7.2.1

CHANGES IN THE WORK

2.2.1, 3.11, 4.2.8, 7, 7.2.1, 7.3.1, 7.4, 7.4.1, 8.3.1,

9.3.1.1, 11.3.9

Claims, Definition of

15.1.1

(Paragraphs deleted)

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, 3.7.4, 6.1.1, 7.3.9, 10.3.2, 15.1.4

Claims for Additional Time

3.2.4, 3.7.46.1.1, 8.3.2, 10.3.2, 15.1.5

Concealed or Unknown Conditions, Claims for

3.7.4

Claims for Damages

3.2.4, 3.18, 6.1.1, 8.3.3, 9.5.1, 9.6.7, 10.3.3, 11.1.1,

11.3.5, 11.3.7, 14.1.3, 14.2.4, 15.1.6

Claims Subject to Arbitration

15.3.1, 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, 11.3.1, 11.3.6, 11.4.1,

15.1.4

Commencement of the Work, Definition of

8.1.2

Communications Facilitating Contract

Administration

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, 13.7, 14.1.2

COMPLETION, PAYMENTS AND

9

Completion, Substantial

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,

13.7

Compliance with Laws

1.6.1, 3.2.3, 3.6, 3.7, 3.12.10, 3.13, 4.1.1, 9.6.4, 10.2.2,

11.1, 11.3, 13.1, 13.4, 13.5.1, 13.5.2, 13.6, 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, 3.7.4, 3.12.8, 3.14.2, 4.1.2, 9.3.2, 9.8.5, 9.9.1,

9.10.2, 9.10.3, 11.3.1, 13.2, 13.4.2, 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, 3.12.8, 4.2.8, 7.1.1, 7.1.2, 7.1.3, 7.3,

9.3.1.1

Construction Schedules, Contractor's

3.10, 3.12.1, 3.12.2, 6.1.3, 15.1.5.2

Contingent Assignment of Subcontracts

5.4, 14.2.2.2

Continuing Contract Performance

15.1.3

Contract, Definition of

1.1.2

CONTRACT, TERMINATION OR SUSPENSION OF THE

5.4.1.1, 11.3.9, 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, 11.1.3, 11.3.6, 11.4.1

Contract Documents, Copies Furnished and Use of

1.5.2, 2.2.5, 5.3

Contract Documents, Definition of

1.1.1

Contract Sum

3.7.4, 3.8, 5.2.3, 7.2, 7.3, 7.4, 9.1, 9.4.2, 9.5.1.4, 9.6.7,

9.7, 10.3.2, 11.3.1, 14.2.4, 14.3.2, 15.1.4, 15.2.5

Contract Sum, Definition of

9.1

Contract Time

3.7.4, 3.7.5, 3.10.2, 5.2.3, 7.2.1.3, 7.3.1, 7.3.5, 7.4,

8.1.1, 8.2.1, 8.3.1, 9.5.1, 9.7, 10.3.2, 12.1.1, 14.3.2,

15.1.5.1, 15.2.5

Contract Time, Definition of

8.1.1

CONTRACTOR

3

Init.

/

Contractor, Definition of
3.1, 6.1.2
Contractor's Construction Schedules
3.10, 3.12.1, 3.12.2, 6.1.3, 15.1.5.2
Contractor's Employees
3.3.2, 3.4.3, 3.8.1, 3.9, 3.18.2, 4.2.3, 4.2.6, 10.2, 10.3,
11.1.1, 11.3.7, 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, 11.3.7, 12.1.2, 12.2.4
Contractor's Relationship with Subcontractors
1.2.2, 3.3.2, 3.18.1, 3.18.2, 5, 9.6.2, 9.6.7, 9.10.2,
11.3.1.2, 11.3.7, 11.3.8
Contractor's Relationship with the Architect
1.1.2, 1.5, 3.1.3, 3.2.2, 3.2.3, 3.2.4, 3.3.1, 3.4.2, 3.5,
3.7.4, 3.10, 3.11, 3.12, 3.16, 3.18, 4.1.3, 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,
11.3.7, 12, 13.5, 15.1.2, 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, 5.3.1, 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
9.7
Contractor's Right to Terminate the Contract
14.1, 15.1.6
Contractor's Submittals
3.10, 3.11, 3.12.4, 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, 11.1.3, 11.4.2
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,
7.3.5, 7.3.7, 8.2, 10, 12, 14, 15.1.3
Contractual Liability Insurance
11.1.1.8, 11.2
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, 2.2.5, 3.11
Copyrights
1.5, **3.17**
Correction of Work
2.3, 2.4, 3.7.3, 9.4.2, 9.8.2, 9.8.3, 9.9.1, 12.1.2, **12.2**
Correlation and Intent of the Contract Documents
1.2
Cost, Definition of
7.3.7

Costs
2.4.1, 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, 7.3.7, 7.3.8, 7.3.9, 9.10.2, 10.3.2, 10.3.6, 11.3,
12.1.2, 12.2.1, 12.2.4, 13.5, 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, 11.1.1, 11.3,
12.2.4
Damage to the Work
3.14.2, 9.9.1, 10.2.1.2, 10.2.5, 10.4.1, 11.3.1, 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, 11.1.1,
11.3.5, 11.3.7, 14.1.3, 14.2.4, 15.1.6
Damages for Delay
6.1.1, 8.3.3, 9.5.1.6, 9.7, 10.3.2
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, 15.2, 6.3,
7.3.7, 7.3.9, 8.1.3, 8.3.1, 9.2, 9.4, 9.5.1, 9.8.4, 9.9.1,
13.5.2, 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
2.3.1, 2.4.1, 3.5, 4.2.6, 6.2.5, 9.5.1, 9.5.2, 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,
15.1.1, 5.1, 6.1.2, 7.2.1, 7.3.1, 8.1, 9.1, 9.8.1
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, 10.4.1, 14.3.2, 15.1.5, 15.2.5
(Paragraphs deleted)
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, 11.1.2
Emergencies
10.4, 14.1.1.2, 15.1.4
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, 11.1.1, 11.3.7, 14.1, 14.2.1.1

Equipment, Labor, Materials or
 1.1.3, 1.1.6, 3.4, 3.5, 3.8.2, 3.8.3, 3.12, 3.13.1, 3.15.1,
 4.2.6, 4.2.7, 5.2.1, 6.2.1, 7.3.7, 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, 2.2.3, 2.2.5, 3.1, 3.3.1, 3.4.1, 3.5,
 3.7.1, 3.10.1, 3.12, 3.14, 4.2, 6.2.2, 7.1.3, 7.3.5, 8.2,
 9.5.1, 9.9.1, 10.2, 10.3, 12.2, 14.2, 14.3.1, 15.1.3
 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,
 10.4.1, 14.3, 15.1.5, 15.2.5
Failure of Payment
 9.5.1.3, 9.7, 9.10.2, 13.6, 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, 11.1.2, 11.1.3, 11.3.1, 11.3.5,
 12.3.1, 14.2.4, 14.4.3
 Financial Arrangements, Owner's
 2.2.1, 13.2.2, 14.1.1.4
 Fire and Extended Coverage Insurance
 11.3.1.1
GENERAL PROVISIONS
1
Governing Law
13.1
 Guarantees (See Warranty)
Hazardous Materials
 10.2.4, 10.3
 Identification of Subcontractors and Suppliers
 5.2.1
Indemnification
 3.17, 3.18, 9.10.2, 10.3.3, 10.3.5, 10.3.6, 11.3.1.2,
 11.3.7
Information and Services Required of the Owner
 2.1.2, 2.2, 3.2.2, 3.12.4, 3.12.10, 6.1.3, 6.1.4, 6.2.5,
 9.6.1, 9.6.4, 9.9.2, 9.10.3, 10.3.3, 11.2, 11.4, 13.5.1,
 13.5.2, 14.1.1.4, 14.1.4, 15.1.3
Initial Decision
15.2
Initial Decision Maker, Definition of
 1.1.8
 Initial Decision Maker, Decisions
 14.2.2, 14.2.4, 15.2.1, 15.2.2, 15.2.3, 15.2.4, 15.2.5
 Initial Decision Maker, Extent of Authority
 14.2.2, 14.2.4, 15.1.3, 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, 10.4.1
 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, 13.5
 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, 13.5.2

Instruments of Service, Definition of
1.1.7
 Insurance
 3.18.1, 6.1.1, 7.3.7, 9.3.2, 9.8.4, 9.9.1, 9.10.2, 11
Insurance, Boiler and Machinery
11.3.2
Insurance, Contractor's Liability
11.1
 Insurance, Effective Date of
 8.2.2, 11.1.2
Insurance, Loss of Use
11.3.3
Insurance, Owner's Liability
11.2
Insurance, Property
 10.2.5, 11.3
 Insurance, Stored Materials
 9.3.2
INSURANCE AND BONDS
11
 Insurance Companies, Consent to Partial Occupancy
 9.9.1
(Paragraph deleted)
 Intent of the Contract Documents
 1.2.1, 4.2.7, 4.2.12, 4.2.13, 7.4
Interest
13.6
Interpretation
 1.2.3, 1.4, 4.1.1, 5.1, 6.1.2, 15.1.1
 Interpretations, Written
 4.2.11, 4.2.12, 15.1.4
 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,
 4.2.6, 4.2.7, 5.2.1, 6.2.1, 7.3.7, 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, 3.2.3, 3.6, 3.7, 3.12.10, 3.13.1, 4.1.1, 9.6.4, 9.9.1,
 10.2.2, 11.1.1, 11.3, 13.1.1, 13.4, 13.5.1, 13.5.2,
 13.6.1, 14, 15.2.8, 15.4
 Liens
 2.1.2, 9.3.3, 9.10.2, 9.10.4, 15.2.8
 Limitations, Statutes of
 12.2.5, 13.7, 15.4.1.1
 Limitations of Liability
 2.3.1, 3.2.2, 3.5, 3.12.10, 3.17, 3.18.1, 4.2.6, 4.2.7,
 4.2.12, 6.2.2, 9.4.2, 9.6.4, 9.6.7, 10.2.5, 10.3.3, 11.1.2,
 11.2, 11.3.7, 12.2.5, 13.4.2
 Limitations of Time
 2.1.2, 2.2, 2.4, 3.2.2, 3.10, 3.11, 3.12.5, 3.15.1, 4.2.7,
 5.2, 5.3.1, 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, 11.1.3, 11.3.1.5,
 11.3.6, 11.3.10, 12.2, 13.5, 13.7, 14, 15

Loss of Use Insurance

11.3.3

Material Suppliers

1.5, 3.12.1, 4.2.4, 4.2.6, 5.2.1, 9.3, 9.4.2, 9.6, 9.10.5

Materials, Hazardous

10.2.4, 10.3

Materials, Labor, Equipment and

1.1.3, 1.1.6, 1.5.1, 3.4.1, 3.5, 3.8.2, 3.8.3, 3.12, 3.13.1, 3.15.1, 4.2.6, 4.2.7, 5.2.1, 6.2.1, 7.3.7, 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, 15.2.8

Mediation

8.3.1, 10.3.5, 10.3.6, 15.2.1, 15.2.5, 15.2.6, **15.3**, 15.4.1

Minor Changes in the Work

1.1.1, 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, 3.11, 4.1.2, 4.2.1, 5.2.3, 7, 8.3.1, 9.7, 10.3.2, 11.3.1

Mutual Responsibility

6.2

Nonconforming Work, Acceptance of

9.6.6, 9.9.3, **12.3**

Nonconforming Work, Rejection and Correction of

2.3.1, 2.4.1, 3.5, 4.2.6, 6.2.4, 9.5.1, 9.8.2, 9.9.3, 9.10.4, 12.2.1

Notice

2.2.1, 2.3.1, 2.4.1, 3.2.4, 3.3.1, 3.7.2, 3.12.9, 5.2.1, 9.7, 9.10, 10.2.2, 11.1.3, 12.2.2.1, 13.3, 13.5.1, 13.5.2, 14.1, 14.2, 15.2.8, 15.4.1

Notice, Written

2.3.1, 2.4.1, 3.3.1, 3.9.2, 3.12.9, 3.12.10, 5.2.1, 9.7, 9.10, 10.2.2, 10.3, 11.1.3, 11.3.6, 12.2.2.1, **13.3**, 14, 15.2.8, 15.4.1

Notice of Claims

3.7.4, 10.2.8, **15.1.2**, 15.4

Notice of Testing and Inspections

13.5.1, 13.5.2

Observations, Contractor's

3.2, 3.7.4

Occupancy

2.2.2, 9.6.6, 9.8, 11.3.1.5

Orders, Written

1.1.1, 2.3, 3.9.2, 7, 8.2.2, 11.3.9, 12.1, 12.2.2.1, 13.5.2, 14.3.1

OWNER

2

Owner, Definition of

2.1.1

(Paragraph deleted)

Owner, Information and Services Required of the

2.1.2, **2.2**, 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, 11.3, 13.5.1, 13.5.2, 14.1.1.4, 14.1.4, 15.1.3

Owner's Authority

1.5, 2.1.1, 2.3.1, 2.4.1, 3.4.2, 3.8.1, 3.12.10, 3.14.2, 4.1.2, 4.1.3, 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, 9.3.1, 9.3.2, 9.5.1, 9.6.4, 9.9.1, 9.10.2, 10.3.2, 11.1.3, 11.3.3, 11.3.10, 12.2.2, 12.3.1, 13.2.2, 14.3, 14.4, 15.2.7

Owner's Financial Capability

2.2.1, 13.2.2, 14.1.1.4

Owner's Liability 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

2.4, 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

2.3

Owner's Right to Suspend the Work

14.3

Owner's Right to Terminate the Contract

14.2

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

1.1.1, 1.1.6, 1.1.7, **1.5**, 2.2.5, 3.2.2, 3.11.1, 3.17, 4.2.12, 5.3.1

Partial Occupancy or Use

9.6.6, **9.9**, 11.3.1.5

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, 13.7, 14.1.1.3, 14.2.4

Payment, Failure of

9.5.1.3, **9.7**, 9.10.2, 13.6, 14.1.1.3, 14.2.1.2

Payment, Final

4.2.1, 4.2.9, 9.8.2, 9.10, 11.1.2, 11.1.3, 11.4.1, 12.3.1, 13.7, 14.2.4, 14.4.3

Payment Bond, Performance Bond and

7.3.7.4, 9.6.7, 9.10.3, **11.4**

Payments, Progress

9.3, **9.6**, 9.8.5, 9.10.3, 13.6, 14.2.3, 15.1.3

PAYMENTS AND COMPLETION

9

Init.

/

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
 7.3.7.4, 9.6.7, 9.10.3, 11.4
Permits, Fees, Notices and Compliance with Laws
 2.2.2, 3.7, 3.13, 7.3.7.4, 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, 15.1.3
Progress Payments
 9.3, 9.6, 9.8.5, 9.10.3, 13.6, 14.2.3, 15.1.3
Project, Definition of
1.1.4
 Project Representatives
 4.2.10
Property Insurance
 10.2.5, 11.3
(Paragraphs deleted)
PROTECTION OF PERSONS AND PROPERTY
10
 Regulations and Laws
 1.5, 3.2.3, 3.6, 3.7, 3.12.10, 3.13, 4.1.1, 9.6.4, 9.9.1,
 10.2.2, 11.1, 11.4, 13.1, 13.4, 13.5.1, 13.5.2, 13.6, 14,
 15.2.8, 15.4
 Rejection of Work
 3.5, 4.2.6, 12.2.1
 Releases and Waivers of Liens
 9.10.2
 Representations
 3.2.1, 3.5, 3.12.6, 6.2.2, 8.2.1, 9.3.3, 9.4.2, 9.5.1, 9.8.2,
 9.10.1
 Representatives
 2.1.1, 3.1.1, 3.9, 4.1.1, 4.2.1, 4.2.2, 4.2.10, 5.1.1, 5.1.2,
 13.2.1
 Responsibility for Those Performing the Work
 3.3.2, 3.18, 4.2.3, 5.3.1, 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, 2.3, 2.4, 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, 12.2.2, 12.2.4,
13.4, 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, 5.3.1, 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, 15.1.5.2
 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
(Paragraph deleted)
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, 9.4.2, 9.10.1, 13.5
 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, 13.5
 Special Inspections and Testing
 4.2.6, 12.2.1, 13.5
Specifications, Definition of
1.1.6
Specifications
 1.1.1, 1.1.6, 1.2.2, 1.5, 3.11, 3.12.10, 3.17, 4.2.14
 Statute of Limitations
 13.7, 15.4.1.1
 Stopping the Work
 2.3, 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, 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, 7.3.7, 9.2, 9.3, 9.8, 9.9.1, 9.10.2, 9.10.3, 11.1.3

Submittal Schedule
3.10.2, 3.12.5, 4.2.7

Subrogation, Waivers of
6.1.1, **11.3.7**
(Paragraphs deleted)

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, 13.7

Substantial Completion, Definition of
9.8.1

Substitution of Subcontractors
5.2.3, 5.2.4

Substitution of Architect
4.1.3

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, 7.3.7, 8.2, 8.3.1, 9.4.2, 10, 12, 14, 15.1.3
(Paragraph deleted)

Surety
5.4.1.2, 9.8.5, 9.10.2, 9.10.3, 14.2.2, 15.2.7

Surety, Consent of
9.10.2, 9.10.3

Surveys
2.2.3

Suspension by the Owner for Convenience
14.3

Suspension of the Work
5.4.2, 14.3

Suspension or Termination of the Contract
5.4.1.1, 14

Taxes
3.6, 3.8.2.1, 7.3.7.4

Termination by the Contractor
14.1, 15.1.6

Termination by the Owner for Cause
5.4.1.1, **14.2**, 15.1.6

Termination by the Owner for Convenience
14.4

Termination of the Architect
4.1.3

Termination of the Contractor
14.2.2

TERMINATION OR SUSPENSION OF THE CONTRACT

14

Tests and Inspections

3.1.3, 3.3.3, 4.2.2, 4.2.6, 4.2.9, 9.4.2, 9.8.3, 9.9.2, 9.10.1, 10.3.2, 11.4.1.1, 12.2.1, **13.5**

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, 10.4.1, 14.3.2, 15.1.5, 15.2.5

Time Limits

2.1.2, 2.2, 2.4, 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, 11.1.3, 12.2, 13.5, 13.7, 14, 15.1.2, 15.4

Time Limits on Claims

3.7.4, 10.2.8, **13.7**, 15.1.2

Title to Work

9.3.2, 9.3.3

Transmission of Data in Digital Form

1.6

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, 7.3.4

Use of Documents

1.1.1, 1.5, 2.2.5, 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

13.4.2

Waiver of Claims by the Contractor

9.10.5, 13.4.2, 15.1.6

Waiver of Claims by the Owner

9.9.3, 9.10.3, 9.10.4, 12.2.2.1, 13.4.2, 14.2.4, 15.1.6

Waiver of Consequential Damages

14.2.4, 15.1.6

Waiver of Liens

9.10.2, 9.10.4

Waivers of Subrogation

6.1.1, **11.3.7**

Warranty

3.5, 4.2.9, 9.3.3, 9.8.4, 9.9.1, 9.10.4, 12.2.2, 13.7.1

Weather Delays

15.1.5.2

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, 9.8.5,

9.9.1, 9.10.2, 9.10.3, 11.4.1, 13.2, 13.4.2, 15.4.4.2

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User Notes:

Written Interpretations

4.2.11, 4.2.12

Written Notice

2.3, 2.4, 3.3.1, 3.9, 3.12.9, 3.12.10, 5.2.1, 8.2.2, 9.7,
9.10, 10.2.2, 10.3, 11.1.3, 12.2.2, 12.2.4, **13.3**, 14,
15.4.1

Written Orders

1.1.1, 2.3, 3.9, 7, 8.2.2, 12.1, 12.2, 13.5.2, 14.3.1,
15.1.2



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 as amended (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract, as amended (General, Supplementary and other Conditions), Performance Bond, Labor and Materials Payment Bond and Proof of Insurance, Contractor's Proposal, Drawings, Specifications, all Addenda issued prior to execution of 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 a Change Proposal Request, or (4) a written order for a minor change in the Work issued by the Architect.

§ 1.1.2 The Contract

The Contract Documents form the Contract for Construction. This agreement, as amended, represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Construction Documents become part of the Contract when accepted by the Owner. All sections of the Project Manual shall be a part of the Contract, including any Proposal signed by the Contractor, and any Request for Proposals for the Project ("RFP"). The Contract may be amended or modified only by a written Modification signed by the Owner. 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 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.

It also includes all supplies, skill, supervision, transportation services, storage requirements 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.

§ 1.1.4 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.

(Paragraphs deleted)

§ 1.1.7 The Project Manual

The Project Manual is a volume assembled for the Work which may include the bidding or proposal requirements, sample forms, Conditions of the Contract and Specifications.

§ 1.1.8 Addenda

Addenda are written or graphic instruments issued prior to the execution of the Contract which modify or interpret the Proposal Documents, including Drawings and Specifications, by additions, deletions, clarifications or corrections. Addenda will become part of the Contract Documents when the Construction agreement is executed. The successful Contractor and his Subcontractors shall post all addendum items on their sets of Drawings and Specifications.

§ 1.1.9 Approved Equal, Approved Equivalent or Equal

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The terms Approved and Approved Equivalent relate to the substitution of products or systems approved in writing by the Architect. Refer to Paragraph 3.19 Substitution of Products and Systems for procedure which must be followed.

§ 1.1.10 Proposal Documents

Proposal Documents consist of all documents bound into or referenced in the Project Manual, the Drawings, and Addenda related thereto. The Project Manual contains the Proposal Requirements, Sample Forms, Conditions of the Contract, the Specifications, and a list of Drawings, and Schedules, some of which are bound into the Project Manual (Other Drawings and Schedules are bound separately).

§ 1.1.11 Miscellaneous Other Words

The terms "Bids" or "Bidding" mean Competitive Sealed Proposal, which by definition allows the Owner to accept the "best value" for the school district, based on factors other than cost.

§ 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.

(Paragraph deleted)

§ 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.

§ 1.2.4 Precedence of the Contract Documents

The most recent issued Document takes precedence over the previous issued forms of the same Document. The order of precedence is as follows with the highest authority listed first.

- .1 The Agreement
- .2 The Addenda
- .3 Conditions of the Contract, Drawings and Specifications shall have equal authority. Should these documents disagree in themselves, the Architect will select the appropriate method for performing the work at no additional increase in the Contract Cost.

In the case of an inconsistency between the Drawings and Specifications or within either set of Documents discovered prior to Proposal Time but too late to be clarified by an Addendum, the better quality or greater quantity of work shall be included in the proposal. Clarification of the inconsistency will be accomplished with Contractor after award of the Contract, and if necessary, an appropriate reduction in the Contract will be accomplished by Change Order.

§ 1.2.5 Relation of Specifications and Drawings

The Drawings and Specifications are correlative and have equal authority and priority. Should they disagree in themselves, or with each other, base the proposals on the most expensive combination of quality or quantity of work indicated. The appropriate method of performing the Work, in the event of the above-mentioned disagreements, will be made by the Architect.

§ 1.2.6 Optional Materials, Brands and Processes

When more than one is specified for a particular item of Work, the choice shall be the Contractor's. The final selection of color and pattern will be made by the Architect from the range available within the option selected by the Contractor, unless the item is specified to match a specific color or sample furnished. Where particular items are specified only products of those named manufacturers are acceptable. Certain specified construction and equipment details may not be regularly included as part of the named manufacturer's standard catalog equipment but shall be provided by the manufacturer as required for the proper functioning of the equipment. Reasonable minor variations in equipment are expected and will be acceptable; however, indicated and specified performance and material requirements are minimum, and will be required in addition to standard accessories. The Architect reserves the right to determine the equality of equipment and materials that deviate from any of the indicated and specified requirements.

§ 1.2.7 Standards and Requirements

When the Contract Documents refer to standards, building codes, manufacturers' instructions, or other documents, unless otherwise specified, then the current edition as of the date of execution of the Agreement by the last party to execute said Agreement shall apply. It shall be the responsibility of the Architect to address revisions or amendments to applicable codes or standards which arise after the date of execution of the Agreement and until Final Completion, pursuant to the terms of the Agreement between Owner and Architect. Requirements of public authorities apply as minimum requirements only and do not supersede more stringent specified requirements.

§ 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 Execution of Contract Documents

§ 1.5.1 The Contract Documents shall be signed by the Owner and Contractor. If either the Owner or Contractor or both do not sign all the Contract Documents, the Architect shall identify such unsigned Documents upon request.

§ 1.5.2 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 to the Contract Documents. If an approved Contract Document requiring Contractor's signature has not been signed, then the missing signature shall be provided within a reasonable period of time. Failure of Contractor to sign an approved Contract Document after notice and a reasonable opportunity to sign, shall be considered a material breach of the Contract by Contractor.

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

§ 1.6.1 The Drawings, Specifications and other documents, including those in electronic form, prepared by the Architect and the Architect's consultants are Construction Documents through which the Work to be executed by the Contractor is described. All ownership rights, whether common law, statutory, or other reserved rights, including copyright ownership of the Construction Documents, are controlled by the Agreement between the Owner and Architect. The Contractor may retain one record set. Neither the Contractor nor any Subcontractor, Sub-subcontractor or material or equipment supplier shall own or claim a copyright in the Drawings, Specifications and other documents prepared by the Architect or the Architect's consultants. The Drawings, Specifications and other documents prepared by the Architect and the Architect's consultants, and copies thereof furnished to the Contractor, are for use solely with respect to this Project. They are not to be used by the Contractor or any Subcontractor, Sub-subcontractor or material or equipment supplier on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner. The Contractor, Subcontractors, Sub-subcontractors and material or equipment suppliers are authorized to use and reproduce applicable portions of the Drawings, Specifications and other documents prepared by the Architect and the Architect's consultants appropriate to and for use in the execution of their Work under the Contract Documents. All copies made under this authorization shall bear the statutory copyright notice, if any, shown on the Drawings, Specifications and other documents prepared by the Architect and the Architect's consultants. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with this Project is not to be construed as publication in derogation of any copyrights or other reserved rights.

(Paragraphs deleted)

§ 1.7 Miscellaneous Other Definitions

§ 1.7.1 Alternate Proposal(s)

A separate amount stated on the 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 a period of 120 days after receipt of proposals, unless otherwise modified, regardless if an Owner Contractor Agreement has been executed, unless indicated otherwise herein.

§ 1.7.2 Base Proposal

The Contractor's proposal for the Work, not including any Alternates.

§ 1.7.3 Contract Time

The period of time which is established in the Contract Documents for Substantial Completion of the Work. This period of time is not subject to adjustment or extension without the written permission of the Owner.

§ 1.7.4 Date of Agreement

The date the Owner formally awards a Contract for Construction of the Work. This date will be inserted on the first page of the Agreement Between Owner and Contractor and shall be referenced in Performance Bond and Payment Bond forms. See also Date of Commencement of the Work.

§ 1.7.5 Date of Commencement of the Work

The commencement date shall be the date the contract award is approved by the CFISD Board of Trustees. This date constitutes day zero ("0") of Contract Time.

§ 1.7.6 Date of Final Completion

The end of construction. Refer to Section 9.10.

§ 1.7.7 Day

The following days are referenced in the documents:

- .1 Calendar Days: The days of the Gregorian Calendar. The Contract Time is established in Calendar Days and extensions of time granted for Regular Work Days lost, in excess of anticipated delay day allowance, will be converted to Calendar Days.
- .2 Holidays: The days officially recognized by the construction industry and/or Owner approved holidays, in this area as a holiday; normally limited to the observance days of New Year's Day, Martin Luther King, Jr. Day, Good Friday, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day and the Friday after, Christmas Eve, Christmas Day and New Year's Eve day.
- .3 Regular Work Days: All calendar days except holidays, Saturdays, and Sundays. Requests for extensions of time shall be requested, after expenditure of the Anticipated Delay Day Allowance, 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). The Contractor is advised to refer to Section 01 35 23.1, Special Owner Requirements regarding after hours use of the premises.
- .4 Anticipated Delay Days Allowance: An allowance of Fifteen (15) Regular Work Days per year (or two (2) regular work days per month, whichever is less) is established as probable days lost due to delays beyond the Contractor's control. This allowance includes District testing dates and any other days the district directs the contractor to not perform work due to unspecified campus events. This additional Delay day allowance does not include anticipated weather days as indicated in section 8.3., also does not include Holidays as indicated in Section 1.7.7.2. These days for weather and holidays are to be added to this additional delay day allowance and are to be calculated in accordance with their respective section as indicated elsewhere in these general conditions to establish the grand total of the anticipated delay day allowance.
- .5 Evaluation of Delay Days: The Architect and Owner will evaluate delays claimed by the Contractor based on the Critical Path of the Contractor's construction schedule, and if the Architect is in agreement that a Critical Path task has been delayed due to circumstances beyond the Contractor's control, the accepted delay days will be deducted from the Anticipated Delay Day Allowance.
- .6 Delay Days: Regular Work Days when circumstances beyond the Contractor's control prevent progress on major portions of the Work as described in Paragraph 8.3, Delays and Extensions of Time, in the General Conditions of the Contract for Construction.

§ 1.7.8 Notice to Proceed

A notice that may be given on behalf of the Owner to the Contractor, through the Architect, that directs the Contractor to start the Work. It also establishes the Date of Commencement of the Work.

§ 1.7.9 Provide

Whenever the word "provide" is used in these documents, it shall mean the same as "furnish and install."

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§ 1.7.10 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. Refer to Article 9.8.

ARTICLE 2 OWNER

§ 2.1 General

§ 2.1.1 The Owner is the independent school district identified in the Contract Documents. The Board of Trustees, by majority vote, is the only representative of the Owner, an independent school district, having the power to: enter into a contract; amend a contract; approve changes in the scope of the Work; approve and execute a Change Order or Construction Change Directive modifying the Contract Sum; agree to an extension to the date of Substantial or Final Completion; or terminate a contract. The Board designates authorized representatives to act on its behalf for day-to-day operations under the Contract. Unless otherwise designated in the Contract Documents, Owner's authorized representative shall be the Superintendent of Schools, who may delegate responsibilities as appropriate. Owner's Board of Trustees hereby delegates to the Superintendent of Schools or designee the authority to approve changes to the Work where such changes are within the Owner's Betterment Allowance or other designated Allowances stipulated in the Contract Documents and also the authority to approve any Change Order which does not exceed \$249,999.99 and the authority to approve any and all time extensions to the Contract. Any Change Order that is valued at or above \$250,000 shall require Board approval in accordance with Local Board Policy. Except as otherwise provided in the Contract Documents, the Architect does not have such authority. Neither Architect nor Contractor may rely upon the direction of any employee of Owner who has not been designated in writing in the Contract Documents. Owner shall not be financially responsible for actions taken by the Architect or Contractor in reliance upon direction from unauthorized persons.

§ 2.1.2 It shall be distinctly understood that by virtue of this Contract, neither the Contractor nor any contractor, subcontractor, sub-subcontractor, consultant, design professional, mechanic, material person, artisan, or laborer, skilled or unskilled, shall ever in any manner have, claim, or acquire any lien upon the buildings or any of the improvements of whatsoever nature or kind so erected or to be erected by virtue of this Contract or upon any of the land on which said buildings or any of the improvements are so erected, built, or situated. It shall be further understood that this Contract is not written for the benefit of third parties nor shall it be construed to create any third party beneficiaries.

§ 2.2 Information and Services Required of the Owner

§ 2.2.1 Prior to commencement of the Work, the Contractor may request in writing that the Owner provide reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. Thereafter, the Contractor may only request such evidence if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) a change in the Work materially changes the Contract Sum; or (3) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due. The Owner shall furnish such evidence as a condition precedent to commencement or continuation of the Work or the portion of the Work affected by a material change. After the Owner furnishes the evidence, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.2 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.

§ 2.2.3 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 reasonably rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work, shall exercise due diligence in attempting to locate underground utilities, and shall notify the Owner and Architect of any discrepancies between the surveys and actual conditions of the site that Contractor observes or should observe in the exercise of ordinary care.

§ 2.2.4 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.

§ 2.2.5 Refer to Section CB, Supplementary Conditions, for quantities of plans and project specifications to be furnished to the Contractor.

§ 2.3 Owner's Right to Stop the Work

(Paragraphs deleted)

§ 2.3.1 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.

§ 2.4 Owner's Right to Carry Out the Work

§ 2.4.1 If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within seven (7) Calendar Days 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, immediately correct such deficiencies. In such case an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor 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. Such action by the Owner and amounts charged to the Contractor are both subject to 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.

§ 2.5 Owner's Right to Occupy the Project

§ 2.5.1 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 have expired. Such occupancy and use shall not constitute acceptance of any work not in accordance with the Contract Documents and Contractor shall be responsible for insurance, utilities and security until Substantial Completion of the entire project.

§ 2.5.2 Refer to Article 11 - Insurance and Bonds regarding property insurance requirements in the event of such occupancy.

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 in a good and workmanlike manner and in an expeditious and economical manner consistent with the interest of the Owner; shall exercise the degree of care, skill, and diligence in the performance of the Work in accordance with and consistent with industry standards for similar projects; shall utilize its best skill, effort, and judgment in diligently performing the Work; and shall furnish efficient business administration and supervision. Workmanship shall be of a quality to produce satisfactory results.

§ 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 The Contractor shall carefully study and compare the Agreement, Conditions of the Contract, Drawings, Specifications, Addenda, Modifications, and information provided by the Owner and shall at once report to the Architect any error, inconsistency, or omission he may discover. Contractor shall be liable for any damage to Owner for failure to report any error, inconsistency or omission he may discover or should have discovered, but he shall not be liable to Owner or Architect for any damage resulting for such error, inconsistency or omission which he did discover and at once so reported. Contractor shall not perform any work without approved Drawings and Specifications issued by the Architect.

§ 3.2.2 Any design errors or omissions noted by the Contractor during this review shall be reported promptly to the Architect, but 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. The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, building codes, and rules and regulations, but any nonconformity discovered by or made known to the Contractor shall be reported promptly to the Architect.

§ 3.2.3 If the Contractor believes that additional cost or time is involved because of clarifications or instructions issued by the Architect in response to the Contractor's notices or requests for information pursuant to Sections 3.2.1 and 3.2.2, the Contractor shall make Claims as provided in Sections 4.3.6 and 4.3.7. If the Contractor fails to perform the obligations of Sections 3.2.1 and 3.2.2, the Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations. The Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents or for differences between field measurements or conditions and the Contract Documents unless the Contractor recognized such error, inconsistency, omission or difference and knowingly failed to report it to the Architect.

(Paragraphs deleted)

§ 3.2.4 The Contractor shall take field measurements and verify field conditions and shall carefully compare such fields measurements and conditions and other information known to the Contractor with the Contract documents before commencing activities. Errors, inconsistencies or omissions discovered shall be reported to the Architect at once.

§ 3.2.5 The Contractor shall not be entitled to additional compensation for the "rework portion" of any additional work caused by his failure to carefully study and compare the contract documents prior to execution of the Work.

§ 3.2.6 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 complies with the Contract Documents. The Contractor shall arrange meetings prior to commencement of the work of all major subcontractors to allow the subcontractor to demonstrate his understanding of the documents to the Architect/Owner and to allow the subcontractor to ask for any interpretation he may require.

§ 3.2.7 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 above requirements before additional services are performed.

§ 3.2.8 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 substitution of materials, shall be accomplished by appropriate Modification.

§ 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, unless the Contract Documents give other specific instructions concerning these matters. If the Contract Documents give specific instructions concerning

construction means, methods, techniques, sequences or procedures, the Contractor shall evaluate the jobsite safety thereof and, except as stated below, shall be fully and 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 written notice to the Owner and Architect and shall not proceed with that portion of the Work without further written instructions from the Architect. 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 Contractor shall not be responsible for any resulting loss or damage arising solely from those Owner-required 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.

§ 3.3.3.1 The Contractor is especially cautioned to coordinate the routing of all mechanical, plumbing and electrical items and provide coordinating drawings in accordance with provisions of the Contract Documents prior to commencing these operations.

§ 3.3.4 Contractor shall document existing facility conditions and systems onsite prior to performing any work with video recording and/or photographs and shall test said systems to identify any pre-existing deficiencies in the presence of the Owner, Architect/Engineer. Any items not noted or identified in this documentation or brought the attention of the Owner in writing will be assumed to be in working order and any problems with such systems will be the responsibility of the Contractor to correct and repair to the pre-contract condition or better.

§ 3.3.5 Prior to performing any work, the Contractor shall locate all utility lines as shown on the plans and specifications, including telephone company lines and cables, sewer lines, water pipes, gas lines, and electrical lines, and shall perform the Work in such a manner as to avoid damaging any such lines, cables, pipes and pipelines. In addition, the Contractor shall independently determine the location of same.

§ 3.4 Labor and Materials

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, eligible to work in accordance with state and federal law. In addition, unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for 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 authorized by the Architect in accordance with Sections 3.12.8 or 7.4, the Contractor may make substitutions only with prior written consent of the Owner, after evaluation by the Architect and in accordance with a Change Order, Construction Change Directive, or Change Proposal Request.

§ 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

(Paragraphs deleted)

§ 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.

The Contractor is solely responsible for, and shall provide written proof of maintenance, service, and protection of materials and equipment installed prior to Substantial Completion.

§ 3.5.2 In the event of failure of materials, products, or workmanship, either during construction or the warranty period (as specified in Section 3.5.5), the Contractor shall take appropriate measures to assure correction or replacement of the defective items, whether notified by the Owner or Architect. Items of work first performed after Substantial Completion shall have their warranties extended by the period of time between Substantial Completion and the actual performance of the Work. Such warranties shall be submitted to owner in writing, documenting such time extensions. This warranty period shall not restrict or modify extended warranties called for or provided on systems, equipment or other specific portions of the work.

§ 3.5.3 Contractor shall establish a spreadsheet-type Warranty Work tracking format included in the Project Manual and shall verify and certify completion of each warranty work item.

§ 3.5.4 Approximately six (6) and eleven (11) months after Substantial Completion, the Contractor shall accompany the Owner and Architect on a complete re-inspection of the Project and be responsible for correcting any additional deficiencies observed or reported, including any uncompleted Punch List Items or outstanding or incomplete Warranty Items.

§ 3.5.5 The Warranty Period for this Project is One (1) Year from the date of Substantial Completion except for any extended warranties as specified herewith in the Contract Documents

§ 3.5.6 The warranty period shall extend one (1) year on specific items of work (materials and labor) if warranty work is performed on a specific item or work that requires the issuance of a second warranty work request within ninety (90) days after the original warranty work request was issued.

§ 3.5.7 Warranty work shall be performed within ten (10) working days after the Contractor receives a request for warranty work, except where immediate responses are required as described below:

- .1 For work which is identified as affecting life safety, fire alarm or security of the occupants and/or the facility on the warranty request, on-site corrective work shall begin immediately after receipt of the warranty work request by the Contractor, 365 days per year, twenty-four (24) hours per day.
- .2 For work affecting the operation of the HVAC system, domestic water heaters, elevators and food service equipment (except walk-in refrigeration and/or freezer equipment), on-site corrective work shall begin within six (6) hours of Contractor's receipt of warranty work, 365 days per year 24 hours per day.
- .3 For walk-in refrigeration and/or freezer equipment, on-site corrective work shall begin within four (4) hours of Contractor's receipt of warranty work, 365 days per year, 24 hours per day.

§ 3.5.8 For warranty work requiring immediate response as described in 3.5.7 above, the Contractor shall maintain or contract for an answering service available 365 days per year, 24 hours per day.

§ 3.5.9 Warranty work shall be completed within six (6) hours after the initiation of on-site corrective work unless additional time is reasonably required, and the Owner has agreed on the additional time frame deemed necessary by the Contractor.

§ 3.5.10 The Owner reserves the right to complete any warranty work that Contractor fails to complete in the specified time period. Owner will backcharge Contractor for the cost of such work, including Consultants' fees.

§ 3.6 Taxes

§ 3.6.1 The Owner is exempt from the Texas Sales Tax on any purchase of tangible personal property and utilities and will issue Certificates of Exemption from the Texas Sales Tax on materials furnished by Contractors on School Construction projects. The Contractor shall give a written statement to the Owner (with a copy to the Architect) as to the proration of costs of skilled crafts, labor and materials for the project prior to awarding of a Construction Contract. The Contractors shall obtain Certificates of Resale from their suppliers in order to avoid payment of the State Sales Tax on materials incorporated in School jobs. Failure of the Contractor to obtain Certificates of Resale from their suppliers shall make the Contractor responsible for absorbing the tax.

§ 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.

§ 3.7.1.1 The Owner will pay directly or to the governing authority directly from the Allowance, the cost of all permanent connection charges, including water and sewer tap charges and the provision and installation of the irrigation meter and the domestic water meter and vault. The Owner will pay directly to the governing authority the cost of all non-taxable entity fees, capacity charges, drainage impact fees and permanent utility account deposits.

§ 3.7.1.2 The Contractor shall pay directly all temporary utility connection charges, including utility district/company inspection, survey, and permit fees for both temporary and permanent connections.

§ 3.7.1.3 The Contractor shall include in the Base Proposal, the cost for providing all backflow preventers, fire sprinkler system backflow preventers, meters, vaults, valves, taps, and piping from taps for domestic water, irrigation, and fire sprinkler systems.

§ 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 It is neither the Contractor's responsibility nor the Owner's responsibility to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations. However, if the Contractor observes or should have observed, that portions of the Contract Documents are at variance therewith, the Contractor shall promptly notify the Architect and Owner in writing, and necessary changes shall be accomplished by appropriate modification.

(Paragraphs deleted)

§ 3.7.4 If the Contractor performs Work which he knew or should have known it to be contrary to laws, statutes, ordinances, building codes, and rules and regulations without such notice to the Architect and Owner, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.8 Allowances

§ 3.8.1 The General Contractor shall include in his proposal all allowances stated in the Specifications.

These stated allowances represent the cost estimate of the materials and equipment delivered and unloaded at the site. The Contractor's supervision, handling costs, estimating costs, miscellaneous fees, overhead, profit, clean-up, as-builts, warranty, and other expenses contemplated for the allowance material and equipment shall be included in allowances only where called for in the various sections of these specifications.

The Contractor shall purchase the allowance materials and equipment as directed by the Architect, upon approval by the Owner, on the basis of the lowest reasonable proposal of at least three (3) competitive proposals unless otherwise directed by Owner. If the actual cost of the materials and equipment delivered and unloaded at the site is more than all the allowance estimates, the Contract Sum will be adjusted by Change Order.

§ 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, miscellaneous fees, 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 in sufficient time to avoid delay of the Work.

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§ 3.9 Superintendent

§ 3.9.1 The General Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work including punch list work. The Superintendents and Project Manager shall be satisfactory to the Owner and Architect and shall not be changed except with the consent of the Owner and Architect, unless the Superintendent leaves the employment of the Contractor. No increase in Contract Time or Contract Sum shall be allowed in the event the Owner or Architects objects to any nominated superintendent or project manager. The superintendent and project manager shall represent the Contractor, and communications given to the superintendent and/or project manager shall be as binding as if given to the Contractor.

(Paragraphs deleted)

§ 3.9.2 The Contractor shall furnish to the Owner and the Architect in writing the names and professional qualifications of the persons proposed by the Contractor as the project manager and superintendent with the submitted proposal. The Contractor shall not assign nor substitute any person as the project manager or superintendent to whom the Owner or the Architect has made reasonable objection. No increase in Contract Time or Contract Sum shall be allowed in the event the Owner or Architect objects to any nominated project manager and/or superintendent. The Contractor's submittal of the project manager and superintendent's professional qualifications with his proposal represent the Contractor's acknowledgement that the selection committee's evaluation of the Contractor's proposal includes said superintendent's qualifications and the understanding that said job superintendent will remain on site, full time, until the Architect and Owner have agreed that all punch list work has been completed. See also, Specification Section 01 35 23 – Special Owner Requirements, for additional job superintendent requirements. In addition, the Owner reserves the right to perform a criminal records history review of the proposed superintendent and other Contractor personnel prior to the Contract Award as may be deemed necessary.

§ 3.9.3 Contractor will be required to keep the job superintendents on each job-site during the course of the construction until completion of all punch list items. In the event the job superintendents is absent from any job site at any time during the project contract time or during punch list completion and an agreed upon substitute is not provided, the Owner may backcharge the Contractor \$250.00 per occurrence.

§ 3.9.4 The Contractor shall notify the Owner and Architect at the beginning of the work day if the superintendent is out sick. If the superintendent is to be out for any other reason, the Owner and Architect are to be notified at least 24 hours in advance. In both cases the Owner and Architect are to be informed of the name of the acting superintendent.

§ 3.10 Contractor's Construction Schedules

§ 3.10.1 The Contractor shall, within the time frame specified in Section 01 32 16, prepare and submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall not exceed time limits current under the Contract Documents, shall be revised at appropriate intervals as required by the conditions of the Work and Project, shall be related to the entire Project to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the Work.

§ 3.10.2 The Contractor shall prepare a submittal schedule, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, and shall submit the schedule(s) for the Architect's approval. The Architect's approval shall not unreasonably be 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, 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.

§ 3.10.4 The Contractor will provide a detailed critical path construction schedule including milestones for this project within the time frame specified in 01 32 16. This schedule shall be prepared using "Suretrak, Primavera, Microsoft Project" or other similar scheduling software. In addition, the Contractor shall submit to the Owner and Architect with each monthly Application for Payment a copy of the progress schedule showing all modifications required to have the schedule reflect appropriate revisions and shall take whatever action is necessary to assure that the project completion schedule is met. The Contractor is required to attend and to give a schedule update at each weekly construction administration meeting and shall provide a detailed 3 week work ahead schedule. The progress schedule will include

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percentages of work completed to date along with percentages of work remaining to be completed. These percentages will be used in the verification of the Contractor's monthly Application for Payment. Pay Applications will not be processed by the Owner unless accompanied by an updated progress schedule. If the project is behind schedule, specific input will be required from the Contractor on how he intends to make up the time. If the project remains behind schedule for more than ten (10) working days, for any reason, the Owner, Architect, and Consultants and their associated personnel, shall be compensated by the Contractor, at their standard hourly billing rate, which will be provided as required, until such time as the Contractor can successfully demonstrate to all parties that the project is back on the agreed schedule. Contractor shall provide two (2) large format color prints one (1) for Owner and one (1) for jobsite of the construction schedule monthly with all items showing current status and original baseline schedule.

§ 3.11 Documents and Samples at the Site

The Contractor shall maintain at the site for the Owner one (1) copy of the Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and one (1) copy of approved Shop Drawings, Product Data, Samples and similar required submittals. These shall be available to the Architect and shall be 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 the way by which 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, (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents, and (4) coordinated said shop drawings, product data, samples and submittals with adjacent work and its related submittals to be compatible and not in conflict for installation.

§ 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 requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Architect in writing 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, except for any such errors or omissions which are within the Architect's statutory or contractual design responsibility.

§ 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 written 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. 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 cause such services or certifications to be provided by a properly 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, accuracy and completeness of the services, certifications and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor all performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review, 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. The Contractor shall not be responsible for the adequacy of the performance and design criteria specified in the Contract Documents.

(Paragraphs deleted)

§ 3.12.11 If, in the opinion of the Architect, the Shop Drawings are incomplete, indicate an inadequate understanding of the work covered by the Shop Drawings, or indicate a lack of study and review by the Contractor prior to submittal to the Architect, the Shop Drawings will be returned, unchecked, to the Contractor for correction of any of the above deficiencies and subsequent resubmittal. Additional service charges may be charged to the Contractor by the Architect in this event.

§ 3.12.12 The Contractor shall submit drawings, data and samples to the Architect at least fifteen (15) Regular Work Days prior to the date the Contractor needs the reviewed submittals returned. The Architect and his consultants will be allowed fifteen (15) Regular Work Days for checking from date of submission of shop drawings that are acceptable and do not require re-submission in the opinion of the Architect. Where colors are to be selected by the Architect, submit all product color samples in adequate time to allow the Architect to prepare a complete selection schedule. In general, all submittals requiring color selection shall be submitted to the Architect within eight (8) weeks [four (4) weeks for a summer remodel] of the Contractor's receipt of Notice to Proceed on the Project.

§ 3.12.13 The Contractor shall submit the number of copies of product data and samples which the Contractor and his subcontractors need for their use PLUS two (2) additional sets for the Architect, two (2) additional set for the Owner; one (1) additional set for each of the Architect's consultants involved with the particular Section of Work; (1) additional set of all mechanical shop drawings for TAB and one (1) additional set to be added to each copy of the Owner's Operation and Maintenance manuals at substantial completion. If, in the opinion of the Architect, the Shop Drawings are incomplete; indicate an inadequate understanding of the work covered by the Shop Drawings; or indicate a lack of study and review by the Contractor prior to submittal to the Architect, the Shop Drawings will be returned, unchecked, to the Contractor for correction of these deficiencies and subsequent resubmittal. Additional service charges as outlined in Article 3.2.7 may be charged to the Contractor by the Architect in this event.

§ 3.12.13.1 Where shop drawings are involved, submit one (1) high quality reproducible transparency and one (1) opaque print of the shop drawing for the Architect plus one (1) additional opaque print for each of the Architect's consultants involved with the particular Section of Work and one (1) additional print for each copy of the Owner's Operation and Maintenance Manuals to be submitted at Substantial Completion. The reproducible transparency will be marked by the Architect and/or his consultants and returned to the contractor for his use, distribution, correction or resubmittal, as

required. After final review and correction of the submittal, the Contractor shall send one (1) corrected set to the Architect and one (1) to each of the Architect's consultants involved with the particular Section of Work. Contractor shall also retain one (1) set of all reviewed Mechanical submittals to be transmitted to the HVAC Test and Balance agency selected by Owner.

§ 3.12.14 The Contractor shall deliver in one (1) submittal, all material samples requiring a color selection by the Architect, within eight (8) weeks [four (4) weeks for summer remodel] of the Contractor's receipt of a Notice to Proceed on the Project. The Architect will return material color selections within six (6) weeks [three (3) weeks for summer remodel] of receipt of the color samples from the Contractor.

§ 3.12.15 The Contractor shall produce and submit for review, composite coordination drawings within four (4) weeks of the Contractor's receipt of a Notice to Proceed on the Project. The composite coordination drawings shall depict the coordination of all structural and architectural elements with HVAC piping, ductwork, mechanical equipment, electrical conduit, low voltage systems cabling, lighting, electrical switchgear and panels, security systems, domestic water piping, roof drains and storm sewer piping, sanitary sewer piping and fire sprinkler piping in a composite above ceiling plan and a composite mechanical and electrical equipment room floor plan. Plans shall be produced at a scale of one-quarter (1/4") per foot and shall include larger scale sections with vertical elevations of elements required to confirm coordination of all elements. A schedule value for the production of the composite coordination drawings shall be included in the Continuation Sheet of the Application and Certificate for Payment for each of the Divisions of trade. Refer to specification section 01 31 13 for detail coordination document requirements.

§ 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, and lawful orders of public authorities and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.13.1 Contractor shall ensure that the Work, at all times, is performed in a manner that affords Owner reasonable access, both vehicular and pedestrian, to the site of the work and all adjacent areas. The Work shall be performed in such a manner that public areas adjacent to the site of the Work shall be free from all debris, building material and equipment likely to cause hazardous conditions. Without limitation of any other provision of the Contract Documents, Contractor shall use its best efforts to minimize any interference with the occupancy or beneficial use of any area of the building adjacent to the site of the Work, or the building, in the event of partial occupancy.

§ 3.13.2 Without prior approval of the Owner, the Contractor shall not permit any workers to use any existing facilities at the Project site, including without limitation, lavatories, toilets, entrances, and parking areas, other than those designated by the Owner. The Contractor shall comply with all rules and regulations established by the Owner in connection with the use and occupancy of the Project site and the Building.

§ 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 and patching shall be restored to the condition existing prior to the cutting, fitting and 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 such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor's consent to cutting or otherwise altering the Work.

§ 3.15 Cleaning Up

§ 3.15.1 The Contractor shall, on a daily basis, keep the premises and surrounding area free from accumulation of waste materials or 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. See specification section 01 71 50 for specific requirements of final cleaning.

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

(Paragraphs deleted)

§ 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; clean roofs; clean site; sweep paved areas and rake clean other surfaces; remove trash and surplus materials from the site.

§ 3.16 Access to Work

The Contractor shall provide the Owner and Architect a job site plan and 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 such 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 the Contractor has reason to believe that the required design, process or product is an infringement of a copyright or a patent, the Contractor shall be responsible for such loss unless such information is promptly furnished to the Architect.

§ 3.18 Indemnification

§ 3.18.1 To the fullest extent permitted by law and to the extent claims, damages, losses or expenses are not covered by Project Management Protective Liability insurance purchased by the Contractor in accordance with Section 11.3, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, Third Party consultants, utility service providers involved with the project, 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 which 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.

§ 3.19 Substitutions of Materials, Products, or Systems

§ 3.19.1 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 is approved in an addendum as a substitution prior to the submission of proposals. If prior written approval has not been obtained, it will be assumed that the Proposal is based upon the materials, products, and systems described in the Proposal Documents and no substitutions will be permitted, except as provided hereinafter.

§ 3.19.2 If, prior to submitting his Proposal, a Proposer at any level determines that any of the materials, 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 Proposer shall promptly notify the Architect in writing, providing substantiation for his position. Any necessary changes shall be set forth in an addendum.

§ 3.19.3 The Architect does not bind himself to consider a substitution during the proposal period unless written

request has been submitted to the Architect for approval at least ten (10) days prior to the date for receipt of Proposals. Each such request shall include a "side-by-side" comparison which may include but is not limited to the following; a complete description of the proposed substitute, the name of the material, project, or system for which it is proposed to be substituted, drawings, cuts, performance and test data and any other data or information necessary for a complete evaluation. Incomplete submittals will not be evaluated. If the Architect approves any proposed substitution, such approval will be set forth in an Addendum.

§ 3.19.4 If, after award of contract, the Contractor or one of his Subcontractors or Suppliers determine 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 accomplished by appropriate modification.

§ 3.20 Record Drawings

§ 3.20.1 Within seven (7) days after substantial completion of the project, the Contractor shall submit two (2) sets of full-size photocopies of the Job Superintendent's field set of marked plans and specifications.

§ 3.20.2 The Contractor shall provide the Owner with Electronic Record Drawings on a thumb drive or solid-state media drive. Drawings shall mirror the construction document sheets with any additions and changes made during the course of the project. Drawings shall be in both AutoCAD version 18 or later, and PDF or Tiff Format. CAD files shall have all referenced drawings in the same directory or folder. The record drawings shall include electronically all changes made during construction, clouded and keyed to identify the instrument of the change, Change Proposal Request or Change Order. For underground utility piping, revised locations shall also be dimensioned from the column grid lines. The record drawings must be delivered to the Architect at least thirty (30) days prior to receipt of the Contractor's Final Application for Payment. The record drawings shall have a statement added to indicate the purpose of the drawings (i.e. "RECORD DRAWINGS") and shall delete the Architects and/or Engineers seal. See additional requirements in Form 'AO'.

§ 3.20.3 The Contractor is to provide the Owner with Record Specifications (one (1) PDF format on thumb drive or solid-state media drive) which denotes the manufacture of materials incorporated into the Project where more than one acceptable manufacturer is listed, and shall include all changes made during construction, clouded and keyed to identify the instrument of change. The record specifications shall have a statement added to indicate the purpose of the specifications (i.e. "RECORD SPECIFICATIONS"). See additional requirements in Form 'AO'.

§ 3.21 Antitrust Violations

§ 3.21.1 To permit the Owner to recover damages suffered; in antitrust violations, the Owner/Contractor Agreement shall include the following wording, "Contractor hereby assigns to Owner any and all claims for overcharges associated with this contract which are under the antitrust laws of the United States, 15 U.S.C.A., Sec. 1 et.seq. (1973)". The Contractor shall include this provision in his agreements with each subcontractor and supplier. Each subcontractor shall include such provisions in agreements with sub-subcontractors and suppliers

§ 3.22 Prevailing Wage Rates

§ 3.22.1 No employee used in this construction may be paid less than the minimum wage rate provided herein in Article 15.

§ 3.23 Construction Progress Photographs

§ 3.23.1 Contractor shall provide color construction progress photographs during the construction period on a monthly basis to the Architect and Owner. Photographs and digital files on thumb drive or solid-state media drive of photos shall be provided. Construction progress monthly photographs (24 minimum per month, showing all aspects of work accomplished during that month) shall be provided with each and every application for payment.

§ 3.23.2 For New Construction, Building Additions and Miscellaneous Renovations provide (Digital files on thumb drive or solid-state media drive):

Two (2) aerial photographs prior to construction

Two (2) aerial photographs after Final Completion, and

Two (2) aerial photographs of the District facility site each month that there is a change in appearance of the

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building exterior and site, or as requested by the Owner.

ARTICLE 4 ADMINISTRATION OF THE CONTRACT

§ 4.1 Architect

§ 4.1.1 The Architect is the person lawfully licensed to practice architecture or an entity lawfully practicing architecture identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The term "Architect" means the Architect or the Architect's authorized representative.

§ 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.

§ 4.1.3 If the employment of the Architect is terminated, the Owner shall employ a new Architect against whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the former Architect.

§ 4.1.4 Except as expressly provided herein, the Contractor shall not be relieved of Contractor's obligation to perform the Work in strict accordance with the Construction Documents and the Contract Documents by the duties, responsibilities, or activities of the Architect.

§ 4.2 Architect's 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 (1) during construction, (2) until final payment is due and (3) with the Owner's concurrence, from time to time during the one-year period for correction of Work described in Section 12.2. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents unless otherwise modified in writing in accordance with other provisions of the Contract.

§ 4.2.2 The Architect shall visit the site at least twice per week (or more per week when deemed necessary by the Owner's Superintendent or Designee or when necessary to protect Owner's interests) and at any other intervals appropriate to the stage of construction, to inspect the progress, quantity and quality of the Work completed, to reject any observed nonconforming Work, and to determine if the Work is being performed in a manner indicating that the Work, when completed, will be in accordance with the Construction Documents and the Contract Documents and on time. Furthermore, a minimum of two job site meetings per month from commencement of construction through Final Completion will be initiated by the Architect and attended by the Contractor. Attendees will include Owner, the Contractor's project manager and/or superintendent, Architect's project representative, and Architect. The Architect, Owner and their representatives shall at all times have access to the Work. Architect, or its structural consultant will provide on-site observation prior to and during all concrete pours that contribute to the structural integrity of the building, including all pours of concrete piers, footings, grade beams, floor slabs, and concrete superstructure components, if applicable. In addition, Architect or its structural consultant will provide on-site observation prior to covering up or closing up of portions of the construction, which if covered, would conceal problems with the structural integrity of the Project. Contractor shall not close or cover said Work until said observations have occurred. Contractor or Architect will advise Owner of the need for any third-party laboratory or testing services to assist the Architect and Owner. On the basis of the on-site observations by Architect, Architect shall keep Owner and Contractor informed of the progress and the quality of the Work, through Architect's field reports, and shall guard Owner against defects and deficiencies in the Work. Architect shall promptly notify Owner and Contractor, orally, regarding any defect or nonconforming Work, which shall be followed by notice in writing of defects or nonconforming Work noted and corrective action taken or recommended. The Architect, however, shall not have control over, or responsibility for the Contractor's construction means, methods, techniques, sequences, procedures, or safety programs, but this does not relieve Architect of Architect's responsibilities under this Agreement. Any services by Contractor made necessary by Contractor's construction defect or nonconforming Work, shall be performed at no additional cost to Owner.

§ 4.2.3 The Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and report to the Owner (1) known deviations from the Contract Documents and from the most recent construction schedule submitted by the Contractor, and (2) 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. The Architect shall endeavor to guard the Owner against defects and deficiencies in the Work.

§ 4.2.4 Communications Facilitating Contract Administration

Except as otherwise provided in the Contract Documents or when direct communications have been specially authorized, the Owner and Contractor shall endeavor to communicate with each other through the Architect about matters arising out of or relating to the Contract. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and material suppliers shall be through the Contractor. Communications by and with separate contractors shall be through the Owner.

§ 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 additional inspection or testing of the Work in accordance with Sections 13.5.2 and 13.5.3, whether or not such 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, material and equipment suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect will review, 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 as to cause no delay in the work or in the activities of the Owner, Contractor, or Subcontractor, 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, unless otherwise specifically stated by the Architect, 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, Change Proposal Requests, and Construction Change Directives, and may authorize minor changes in the Work as provided in Section 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; will 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, and will issue a final Certificate for Payment upon compliance with the requirements of the Contract Documents.

§ 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.

§ 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. If no agreement is made concerning the time within which interpretations required of the Architect shall be furnished in compliance with this Section 4.2, then delay shall not be recognized on account of failure by the Architect to furnish such interpretations until 15 days after written request is made for them.

§ 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.

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§ 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 Contractor shall not cover up any work without the Architect and Owner performing an observation of such work. The Contractor will be responsible for any and all associated costs to allow for observations of the work, uncovered, by the Architect and Owner if the Contractor covers work without either the consent of the Architect and Owner or without providing the Architect and Owner with reasonable opportunity to observe the work, whether or not such work is found to be acceptable by the Architect or Owner.

§ 4.3 Claims and Disputes

§ 4.3.1 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. Claims must be initiated by written notice. The responsibility to substantiate Claims shall rest with the party making the Claim.

§ 4.3.2 Time Limits on Claims. Claims by either party must 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. Claims must be initiated by written notice to the Architect and the other party.

§ 4.3.3 Continuing Contract Performance. Pending final resolution of a Claim unless as otherwise agreed in writing, the Contractor shall proceed diligently with performance of the Contract.

§ 4.3.4 Claims for Concealed or Unknown Conditions. If conditions are encountered at the site which are (1) subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature, which 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, then notice by the observing party shall be given to the other party promptly before conditions are disturbed and in no event later than 21 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if 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 an equitable adjustment 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 so notify the Owner and Contractor in writing, stating the reasons. Claims by either party in opposition to such determination must be made within twenty-one (21) days after the Architect has given notice of the decision. If the conditions encountered are materially different, the Contract Sum and Contract Time shall be equitably adjusted, but if the Owner and Contractor cannot agree on an adjustment in the Contract Sum or Contract Time, the adjustment shall be referred to the Architect for initial determination, subject to further proceedings pursuant to Section 4.4.

§ 4.3.5 Claims for Additional Cost. If the Contractor wishes to make Claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the Work. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.6.

§ 4.3.6 If the Contractor believes additional cost is involved for reasons including but not limited to (1) a written interpretation from the Architect, (2) an order by the Owner to stop the Work where the Contractor was not at fault, (3) a written order for a minor change in the Work issued by the Architect, (4) failure of payment by the Owner, (5) termination of the Contract by the Owner, (6) Owner's suspension or (7) other reasonable grounds, Claim shall be filed in accordance with this Section 4.3.

§ 4.3.7 Claims For Additional Time

§ 4.3.7.1 If the Contractor wishes to make Claim for an increase in the Contract Time, written notice as provided herein 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.

§ 4.3.7.2 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.

§ 4.3.8 Injury or Damage to Person or Property. If either party to the Contract 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, written notice of such 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.

§ 4.3.9 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed in a proposed Change Order or Construction Change Directive so that application of such unit prices to quantities of Work proposed will cause substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 4.3.10 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 without limitation:

- .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 4.3.10 shall be deemed to preclude an award of liquidated direct damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 4.4 Resolution of Claims and Disputes

§ 4.4.1 Decision of Architect. Claims, including those alleging an error or omission by the Architect, shall be referred initially to the Architect for recommendation. If the parties are unable to agree, an appeal may be submitted as stated in Section 4.4.1.1 below.

§ 4.4.1.1 Any claim, disputes or matters arising out of this contract between the Architect, Owner and Contractor or any combination of those parties shall be submitted to a court of appropriate jurisdiction.

§ 4.4.2 The Architect will review Claims and within ten (10) days of the receipt of the Claim take one or more of the following preliminary actions: within ten (10) days of receipt of claim: (1) request additional supporting data from the claimant, (2) submit a schedule to the parties indicating when the Architect expects to take action, (3) reject the Claim in whole or in part, stating the reasons for rejection, (4) recommend approval of the Claim by the other party, or (5) suggest a compromise.

§ 4.4.3 In evaluating Claims, the Architect 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 Architect in rendering a decision. The Architect may request the Owner to authorize retention of such persons at the Owner's expense.

§ 4.4.4 If the Architect requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten (10) days after receipt of such request, and shall either provide a response on the requested supporting data, advise the Architect when the response or supporting data will be furnished or advise the Architect that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Architect will either reject or approve the Claim in whole or in part.

§ 4.4.5 The Architect will approve or reject Claims by written decision, which shall state the reasons therefore and which shall notify the parties of any change in the Contract Sum or Contract Time or both. The approval or rejection of a Claim by the Architect shall be final and binding on the parties but subject to mediation.

§ 4.4.6 Upon receipt of a Claim against the Contractor or at any time thereafter, the Architect or 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 Architect or the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 4.4.7 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 prior to resolution of the Claim by the Architect, or by mediation.

§ 4.4.8 If a Claim has not been resolved after consideration of the foregoing and of further evidence presented by the parties or requested by the Architect, the Architect will notify the parties in writing that the Architect's decision will be made within seven (7) days.

Upon expiration of such time period, the Architect will render to the parties the Architect's written decision relative to the Claim, including any change in the Contract Sum or Contract Time or both. If there is a surety and there appears to be possibility of a Contractor's default, the Architect shall notify the surety and request the surety's assistance in resolving the Claim.

§ 4.5 Mediation

§ 4.5.1 Any Claim arising out of or related to the Contract, except Claims relating to aesthetic effect and except those waived as provided for in Sections 4.3.10, 9.10.4 and 9.10.5 shall, after initial decision by the Architect or 30 days after submission of the Claim to the Architect, be subject to mediation only upon the mutual consent of both parties. In the event that mutual consent is not achieved, the parties are free to pursue any claims, disputes or matters in any manner allowed by law.

§ 4.5.2 Mediation, 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 and with the American Arbitration Association.

§ 4.5.3 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.

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

(Paragraph deleted)

§ 5.2.1 As soon as practicable after award of the Contract, but not later than five (5) days prior to the submittal date for the Contractor's first Application for Payment, the Contractor shall furnish in writing to the Owner and the Architect the names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each principal portion of the Work. Where subcontractors have been listed in the Specifications or on the Contractor's Proposal Form, the proposed entities shall be those firms listed in the Specifications and on the Contractor's Proposal Form, unless an agreement has been reached with the Owner to accept a proposed substitute(s). The Architect will promptly reply to the Contractor in writing stating whether or not the Owner or the Architect, after due investigation, has reasonable objection to any such proposed person or entity. Failure of the Owner or Architect to reply promptly shall constitute notice of no objection. Failure of the Contractor to submit the subject names in a timely manner will delay processing of the Contractor's Application for Payment.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made a timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made an objection under provisions of Subparagraph 5.2.1.

§ 5.2.3 If the Contractor has acted promptly and responsibly in submitting names as required, and the Owner or Architect objects to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no objection. The Contract Sum 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.

§ 5.2.4 Prior to any substitution of a subcontractor by the Contractor, the Contractor shall notify the Architect of his intent and reasons for such proposed substitutions. The Contractor shall not substitute a Subcontractor, person or entity previously selected if the Owner or Architect objects to such change.

(Paragraphs deleted)

§ 5.2.5 The Contractor shall submit the list of proposed Subcontractors on AIA Document G805 or the form provided in the Project Manual.

§ 5.2.6 The Contractor is required to visit the site and completely familiarize himself with the existing conditions prior to the proposal. Neither additional increase in the Contract Sum nor extension in Contract Time will be granted when existing or known conditions require a certain amount of work to comply with the intent of the Contract Documents.

§ 5.3 Subcontractual Relations

By appropriate agreement, written where legally required for validity, 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, which the Contractor, by these 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. 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. Each subcontractor shall provide proof of insurance to Contractor consistent with the Contractor's insurance to Owner and in an amount commensurate with the Work to be performed by the Subcontractor.

§ 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 in writing; and
- .2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

§ 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.

(Paragraph deleted)

§ 5.5 Neither the Owner nor the Architect shall be obligated to pay or to ensure the payment of any monies to subcontractors due to any non-payment to the Contractor or non-payment of subcontractors by the Contractor.

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 Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and to award separate contracts in connection with other portions of the Project or other construction or operations on the site under Conditions of the Contract identical or substantially similar to these including those portions related to insurance and waiver of subrogation. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, the Contractor shall make such Claim as provided in Section 4.3.

§ 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 other separate contractors and the Owner in reviewing their construction schedules when directed to do so. The Contractor shall make any revisions to the 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, the Owner shall be deemed to be subject to the same obligations and to have the same rights that apply to the Contractor 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 report to the Architect apparent discrepancies or defects in such other construction that would render it unsuitable for such proper execution and results. Failure of the Contractor so to report 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, except as to defects not then reasonably discoverable.

§ 6.2.3 The Owner shall be reimbursed by the Contractor for costs incurred by the Owner which are payable to a separate contractor because of delays, improperly timed activities or defective construction of the Contractor. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of delays, improperly timed activities, damage to the Work or defective construction of a separate contractor.

§ 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, Change Proposal Request, Construction Change Directive, order for a minor change in the

Work, or a Change Proposal Request issued by Architect or Contractor, signed by Owner, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 All Change Orders and Change Proposal Requests 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, and the Contractor shall proceed promptly, unless otherwise provided in the Change Order, Change Proposal Request 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.

§ 7.2.2 The parties mutually may agree upon a Change Order that adjusts Contract Time and/or Contract Sum based on a change in the Scope of Work requested by the Owner or that results from unanticipated, extraordinary adverse weather conditions as described in Article 15 of these General Conditions. The parties further agree that Contractor shall proceed with the Work only as set forth in a Change Order upon Contractor's physical receipt of a Change Order duly executed by the Owner. Contractor shall be entitled to reimbursement of a previously agreed to cost for estimating services.

§ 7.2.3 If a change in the Work is to be ordered, a written request shall be issued by Owner to Contractor describing the change and requesting the submission of a Change Order Request. When time does not permit the processing of a Change Order in advance of commencing the change in the Work, upon receipt of a written authorization from Owner, Contractor shall proceed with a change in the Work pursuant to a Construction Change Directive and Contractor shall concurrently proceed with submission of a Change Order Request.

§ 7.2.4 Within thirty (30) days following receipt of a written request, Contractor shall submit a Change Order Request to Owner together with the revised or new documents which, if approved, will become part of the Contract Documents setting forth any requested adjustment in the Contract Sum or the Contract Time, and including an itemization of all costs of material and labor with extensions listing quantities and total costs, and a substantiation of any Claim for an extension of the Contract Time. Any Change Order for a change in the work must be signed by the Owner before the Owner is obligated for payment related to the Change Order. If Contractor is unable to submit the above information within the time limit, it shall notify Owner in writing, setting forth for Owner's approval a date by which Contractor will submit the information as well as a schedule for the performance of the Work for which a Change Order Request will be forthcoming. If within the 30 days the Construction Manager cannot ascertain the financial or time impact of a claim a letter alerting the Owner of a forthcoming claim will suffice. This must be sent during this 30-day window.

§ 7.2.5 If Owner accepts a Change Order Request submitted by Contractor, Contractor shall prepare a Change Order that is based upon such Change Order Request for execution by Contractor and Owner and to the extent that the Owner and Contractor agree, the Contract Sum and Contract Time shall be adjusted as provided in the Change Order upon execution of such Change Order.

§ 7.2.6 Nothing contained herein shall limit the right of Owner to order changes in Work by Change Orders that have not been signed by Contractor, and Contractor shall promptly perform all Work required under the Contract Documents or a Change Order despite its failure to execute the Change Order. However, the Owner shall issue and execute a Change Order authorizing payment for all undisputed amounts.

§ 7.2.7 No change in the Work shall be the basis of an addition to the Contract Sum or a change in the Contract Time unless and until such change has been authorized by a Change Order executed and issued by the Owner in accordance with the Contract Documents. Changes in the Work may be made without notice to Contractor's sureties and absence of such notice shall not relieve such sureties of any of their obligations to Owner.

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§ 7.2.8 Acceptance of a Change Order by the Contractor shall constitute full accord and satisfaction for any and all Claims, whether direct or indirect, including but not limited to, impact or delay damages, arising from the subject matter of the Change Order; or attorneys' fees and costs arising from a dispute with a Subcontractor over the Change Order.

§ 7.2.9 Methods used in determining adjustments to the Contract Sum shall be those listed in Section 7.3.3.

§ 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 and/or Change Proposal Request shall be used in the absence of total agreement on the terms of a Change Order.

§ 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. 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. Contractor shall provide on company letterhead backup documentation and submit proposal cost and/or by either using unit costs method with attached supporting data or by using labor, materials and equipment method with attached supporting data. One form shall be utilized by each trade involved in the change in the work with an overall summary form by the Contractor for the entire change. Where additional Work is involved, the lump sum shall represent the estimated cost of labor and materials; plus markups to cover miscellaneous fees and profit if not funded by an allowance:

To compensate the Contractor or Subcontractor actually performing a part of the Work for the combined cost of miscellaneous fees and profit, the performing party shall be entitled to a single markup not to exceed 15% of the estimated cost of that part of the Work.

To compensate the Contractor for the combined cost of miscellaneous fees and profit on work performed by Subcontractors, the Contractor shall be entitled to a single markup not to exceed 10% of the subcontract amount if not funded from an allowance. (Contractor shall not be allowed a markup for miscellaneous fees and profit if change is funded by an allowance.)

When a Sub-subcontractor performs the Work of a change, the 15% markup for combined miscellaneous fees and profit shall be used only by the Subcontractor. The Subcontractor and Contractor would each be entitled to a single markup not to exceed 10% of the cost to them from the Subcontractor and sub-subcontractor respectively if not funded by an allowance. (Contractor shall not be allowed a markup for miscellaneous fees and profit if change is funded by an allowance.)

- .2 By unit prices stated in the Contract Documents or subsequently agreed upon; Additional markups for miscellaneous fees, 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; or
- .4 As provided in Subsection 7.3.6.
- .5 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 itemization of costs including labor, materials, and Subcontracts. Labor and materials shall be itemized in the manner prescribed above on company letterhead. Where major cost items are Subcontracts, they shall be itemized also. In no case will a change be approved without such itemization.
- .6 For changes in the work the Contractor, Owner and Architect agree to be bound by the below stated required time lines.

Upon issuance of a Change document, Contractors, Subcontractors and Sub-subcontractors shall provide the proposed pricing on company letterhead with the required supporting back up

documentation no later than fifteen (15) business days after receipt of the proposed change document. Architect and Owner shall review Contractor's pricing and within ten (10) business days accept pricing as submitted by the Contractor or reject the pricing and return to the Contractor with specific reasons for rejections. If pricing is rejected, Contractor shall review the specific rejections and modify pricing to address the specific rejection and resubmit to the Architect and Owner comments within two (2) business days after receipt of rejection comments. The Architect and Owner shall review the revised pricing and either accept the revised pricing, or if pricing is still in dispute, the Architect shall issue a Construction Change Directive.

§ 7.3.4

(Paragraphs deleted)

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.

§ 7.3.5 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.

§ 7.3.6 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect or Owner shall determine the method and 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 miscellaneous fees, overhead and profit except if funded by Allowance. 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 7.3.7 shall be limited to the following:

- .1 costs of labor, including social security, retirement and unemployment insurance, fringe benefits required by agreement or custom, and workers' compensation insurance;
- .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, and;
- .4 additional costs of supervision and field office personnel directly attributable to the change.

§ 7.3.7 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 miscellaneous fees and profit shall be figured on the basis of net increase or decrease, if any, with respect to that change.

§ 7.3.8 Pending final determination of the total cost of a Construction Change Directive to the Owner, amounts not in dispute for such changes in the Work shall be included in Applications for Payment accompanied by an approved Change Order or Change Proposal Request indicating the parties' agreement with part or all of such costs. For any portion of such costs that remains in dispute, the Architect will make an interim determination for purposes of monthly certification for payment for those costs. The 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 4.

§ 7.3.9 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 shall be recorded by preparation and execution of an appropriate Change Order.

(Paragraph deleted)

§ 7.4 Minor Changes in the Work

§ 7.4.1 The Architect has authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents with Owner's written approval. Such changes will be effected by written order and shall be binding on the Owner and Contractor. The Contractor shall carry out such written orders promptly with Owner's written approval.

§ 7.5 Changes Funded by Allowances

§ 7.5.1 Allowance balances may be used to fund changes in the work. The Contractor will not be allowed a mark-up for overhead and profit when changes in the work are funded by one of the Allowances. Cost for changes funded by allowances shall be determined by methods described in Article 7.3.3. Miscellaneous fees and profit mark-up shall be allowed on work performed by Subcontractors, Sub-subcontractors and the Contractor's own forces, in accordance with Section 7.2 and 7.3.

§ 7.5.2 Changes funded by Allowances shall require back-up documentation per Section 7.3.3.

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 Unless agreed otherwise, the date inserted on the Agreement form and the Date of Commencement constitute "0" (zero) of the stated Completion Time.

§ 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. The term "regular working day" as used in the Contract Documents shall mean any day from Monday through Friday, exclusive of those holidays normally recognized in the construction industry and/or approved by District-approved calendar.

§ 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, prematurely commence operations on the site or elsewhere prior to the effective date of insurance required by Article 11 to be furnished by the Contractor and Owner, and approved by the Owner. The date of commencement of the Work shall not be changed by the effective date of such insurance. Unless the date of commencement is established by the Contract Documents or a notice to proceed given by the Owner, the Contractor shall notify the Owner in writing not less than five (5) days or other agreed period before commencing the Work to permit the timely filing of mortgages, mechanic's liens and other security interests.

§ 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 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 fire, or other causes beyond the Contractor's control; or by delay authorized by the Owner pending mediation and arbitration; or by other causes that the Architect and Owner determines may justify delay, then the Contract Time shall be extended by Change Order for such reasonable time as the Architect and Owner may determine.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 4.

§ 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.

§ 8.3.4 Extensions of time granted for causes described herein will be granted on the basis of one Regular Working Day extension for each Regular Working Day lost (i.e. seven (7) Calendar Days extension will be granted after five (5) Regular Work Days are lost except as modified by the provisions contained herein related to Anticipated Weather days).

§ 8.3.5 Each Proposer shall include in his proposed construction schedule an allowance of regular work days per year as defined in 1.7.7.4, in which work is delayed for student testing or other unspecified campus events. In addition, each proposer shall include an allowance of Anticipated Weather Days in accordance with following:

Number of anticipated Weather Days (These are regular working days)

January	5	July	8
February	5	August	8
March	5	September	7
April	4	October	4
May	7	November	6
June	7	December	5

§ 8.3.6 Weather Days shall pertain to such items as rain, flooding, snow, unusually high winds, excessively wet grounds, or the like which prevent progress on major portions of the work on regular working days only. If such situations occur on more than the number of Anticipated Weather Days indicated above and if those additional days prevent the Contractor from performing critical portions of the scheduled work, extensions of time cause by inclement weather may be requested as enumerated hereinafter: if the inclement weather is rain related, the rain at the site must have been in excess of 0.5 inch in 24 hours.

§ 8.3.7 At the beginning of each month the Contractor shall submit a status report for the preceding month, showing 1) the scheduled number of Anticipated Weather Days for the particular month, 2) the actual Weather Days requested, and 3) the Net Weather Days (plus, minus, or no change). At times deemed appropriate by the Architect or when requested in writing by the Contractor, the Contract time will be adjusted by Change Order if the total of Net Weather Days is substantially greater than "0". Unused Anticipated Weather Days may be accumulated during the Contract Time and may be used to offset Actual Weather days in other months. If the Contractor fails to submit said monthly status report, it will be assumed that none of the Anticipated Weather Days were used for that month and that they shall accumulate for possible future offset against Net Weather Days; however, if at the end of the project all Anticipated Weather days have not been used, the contract completion time will not be reduced. An example of the monthly schedule to be submitted is as follows:

Month	Anticipated Weather Days (Regular)	Actual Weather Days (Regular) Requested	Net Weather Days (Regular)
January	5	11	6
February	5	0	-5
March	5	2	-3
April	4	2	-2
May	7	12	5
June	7	11	4
Totals	33	38	5

Using this example (and assuming that all requested days were approved) there were 5 Net Weather Days (regular) for the six (6) months of the project and the extension of Contract Time would be seven (7) Calendar Days).

§ 8.3.8 Extensions of the Contract Time will only be considered after the number of anticipated delay days has been expended through mutual agreement by the Owner, Architect and Contractor.

§ 8.3.9 The following is a requirement of the Contract and will be included in the Agreement Between Owner and Contractor under Time of Completion and the blank spaces will be completed indicating the completion date as stated on the Proposal Form.

§ 8.3.10 The Work to be performed under this Contract shall be commenced in accordance with Section 8.1.2 and the following Substantial Completion Date(s) must be achieved. Refer to the Project Manual for description of Phasing, if any.

1. Refer to Document A101-2017 Standard Form of Agreement Between Owner and Contractor as amended, Article 3.3 for required substantial completion date(s).

The parties hereto agree that time is of the essence of this Contract and that the pecuniary damages which would be suffered by the Owner, if the Contractor does not achieve the phased construction completion called for in the Contract Documents by the specified dates, are in their very nature difficult to ascertain. Refer to Section 8.4 for Liquidated Damages.

§ 8.4 Liquidated Damages

§ 8.4.1 The parties hereto agree that time is of the essence of this Contract and that the pecuniary damages which would be suffered by the Owner, if the Contractor does not achieve the phased construction completion called for in the Contract Documents by the specified dates, are in their very nature difficult of ascertainment. The sums per Calendar Day to be paid in consideration of all actual costs such as rental costs, additional supplies, labor, overtime, and especially disruption of the educational programs and lost administrative time, which cannot be readily determined are as follows:

Elementary Schools (New Construction and/or Renovations):	\$1,000.00/Calendar Day
Middle Schools (New Construction and/or Renovations):	\$2,000.00/Calendar Day
High Schools (New Construction and/or Renovations):	\$3,000.00/Calendar Day
Athletic Fields (New Construction and/or Renovations):	\$1,000.00/Calendar Day
Miscellaneous Facilities (New Construction and/or Renovations):	\$1,000.00/Calendar Day

§ 8.4.1.1 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 an equitable sum per Calendar Day for each and every Calendar Day beyond the specified date of Substantial Completion, which the Contractor shall require for Substantial Completion of the Work included in this Contract. 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 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 damages being caused by additional compensation to personnel, for loss of interest on money, and other increased costs, all of which are by their nature difficult of exact ascertainment.

§ 8.4.1.2 If the Contractor fails to complete all requirements of Final Completion within ninety (90) days after the actual Substantial Completion date, Contractor shall be required to attend weekly meetings at the job site or Owner's office until such time as the close-out documents and all punch list items are completed and accepted by Owner. During this time the General Contractor will be charged for the Owner's, Architect's, and any consultant's time. Billable time will include without limitation travel time, meeting time, document preparation, document review, and re-inspection of on-site conditions. These weekly meetings shall include a minimum two (2) hour charge per participant. Costs will be deducted from Contractor's Final Payment. Hourly rates shall be as follows:

Consultants:

- Principal Architect/Engineer/Consultant: \$175.00
- Project Architect/Engineer/Consultant \$150.00
- Staff Architect/Engineer/Consultant \$120.00
- Field Representative/Architect/Engineer/Consultant \$100.00
- Secretarial \$ 50.00

Project Owner:

- Associate Superintendent \$225.00
- Assistant Superintendent \$200.00
- Director \$175.00
- Senior Project Manager \$165.00
- Project Manager \$150.00
- Project Coordinator \$120.00
- Secretarial \$ 50.00
- Maintenance Technician \$ 50.00
- Operations Personnel \$ 33.00

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.

(Paragraph deleted)

§ 9.2 Schedule of Values

§ 9.2.1 Before the first Application for Payment, the Contractor shall submit to the Architect a schedule of values allocated to various portions of the Work, prepared in such form and supported by such data to substantiate its accuracy as the Architect and Owner may require. This schedule, unless objected to by the Architect or Owner, shall be used as a basis for reviewing the Contractor’s Applications for Payment.

§ 9.2.2 In order to facilitate the review of Applications for Payment, the Schedule of Values shall be submitted on AIA Documents G702 and G703 or other similar forms approved by the Owner, and shall include the following:

- .1 General Contractor’s costs for Contractor’s fee, bonds and insurance, mobilization, project close-out etc., shall be listed as individual line items.
- .2 Contractor’s costs 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.
- .3 On major subcontracts, such as mechanical, electrical, plumbing, and low voltage, the schedule shall indicate line items and amounts in detail (e.g. underground, major equipment, fixtures, installation of fixtures, start up, close-out, etc.)
- .4 Costs for subcontract Work shall be listed without any addition of General Contractor’s costs for miscellaneous fees, profit or supervision.
- .5 Where payment for stored materials may be requested prior to installation, material and labor shall be listed as separate line items. Stored materials will only be paid for the amount of actual invoices of same materials.
- .6 Sample pages from an approved schedule of values are included in Section 01 29 73 of the project specifications.
- .7 Where work occurs at more than one building, for the Owner’s accounting purposes and to facilitate the checking and verification of the Contractor’s Application for Payment, cost shall be scheduled separately for each building on the G703 Continuation Sheets. Building additions and renovations shall be listed separately.
- .8 All work outside the building envelope excluding overhangs and canopies shall be listed separately under Site work.

§ 9.3 Applications for Payment

§ 9.3.1 At least ten (10) days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment for operations completed in accordance with the schedule of values.

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Prior to this submittal, the Contractor shall contact the Architect's Field Department and Owner for on-site review of the proposed application. On-site reviews shall include review of all lien releases and stored materials. See project manual for additional requirements. Upon approval by the Architect's Field Department and Owner, the Application for Payment shall be notarized and submitted to the Architect. Included shall be data required to support lien releases, Application for Payment Checklist (Section CA), invoices and/or receipts. Such application shall be notarized, if required, and supported by such data substantiating the Contractor's right to payment as the Owner or Architect may require, such as copies of requisitions from Subcontractors and material suppliers, and reflecting retainage if provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.8, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Change Proposal Requests, but not yet included in Change Orders.

(Paragraph deleted)

§ 9.3.2 Payments will be made on account of materials or equipment 1) incorporated in the Work and 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 The location must be a bonded warehouse.
- .3 Surety must agree, in writing, to each request for payment.
- .4 The Contractor must bear the cost of the Owner's and Architect's expenses related to visiting the off-site storage area.
- .5 All items shall be marked and clearly tagged as property of the Owner.

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 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. Under no circumstances will the Owner reimburse the Contractor for down payments, deposits, or other advance payments for materials or equipment. Contractor shall only be paid for the amount of the actual invoices submitted as backup for stored materials.

The Contractor acknowledges that the review of materials stored off site is an additional service of the Architect and shall be charged for that service. The cost for that service will be established by the Architect and is not subject to appeal.

§ 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, material suppliers, or other persons or entities making a claim by reason of having provided labor, materials and equipment relating to the Work.

§ 9.3.4 Contractor's progress payment draws for fees and general conditions (including miscellaneous fees and profit) shall not exceed the percentage completion of the Work in place for the entire Project as indicated on the Application for Payment.

§ 9.3.4.1 By signing each Application for Payment, Contractor stipulates and certifies the following: that the information presented is true, accurate, and complete; that the Contractor has made the necessary detailed examinations, audits, and arithmetic verifications that the submitted Work has been completed to the extent represented in the Application for Payment, that the materials and supplies identified in the Application for Payment have been purchased, paid for, and received; that the subcontractors have been paid as identified in the Application for Payment or that the Contractor has been invoiced for same; that he has made the necessary on-site inspections to confirm the accuracy of the Application for Payment; that there are no known mechanics' or materialmen's liens outstanding at the date of this requisition; that all due and payable bills with respect to the Work have been paid to date or are included in the amount requested in the current application; that except for such bills not paid but so included, there is no known basis for the filing of any mechanics' or materialmen's liens on the Work; that the Payment Application includes only Work self-performed by Contractor of for which Contractor has been invoiced; and that releases from all subcontractors and materialmen have been obtained in such a form as to constitute an effective release of lien under the laws of the State of Texas covering all Work performed and for which payment has been made by the Owner to the Contractor.

§ 9.3.5 Contractors shall submit digitally one (1) application using AIA Document G702 and G703, Application and

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User Notes:

Certificate for Payment, 1992 Edition. All blanks in the form must be completed and signatures of Contractor and Notary Public must be original on each form.

§ 9.3.6 Contractor shall submit Application to the Architect in sufficient time (no later than Thursday at noon) to ensure that the Architect submits Application to the Owner on the first Monday of the Month (or previous business day if Monday is a Holiday as defined in this Agreement), prior to 12:00 pm. Applications will not be accepted on any other day of the week.

§ 9.4 Certificates for Payment

§ 9.4.1 The Architect will, within seven (7) days after receipt of the Contractor's Application for Payment, either issue to the Owner a Certificate for Payment, with a copy to the Contractor, for such amount as the Architect determines is properly due, or notify the Contractor and Owner in writing of the Architect's reasons for withholding certification in whole or in part 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 comprising the Application for Payment, that, to the best of the Architect's knowledge, information and belief, the Work has progressed to the point indicated and that the quality of the Work is in accordance with the Contract Documents. 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. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. 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 material 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.

§ 9.4.3 The Architect will affix his signature to the same form described in Paragraph 9.3.4 to signify his certification of payment provided the application is otherwise satisfactory.

§ 9.4.4 The issuance of a Certificate for Payment shall constitute a recommendation to the Owner regarding the amount to be paid, this recommendation is not binding on the Owner if the Owner knows of other reasons under the Contract Documents why payment should be withheld.

§ 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 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 persistent failure to carry out the Work in accordance with the Contract Documents.

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

(Paragraphs deleted)

§ 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 (7) 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 Neither the Owner nor Architect shall have an obligation to pay or to see to the payment of money to a Subcontractor except as may otherwise be required by law.

§ 9.6.5 Payments to material and equipment 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 and 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, shall create any fiduciary liability or tort liability on the part of the Contractor for breach of trust or shall entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

(Paragraph deleted)

§ 9.6.8 Based upon Applications for Payment and supporting documents including monthly updates of record drawings 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 in the conditions of the Contract as follows:

95% of the proportion of the Contract Sum properly allocable to labor, materials and equipment incorporated in the Work and 95% of the portion of the Contract Sum properly allocable to materials and equipment suitably stored at the site or at some other location agreed upon in writing by the parties; less the aggregate of previous payments in each case; and upon Substantial Completion of the entire work, a sum sufficient to increase the total payments to 95% of the Contract Sum less such retainages as the Architect shall determine for all incomplete work and unsettled claims.

Owner reserves the right to require that conditional Lien Releases be submitted by the Contractor and all subcontractors, sub-subcontractors and major suppliers with each Application for Payment after the first Application for Payment for which payment was made by the Owner for the certified amount for all previous applications for payments. Owner may withhold payment on-line items for which a lien or claim (or similar notice of intent) has been filed, until satisfactory release has been received by Owner.

Contractor shall not withhold as retainage a greater percentage for the Subcontractors or materialmen than the percentage that Owner withheld as retainage from payments to the Contractor.

§ 9.7 Failure of Payment

If the Architect does not issue a Certificate for Payment or notify Contractor of rejection, through no fault of the Contractor, within seven (7) days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven (7) days after the date established in the Contract Documents the amount certified by the Architect, then the Contractor may, upon seven (7) additional days' written 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 shut-down, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.7.1 If the Owner is entitled to reimbursement or payment from the Contractor under or pursuant to the Contract Documents, then such payment shall be made promptly upon demand by the Owner. Any payments that are past due more than thirty (30) days after the Owner's invoice date may result in owner's rejection of Application for Payment.

§ 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work is sufficiently complete for the Owner to occupy, operate, and maintain the Work. Owner and Architect shall make the final determination as to which provisions of the Contract Documents are necessary to meet this criteria, whether or not such requirements are specifically enumerated in this Section or in other portions of the Contract Documents as being specifically required for Substantial Completion.

§ 9.8.1.1 The following items are a partial list of requirements, as applicable to the Project, that must be completed prior to the established Substantial Completion. This is not intended to be an exhaustive list, but a guideline:

1. All fire alarm system components must be completed and demonstrated to the Owner.
2. All inspections by government authorities having jurisdiction over the project must have been finalized, any remedial work required by them must have been completed, and Certificates of Occupancy, local fire marshal and health department approval certificates and similar governmental approval forms must have been issued and copies delivered to the Owner and Architect.
3. All exterior clean-up and landscaping must be complete, including required stand of grass mowed, edged, weeded, and fertilized.
4. All interior shall have been completed and cleaned except minor items which, if complete after occupancy, will not, in the Owner's opinion, cause interference to the Owner's use of the building or any portion thereof. Contractor shall provide list of these specific items, which include punch list and completion items. 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 shall be the sole judge of what constitutes a significantly large number of items.
5. All third-party HVAC air and water balancing must be complete.
6. All energy management systems must be complete, fully operational and demonstrated to the Owner, with graphics transferred to the main server.
7. All emergency/standby generator and low voltage lighting control systems must be complete, fully operational and demonstrated to the Owner.
8. All security systems must be complete, fully operational and demonstrated to the Owner, and must be monitorable from the District's central Police/Security Center.
9. All school communications equipment, telephone systems and P.A. systems must be complete and demonstrated to the Owner.
10. All final lockset cores must be installed and all final Owner directed keying completed.
11. All room plaques and exterior signage must be complete.
12. All Owner demonstrations must be completed including kitchen equipment, HVAC equipment, plumbing equipment, and electrical equipment and all life safety systems.
13. A final certificate of occupancy must be signed by the Contractor and delivered to the Owner.
14. All operation and maintenance manuals are delivered and approved by Architect and Owner ("D-slant" ring binders in duplicate).
15. Health Department Inspections and Municipal Utility District (MUD) and Drainage District and County approvals must be provided.
16. All other reports, testing results, certifications, studies, etc. required by Contract Documents.

§ 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

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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, operate, and maintain 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, shall establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and shall 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 such Certificate.

§ 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 as required under Article 11 and authorized by public authorities having jurisdiction over the Work. 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 written notice that the Work is ready for final inspection and acceptance, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, and the Owner agrees that all closeout requirements have been fulfilled, 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 terms and conditions of 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 and will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner, (3) a written statement that the Contractor

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knows of no substantial 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 and (5), if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, 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.

§ 9.10.3 Prior to final payment, the Contractor shall submit in triplicate (one (1) original and two (2) copies) to the Architect the following completed forms:

1. Contractor's Affidavit of Payment of Debts and Claims, AIA Document G706.
2. Contractor's Affidavit of Release of Liens, AIA Document G706A
3. Consent of Surety to Final Payment, AIA Document G707.
4. General Contractor's Guarantee - notarized
5. Subcontractor's Warrantees from each Subcontractor on Final Subcontractor List
6. All Subcontractors and suppliers and also any other parties that had submitted claims of non-payment shall submit Conditional Lien Releases – notarized. Executed document shall be dated within thirty (30) days of submission of final pay application.
7. Each Offeror (and Subcontractor and supplier submitting a proposal to an Offeror) shall submit a notarized affidavit stating that no asbestos, PCB or lead containing building materials were used on Owner's form.
8. Maintenance, inspection and warranty manuals. Two (2) sets of each bound in a 3-inch "D-slant" ring binder.
9. Record drawings. See Section 3.20.
10. Final Subcontractor List.
11. Refer to Specification Section 01 77 00, Guarantees, Certificates and Project Closeout for any additional information and requirements.
12. Executed TEA Project Compliance Certificate Form (Form 'AL').
13. Executed project Close-Out Form (Form 'AO'), and any additional provisions stated on Form 'AO' as being the responsibility of Contractor.

Documents identified as affidavit must be notarized. All documents requiring signatures must have original signatures (no stamps), and must indicate printed name of signer. All manuals will contain an index listing the information submitted. The index sections will be divided and identified by tabbing each section as listed in the index.

All Manufacturers' warranties must be on manufacturer's original form, indicating project name, and length of warranty.

The Owner may accept certain portions of the work as being complete prior to the acceptance of the entire project. If certain areas are accepted by the Owner as being complete, and if the Contractor has completed all of the requirements for final payment of that portion of work, the Owner may release retainage for that area/portion of work. Amounts of retainage shall be agreed upon by both Owner and Contractor prior to final acceptance of these areas.

Refer to Project Manual for additional requirements.

§ 9.10.4

(Paragraphs deleted)

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 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 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.

§ 9.10.5 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

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- .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; or
- .3 terms of special warranties required by the Contract Documents.

§ 9.10.6 Acceptance of final payment by the Contractor, a Subcontractor or material 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.

§ 10.1.1 Contractor's employees, agents, and Subcontractors and Sub-subcontractors shall not perform any service under this Contract while under the influence of alcohol or any controlled substance. Contractor, its employees, agents, and Subcontractors shall not use, possess, distribute, or sell illicit or unprescribed controlled drugs or drug paraphernalia, or misuse legitimate prescription drugs while performing the Work. Contractor, its employees, agents, and Subcontractors shall not use, possess, distribute, or sell alcoholic beverages while performing the Work.

§ 10.1.2 Contractor has adopted or will adopt its own policy to assure a drug and alcohol-free workplace while performing the Work. Contractor will remove any of its employees from performing the Work any time there is suspicion of alcohol and/or drug use, possession, or impairment involving such employee, and at any time an incident occurs where drug or alcohol use could have been a contributing factor. Owner has the right to require Contractor to remove employees from performing the Work any time cause exists to suspect alcohol or drug use. In such cases, Contractor's employees may only be considered for return to work after the Contractor certifies as a result of a for-cause test, conducted immediately following removal that said employee was in compliance with this Contract. Contractor will not use an employee to perform the Work who either refuses to take, or tests positive in any alcohol or drug test.

§ 10.1.3 Contractor will comply with all applicable federal, state, and local drug and alcohol related laws and regulations (e.g., Department of Transportation regulations, Department of Defense Drug-free Work-free Workforce Policy, Drug-Free Workplace Act of 1988). Owner has also banned the presence of all weapons on the Project Site, whether or not the owner thereof has a permit for a concealed weapon.

§ 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 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 owners and users of adjacent sites and utilities.

§ 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. When use or storage of explosives or other Hazardous Substances (as hereinafter defined) or equipment or unusual construction methods are necessary, the Contractor shall give the Owner reasonable advance notice of the presence or use of such materials, equipment, or methods. Contractor shall be

responsible for any Hazardous Substances Contractor or Contractor's employees, contractors, consultants, subcontractors, sub-subcontractors, materialmen, and suppliers use, store, or otherwise introduce to the Premises.

§ 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, except damage or loss 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.

(Paragraphs deleted)

§ 10.2.8 The Contractor shall be responsible for taking all precautions necessary to protect the work in place from any weather conditions including without limitations to flooding, freezing, high winds, tropical storms, hurricanes, etc. 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 such weather conditions.

§ 10.3 Hazardous Materials

§ 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, 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 report the condition to the Owner and Architect in writing.

§ 10.3.2 If requested in writing by the Contractor, 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 verify that it has been rendered harmless. If requested in writing by the Contractor or Architect, 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 such material or substance or who are to perform the task of removal or safe containment of such 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.

(Paragraphs deleted)

§ 10.4 The Owner shall not be responsible under this Section 10.3 for materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents.

§ 10.5 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 Section 4.3.7.

§ 10.6 Asbestos, Lead or PCBs Containing Materials

§ 10.6.1 The contractor and each subcontractor, **sub-subcontractor and suppliers** prior to final payment, shall submit an original notarized statement on their letterhead certifying "to the best of their information, knowledge, and belief asbestos-, lead-, and PCB-containing materials, and have not been used or incorporated into the Work and lead or lead-bearing materials have not been incorporated into potable water systems." For the purpose of definition as used in

this statement, the term "potable water systems" includes, but is not limited to, those water systems for drinking fountains, all sinks, showers, bath tubs, residential and commercial kitchen equipment, ice machines, and hose bibs, as applicable to the project.

§ 10.6.2 To the best knowledge of the Owner, the Architect and his consultants, no products or materials containing asbestos or polychlorinated biphenyl (PCB) or other toxic substances have been specified for this project. No products or materials containing asbestos or PCB are to be incorporated in this project. In the event the Contractor or his Sub-contractors become aware that any products or materials specified, ordered, scheduled for or already incorporated in the work on this project, contain asbestos, or PCB, the situation shall be reported immediately to the Owner and Architect in writing. An acceptable, equal substitute for the product or material in question shall be proposed by the Contractor and the product or material in question, if already onsite or incorporated in the work, shall be removed from the site immediately and returned to the supplier or manufacturer.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Liability Insurance

(Paragraph deleted)

§ 11.1.1 Refer to Section BD - Insurance and Bonds Requirements for Contractors and Facility Renters Cypress-Fairbanks Independent School District Insurance Management. The Contractor and Contractor's Subcontractors shall purchase and maintain, in a company or companies licensed and admitted by the Texas Department of Insurance to engage in the business of furnishing insurance in the State of Texas, the types and amounts of insurance as set forth in Section BD of the Agreement to protect it and the Owner from claims that may arise out of, or result from, the Contractor's operations under the Contract, whether such operations be by itself, or by any Subcontractor, or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable. All insurance companies shall have an "A-VIII" in Best's Rating Guide and shall be satisfactory to the Owner. No Work will be commenced until all requirements of this Article have been approved by the Owner in writing.

§ 11.1.2 The insurance required by Section BD - Insurance and Bonds Requirements for Contractors and Facility Renters Cypress-Fairbanks Independent School District Insurance Management shall be written for not less than limits of liability specified in the Contract Documents or required by law, whichever coverage is greater. Coverages, whether written on an occurrence or claims-made basis, shall be maintained without interruption from date of commencement of the Work until dates specified in Section BD.

§ 11.1.3 Original Certificates of insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work. These certificates and the insurance policies required by this Section BD – Insurance and Bonds Requirements for Contractors and Facility Renters Cypress-Fairbanks Independent School District Insurance Management shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire until at least thirty (30) days prior written notice has been given to the Owner. If any of the foregoing insurance coverages are required to remain in force after final payment and are reasonably available, an additional certificate evidencing continuation of such coverage shall be submitted with the Final Application for Payment as required by Section 9.10.2. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness in accordance with the Contractor's information and belief.

(Paragraphs deleted)

§ 11.2 Owner's Liability Insurance

§ 11.2.1 The Owner shall be responsible for purchasing and maintaining the Owner's usual liability insurance.

(Paragraphs deleted)

§ 11.3 Project Management Protective Liability Insurance

§ 11.3.1 Optionally, the Owner may require the Contractor to purchase and maintain Project Management Protective Liability insurance from the Contractor's usual sources as primary coverage for the Owner's, Contractor's and Architect's vicarious liability for construction operations under the Contract. Unless otherwise required by the Contract Documents, the Owner shall reimburse the Contractor by increasing the Contract Sum to pay the cost of purchasing and maintaining such optional insurance coverage, and the Contractor shall not be responsible for purchasing any other liability insurance on behalf of the Owner. The minimum limits of liability purchased with such coverage shall be equal to the aggregate of the limits required for Contractor's Liability Insurance under Section 11.1.1.

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(Paragraphs deleted)

§ 11.3.2 To the extent damages are covered by Project Management Protective Liability insurance, the Owner, Contractor and Architect waive all rights against each other for damages, except such rights as they may have to the proceeds of such insurance. The policy shall provide for such waivers of subrogation by endorsement or otherwise.

§ 11.4 Performance Bond and Payment Bond

§ 11.4.1 The Owner requires the Contractor to furnish payment and performance bonds covering faithful performance of the Contract and payment of obligations arising thereunder as stipulated in bidding requirements or specifically required in the Contract Documents on the date of execution of the Contract in a total amount equal to 100% of the Contract Sum and in conformity with applicable law. All bonds shall be issued by a surety company licensed, listed, and authorized to issue bonds in the State of Texas by the Texas Department of Insurance. The surety company may be required by the Owner to have a rating of not less than "B" in the latest edition of Best's Insurance Reports, Property-Casualty. The surety company shall provide, if requested, information on bonding capacity, other projects under coverage and shall provide proof to establish adequate financial capacity for the Project. Should the bond amount be in excess of ten percent (10%) of the surety company's capital and surplus, the surety company issuing the bond shall certify that the surety company has acquired reinsurance, in a form and amount acceptable to the Owner, to reinsure the portion of the risk that exceeds ten percent (10%) of the surety company's capital and surplus with one or more reinsurers who are duly authorized and admitted to do business in Texas and that amount reinsured by a reinsurer does not exceed ten percent (10%) of the reinsurers capital and surplus.

§ 11.4.2 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 permit a copy to be made.

§ 11.4.3 The Contractor shall deliver the required Bonds to the Owner not later than the date of the preconstruction meeting if the Contract has been executed by Owner. All Bonds will be reviewed and approved by the Owner for compliance with the Contract Documents prior to the Contractor mobilizing onsite. Upon Owner approval, the Contractor will be allowed to mobilize onsite.

§ 11.4.4 All bonds shall be originals. The Contractor shall require the attorney in fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of the power of attorney. The name, address, and telephone number of a contact person for the Bonding Company shall be provided.

§ 11.4.5 Bonds shall guarantee the faithful performance of all the covenants, stipulations, and agreements of the Contract. Bonds shall be signed by an agent resident in the State of Texas and date of bond shall be the date of execution of the Contract. If at any time during the continuance of the Contract, the surety of the Contractor's bonds becomes insufficient, the Owner shall have the right to require additional and sufficient sureties which the Contractor shall furnish to the satisfaction of the Owner within ten (10) days after notice to do so. In default thereof, all payment or money due to the Contractor may be withheld until Contractor provides additional surety.

§ 11.4.6 It is distinctly understood that no mechanic, contractor, Contractor, materialman, vendor, artisan or laborer, skilled or unskilled, shall have, claim or acquire any lien upon the Project or any of the improvements in the Project, nor upon any of the land upon which the Project is located.

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, costs of uncovering and replacement shall, by appropriate Change Order, be at the Owner's expense. If such Work is not in accordance with the Contract Documents, such costs and the cost of correction shall be at the Contractor's expense unless the condition was caused by the Owner or a separate contractor in which event the Owner shall be responsible for payment of such costs.

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§ 12.2 Correction of Work

§ 12.2.1 Before or After Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, whether discovered before or after 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 (1) 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 an 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 written 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 2.4.

§ 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.

(Paragraph deleted)

§ 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, whether completed or partially completed, of the Owner or separate contractors 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

§ 12.3.1 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

§ 13.1.1 The Contract shall be governed by Texas law and mandatory and exclusive venue for any disputes shall be in Harris County, Texas.

§ 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns and legal representatives to the other party hereto and to partners, successors, assigns and legal representatives of such other party in respect to covenants, agreements and obligations contained in the Contract Documents. Neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make such

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an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

(Paragraph deleted)

§ 13.3 Written Notice

Written notice shall be deemed to have been duly served if delivered in person to the individual, to a member of the firm or entity, or to an officer of the corporation for which it was intended; or if delivered at, or sent by registered or certified mail or by courier service providing proof of delivery to, the last business address known to the party giving notice.

(Paragraphs deleted)

§ 13.4 Rights and Remedies

§ 13.4.1 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.

§ 13.4.2 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 there under, except as may be specifically agreed in writing.

(Paragraphs deleted)

§ 13.5 Tests and Inspections

§ 13.5.1 Tests, inspections and approvals of portions of the Work required by the Contract Documents or by laws, ordinances, rules, regulations or orders of public authorities having jurisdiction shall be made at an appropriate time. 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 which do not become requirements until after bids are received or negotiations concluded.

§ 13.5.2 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 13.5.1, 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 13.5.3, shall be at the Owner's expense.

§ 13.5.3 If such procedures for testing, inspection or approval under Sections 13.5.1 and 13.5.2 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, their Consultants, or Owner's Third Party Consultant services, and expenses shall be at the Contractor's expense.

§ 13.5.4 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.

§ 13.5.5 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.

§ 13.5.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.6 Commencement of Statutory Limitation Period

§ 13.6.1 As between the Owner and Contractor:

- .1 Before Substantial Completion. As to acts or failures to act occurring prior to the relevant date of Substantial Completion, any applicable statute of limitations shall commence to run and any alleged

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cause of action shall be deemed to have accrued in any and all events not later than such date of Substantial Completion;

- .2 Between Substantial Completion and Final Certificate for Payment. As to acts or failures to act occurring subsequent to the relevant date of Substantial Completion and prior to issuance of the final Certificate for Payment, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of issuance of the final Certificate for Payment; and
- .3 After Final Certificate for Payment. As to acts or failures to act occurring after the relevant date of issuance of the final Certificate for Payment, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of any act or failure to act by the Contractor pursuant to any Warranty provided under Section 3.5, the date of any correction of the Work or failure to correct the Work by the Contractor under Section 12.2, or the date of actual commission of any other act or failure to perform any duty or obligation by the Contractor or Owner, whichever occurs last.

§ 13.7 Refer to Specification Sections 01 35 23, 01 35 23.1 and 01 35 23.2 - Special Owner Requirements for additional requirements to be included as part of the Contract.

§ 13.8 The Owner shall have the right to examine, copy and/or audit the books and other records in possession of the Contractor relating to this Contract at any time deemed necessary by the Owner.

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 sixty (60) consecutive days through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, 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 promptly, upon the Contractor's request, reasonable evidence as required by Section 2.2.1.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, 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 (7) days' written notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work properly executed and for proven loss with respect to materials, equipment, tools, and construction equipment and machinery, including reasonable miscellaneous fees, profit, and damages.

§ 14.1.4 If the Work is stopped for a period of sixty (60) consecutive Calendar Days through no act or fault of the Contractor or a Subcontractor or their agents or employees or any other persons performing portions of the Work under contract with the Contractor 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 (7) additional days' written notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 TERMINATION BY THE OWNER FOR CAUSE

(Paragraphs deleted)

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11-17-2024 Issue for Bids

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§ 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 for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;
- .3 repeatedly disregards laws, ordinances, or rules and regulations, or orders of a public authority having jurisdiction; or
- .4 otherwise is guilty of substantial breach of a provision of the Contract Documents.
- .5 fails to furnish the Owner, upon written request, with assurances satisfactory to the Owner, evidencing the Contractor's ability to complete the Work in compliance with all the requirements of the Contract Documents;
- .6 engages in serious or repeated worker misconduct in violation of Article 3.3.2;
- .7 engages in conduct that would constitute a violation of state or federal criminal law, including but not limited to, the laws prohibiting certain gifts to public servants, or engages in conduct that would constitute a violation of the Owner's ethics or conflict of interest policies; or
- .8 fails to proceed continuously and diligently with the construction and completion of the Work, except as permitted under the Contract Documents.

§ 14.2.2 When any of the above reasons exist, 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 (7) days' written 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 the site and 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.

(Paragraph deleted)

§ 14.2.3 The parties hereby agree that: 1) if an order for relief is entered on behalf of the Contractor, pursuant to Chapter 11 of the U.S. Bankruptcy Code; 2) if any other similar order is entered under any debtor relief laws; 3) if Contractor makes assignments for the benefit of one or more of its creditors; 4) if a receiver is appointed for the benefit of its creditors; or 5) if a receiver is appointed on account of its insolvency, any such event could impair or frustrate Contractor's performance of the Contract Documents. Accordingly, it is agreed that upon occurrence of any such event, Owner shall be entitled to request of Contractor or its successor in interest, adequate assurance of future performance in accordance with the terms and conditions of the Contract Documents. Failure to comply with such request within ten (10) days of delivery of the request shall entitle Owner to terminate the Contract and to the accompanying rights set forth in Subparagraphs 14.2.1 through 14.2.6. In all events, pending receipt of adequate assurance of performance and actual performance in accordance with the Contract Documents, Owner shall be entitled to proceed with the Work with Owner's own forces or with other Contractors on a time and material or other appropriate basis, the cost of which will be charged against the Contract Sum.

§ 14.2.4 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.

§ 14.2.5 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 Architect, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.2.6 Contractor hereby assigns the 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).

§ 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.

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§ 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 as described in 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 written 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 Contractor shall be entitled to receive payment from the Owner on the same basis provided in Section 14.1.3.

(Paragraphs deleted)

ARTICLE 15 LABOR STANDARDS

(Paragraphs deleted)

§ 15.1 PREVAILING WAGE RATES

(Paragraphs deleted)

§ 15.1.1. Contractor, Contractor's Subcontractors and Sub-subcontractors shall pay all workers not less than the general prevailing rate of per diem wages for work of a similar character where the project is located as detailed in the "Minimum Wage Schedule" in section CB of the specifications, or as otherwise provided in the Contract Document. Wages listed are minimum rates only. However, no claims for additional compensation above the Contract Sum shall be considered by the Owner because of payments of wage rates in excess of the applicable rate provided herein. Texas Government Code § 2258.001 *et seq.*

(Paragraphs deleted)

§ 15.1.2 Contractor shall forfeit, as a penalty to the Owner, \$60 for each laborer, worker, or mechanic, employed for each calendar day or part of the day that the worker is paid less than the wage rates stipulated in the Contract Documents.

(Paragraphs deleted)

§ 15.1.3 Owner reserves the right to receive and review payroll records, payment records, and earning statements of employees of Contractor, and of Contractor's Subcontractors and Sub-subcontractors.

(Paragraphs deleted)

§ 15.1.4 If no prevailing wage rate schedule is made part of the Contract Documents, then the parties shall use the wage rate determined by the U.S. Department of Labor in accordance with the Davis-Bacon Act, 40 U.S.C. § 276a.

(Paragraphs deleted)

FORM BB

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 this _____ day
of _____, _____.

**2024 CY LAKES HS RENOVATION
CYPRESS-FAIRBANKS INDEPENDENT SCHOOL DISTRICT
CYPRESS-FAIRBANKS I.S.D. PROPOSAL NUMBER: 24-02-5749R-RFP**

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 22.53 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 _____, _____.

Principal (Seal)

Surety Address _____
By: _____
Signature and Printed Name

Surety (Seal)

Surety Telephone Number _____
By: _____
Attorney-in-Fact: Signature and Printed Name

FORM BC

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 this _____ day
of _____, _____.

**2024 CY LAKES HS RENOVATION
CYPRESS-FAIRBANKS INDEPENDENT SCHOOL DISTRICT
CYPRESS-FAIRBANKS I.S.D. PROPOSAL NUMBER: 24-02-5749R-RFP**

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 _____, _____.

Witness: _____ (Seal)
Principal

_____ By: _____
Signature and Printed Name

Witness: _____ (Seal)
Surety

_____ By: _____
Attorney-in-Fact: Signature and Printed Name

_____ Surety Address
_____ Surety Telephone Number

SECTION BD

INSURANCE AND BONDS REQUIREMENTS FOR CONTRACTORS AND FACILITY RENTERS

CYPRESS-FAIRBANKS INDEPENDENT SCHOOL DISTRICT INSURANCE MANAGEMENT

1.0 GENERAL

- A. The District shall require that the following insurance requirements be met on public works contracts:
1. No Work will be commenced until all requirements of this Section have been approved by the District in writing.
 2. The District shall be furnished a Declaration of Insurance evidencing all policies and endorsements required by this Section prior to proceeding with any work.
 3. The insurance shall contain a provision that at least thirty days prior written notice shall be given to the District in the event of cancellation, material change, or non-renewal.
 4. Insurance shall be underwritten by a company rated not less than B+ VII in Best's latest published guide.
 5. There shall be a hold harmless agreement in which the Contractor assumes liability on the contract and holds the School District harmless.
 6. The Contractor shall purchase and maintain in force the following kinds of insurance and bonds for operations under construction contracts and as specified in each section.
 7. No deletions/exclusions from standard coverage form are allowed without the written consent of Cypress-Fairbanks Independent School District.
 8. Furnish copies of subcontractors Certificates of Insurance to Owner.
 9. Furnish copies of Worker Compensation Documents to Owner.

2.0 CASUALTY INSURANCE

- A. Worker's Compensation Insurance Coverage

Definitions:

Certificate of coverage ("Certificate") - A copy of a certificate of insurance, a certificate of authority to self-insure issued by the commission, or a coverage agreement (TWCC-81, TWCC-82, TWCC-83, or TWCC-84), showing statutory workers' compensation insurance coverage for the person's or entity's employees providing services on a project, for the duration of the project.

Duration of the project - includes the time from the beginning of the work on the project until one (1) year after Substantial Completion of the project.

Persons providing services on the project ("subcontractor" in Texas Labor Code 406.096) - includes all persons or entities performing all or part of the services the contractor has undertaken to perform on the project, regardless of whether that person has employees. This includes, without limitation, independent contractors, subcontractors, leasing companies, motor carriers, owner-operators, employees of any such entity, or employees of any entity that furnishes persons to provide services on the project. "Services" shall include, without limitation, providing, hauling, or delivering equipment or materials, or providing labor, transportation, or other service related to a project. "Services" does not include activities unrelated to the project, such as food/beverage vendors, office supply deliveries, and delivery of portable toilets.

1. The contractor shall provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code 401.011 (44) for all employees of the contractor providing services on the project for the duration of the project.

2. The contractor must provide a certificate of coverage to the governmental entity prior to being awarded the contract. The certificate shall show Cypress-Fairbanks Independent School District as the certificate holder. The policy must be endorsed to provide a “waiver of subrogation in favor of Cypress-Fairbanks Independent School District.”
3. If the coverage period shown on the contractor’s current certificate of coverage ends during the duration of the project, the contractor must, prior to the end of the coverage period, file a new certificate of coverage with the governmental entity showing the coverage has been extended.
4. The contractor shall obtain from each person providing services on a project, and provide to the governmental entity:
 - a. a certificate of coverage, prior to that person beginning work on the project, so the governmental entity will have on file certificates of coverage showing coverage for all persons providing services on a project; and
 - b. no later than seven (7) days after receipt by the contractor, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project.
5. The contractor shall retain all required certificates of coverage for the duration of the project and two (2) years thereafter.
6. The contractor shall notify the governmental entity in writing by certified mail or personal delivery, within 10 days after the contractor knows or should know, of any change that materially affects the provision of coverage of any person providing services on the project.
7. The contractor shall post on each project site a notice, in the text, form and manner prescribed by the Texas Workers’ Compensation Commission, informing all persons providing services on the project that they are required to be covered, and stating how a person may verify coverage and report lack of coverage.
8. The contractor shall contractually require each person with whom it contracts to provide services on a project, to:
 - a. provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section 401.011 (44) for all of its employees providing services on the project, for the duration of the project. The policy must be endorsed to provide a “waiver of subrogation” in favor of Cypress-Fairbanks Independent School District;
 - b. provide to the contractor, prior to that person beginning work on the project, a certificate of coverage showing that coverage is being provided for all employees of the person providing services on the project, for the duration of the project. The certificate shall show Cypress-Fairbanks Independent School District as the certificate holder;
 - c. provide the contractor, prior to the end of the coverage period, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project;
 - d. obtain from each other person with whom it contracts, and provide to the contractor:
 - 1) a certificate of coverage, prior to the other person beginning work on the project; and

- 2) a new certificate of coverage showing extension of coverage, prior to the end of the coverage period, if the coverage period shown on the current certificate of coverage ends during the duration of the project.
 - e. retain all required certificates of coverage on file for the duration of the project and for one year thereafter;
 - f. notify the governmental entity in writing by certified mail or personal delivery, within 10 days after the person knew or should have known, of any change that materially affects the provisions of coverage of any person providing services on the project; and
 - g. contractually require each person with whom it contracts to perform as required by paragraphs a - g, with the certificates of coverage to be provided to the person for whom they are providing services.
9. By signing this contract or providing or causing to be provided a certificate of coverage, the contractor is representing to the governmental entity that all employees of the contractor who will provide services on the project will be covered by workers' compensation coverage for the duration of the project, that the coverage will be based on proper reporting of classification codes and payroll amounts, and that all coverage agreements will be filed with the appropriate insurance carrier or, in the case of self-insured, with the commission's Division of Self-Insurance Regulation. Providing false or misleading information may subject the contractor to administrative penalties, criminal penalties, civil penalties, or other civil actions.
10. The contractor's failure to comply with any of these provisions is a breach of contract by the contractor which entitles the governmental entity to declare the contract void if the contractor does not remedy the breach within ten days after receipt of notice of breach from the governmental entity.
11. The Contractor shall post the following language:

REQUIRED WORKERS' COMPENSATION COVERAGE

"The law requires that each person working on this site or providing services related to this construction project must be covered by workers' compensation insurance. This includes persons providing, hauling, or delivering equipment or materials, or providing labor or transportation or other service related to the project, regardless of the identity of their employer or status as an employee." Furnish copies of Workers' Compensation coverage for each person working on the project.

"Call the Texas Workers' Compensation Commission at (512) 440-3789 to receive information on the legal requirements for coverage, to verify whether your employer has provided the required coverage, or to report an employer's failure to provide coverage."

B. Commercial General Liability Insurance (Occurrence basis only).

Each Occurrence Limit		\$1,000,000 CSL
Products/Completed Operations	Aggregate	\$1,000,000
Personal and Advertising Injury	Occurrence	\$1,000,000
Fire Damage, Legal Liability	Any one fire	\$50,000
Medical Expenses	Any one person	\$5,000

- C. The Owner shall be named as an additional insured by endorsement on the Contractor's policy as to the subject job.

2.1 AUTOMOBILE LIABILITY INSURANCE

- A. Business (Commercial) Automobile Liability Insurance
 - 1. Coverage for all owned, non-owned and hired vehicles:

Bodily Injury/Property Damage \$1,000,000 CSL

2.2 UMBRELLA LIABILITY INSURANCE (EXCESS) \$1,000,000

- A. The Owner shall be named as an additional insured on the Contractor's policy as to the subject job.
- B. This policy shall provide coverage over the Workmen's Compensation, Commercial General Liability and Business Automobile Liability policies.

2.3 PROPERTY INSURANCE (BUILDER'S RISK/INSTALLATION FLOATER)

- A. The policy shall be written in the name of the Owner, Contractor, and subcontractors as their interest may appear.
- B. The policy shall be written on an all risk basis for physical loss or damage and include theft, vandalism, malicious mischief.
- C. The amount of coverage shall be for the full insurable value of work.
- D. The deductible shall not be over \$1,000.00 without the approval of the Owner. (Deductible losses shall be paid by the Contractor.)
- E. The policy shall include an endorsement allowing Owner occupancy, and the insurance shall not be canceled or altered on account of partial occupancy prior to completion.
- F. A subrogation clause shall waive subrogation as to the Contractor, subcontractor, sub-subcontractors, the Owner and his employees and representatives.
- G. The original builders risk policy shall be furnished to the Owner prior to start of the job and maintained through Substantial Completion

3.0 BONDS

- A. Bonds are required for public works contracts under the following circumstances:
 - 1. Performance Bond and Labor and Material Payment Bond, each in a personal sum equal to 100% of contract sum if the formal contract is in excess of \$25,000.00.
 - 2. A Proposal Bond or Proposal Security in the amount of 10% of any proposal of \$25,000.00 or more must be submitted with formal proposals on public works contracts or as otherwise specified in each contract.
 - 3. Copies of the bonds shall be filed with the county clerk and the owner shall receive a file receipt.
 - 4. Performance and Payment Bonds shall remain in force for one (1) year after substantial completion.
 - 5. The Work will not be started until the bonds and issuing companies have been accepted in writing as satisfactory by the Owner.
 - 6. The original bonds will be delivered to the Owner with an attached authorized power of attorney.

END OF DOCUMENT

**SECTION CA
APPLICATION AND CERTIFICATION FOR PAYMENT
CHECK LIST AND TRANSMITTAL**

Date: _____ Application for Payment No.: _____
 Project: 2024 Cy Lakes HS Renovation Architect's Proposal Number: 24-05
 Owner: Cypress-Fairbanks Independent School District Architect: NATEX Architects
 Contractor: _____

Transmitted herewith is one (1) completed copy of the above referenced Application and Certificate for Payment. By initialing each item listed below, the undersigned certifies that he/she has personally checked and determined that each of the items is in compliance with the requirements of the Contract Documents.

Item	Description	CONTRACTOR Initial to Acknowledge Compliance	ARCHITECT Initial to Acknowledge Compliance	OWNER Initial to Acknowledge Compliance	Notes, Exceptions
A	One (1) complete copy 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 is less than or equal to the Continuation Sheet grand total percentage complete.				
D	Unconditional Release for each lien or claim that is applicable to period covered in Previously Approved Pay Application. Release must identify exact amount and period as stated in the Application for Payment.				
E	Conditional Release for each lien or claim that is applicable to period covered in Current Pay Application. Release must identify exact amount and period as stated in the Application for Payment.				
F	One (1) copy of Stored Materials Inventory List and Invoices enclosed for each line item of stored materials.				
G	One (1) updated Construction Schedule enclosed.				
H	Recovery Plan from GC if project is behind schedule.				
I	Anticipated Weather Delay Log				
J	Construction Progress Photographs enclosed.				
K	Back charges are paid to date (e.g. Operations (Custodial)/Maintenance overtime, badges and retesting.)				

Submitted by (Signature): _____
 Name (Printed or Typed): _____
 Title: _____
 Date: _____

SECTION CB

**SUPPLEMENTARY CONDITIONS TO THE
GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION AS AMENDED**

Add the following Subparagraph:

1.1.11 DESCRIPTION OF PARTIES

The following definitions apply to parties named in the Contract Documents.

1. Owner: Cypress-Fairbanks Independent School District Facilities & Construction Department
11430-B Perry Road
Houston, Texas 77064
Phone: (281) 897-4057
Representative: Matt Morgan, Asst. Superintendent of Facilities & Construction
2. Architect: Natex Corporation Architects
447 Heights Blvd.
Houston, Texas 77007
Representative: M. Carolina Weitzman
3. Associate Architect: Coleman Partners
3701 Kirby Dr., Suite 988
Houston, Texas 77098
Phone: (225) 387-4414
4. Civil Engineer: Brooks & Sparks
21020 Park Row
Katy, Texas 77449
Phone: (281) 578-9595
5. Structural Engineer: Dally & Associates
9800 Richmond Ave., Suite 468
Houston, Texas 77042
Phone: (713) 337-8881
6. MEP Engineer: Salas O'Brien
10930 W. Sam Houston Pkwy. North, Suite 900
Houston, Texas 77064
Phone: (281) 664-1900
7. Food Service Consultant: Foodservice Design Professionals (FDP)
26215 Oak Ridge Drive
Spring, Texas 77380
Phone: (281) 350-2323

- | | | |
|-----|--|--|
| 8. | Environmental
Consultant: | EFI Global, Inc.
2000 S. Dairy Ashford, Suite 600
Houston, Texas 77077
Phone: (832) 518-5145 |
| 9. | Competition Field
Irrigation
Consultant: | GreenScape Associates
Justin Morales
jmorales@greenscapeassociates.com
Phone: (281) 341-5419 |
| 10. | Irrigation Consultant: | Landesign Group

John O. Williams, RLA
jwilliams@landesignla.com
Phone: 713-899-8899 |

2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

Add the following Subparagraph:

- 2.2.6** The Contractor will be furnished, free of charge, **five (5)** sets of drawings, specifications and addenda, for pickup by the Contractor from the office of the Architect.

15.1 PREVAILING WAGE RATES

- 15.1.3** Prevailing Wage Rate Determination Information follows on the *next page*.

15.1 PREVAILING WAGE RATES

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

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.

END OF DOCUMENT

Section CC

Right of Audit - Examination of Records

1. Records for all contracts, specifically including but not limited to lump sum contracts (i.e. fixed price or stipulated sum contracts), unit price, cost plus or time & material contracts with or without a guaranteed maximum (or not-to-exceed amounts) shall upon reasonable notice be open to inspection and subject to audit, scanning, and/or reproduction during normal business working hours. Such audits may be performed by any Owner's representative, or any outside representative engaged by Owner for the purpose of examining such records. The Owner or its designee may conduct such audits or inspections throughout the term of this contract and for a period of three years after final payment or longer if required by law. Owner's representatives may (without limitation) conduct verifications such as counting employees at the Construction Site, witnessing the distribution of payroll, verifying information and amounts through interviews and written confirmations with Contractor employees, field and agency labor, subcontractors, and vendors.
2. Contractor's "records" as referred to in this Exhibit shall include any and all information, materials and data of every kind and character, including without limitation, records, books, papers, documents, subscriptions, recordings, agreements, purchase orders, leases, contracts, commitments, arrangements, notes, daily diaries, superintendent reports, drawings, receipts, vouchers and memoranda, and any and all other agreements, sources of information and matters that may in Owner's judgment have any bearing on or pertain to any matters, rights, duties or obligations under or covered by any Contract Document. Such records shall include (hard copy, as well as computer readable data if it can be made available), written policies and procedures; time sheets; payroll registers; payroll records; cancelled payroll checks; subcontract files (including proposals of successful and unsuccessful bidders, bid recaps, negotiation notes, etc.); original bid estimates; estimating work sheets; correspondence; change order files (including documentation covering negotiated settlements); backcharge logs and supporting documentation; invoices and related payment documentation; general ledger, information detailing cash and trade discounts earned, insurance rebates and dividends; and any other contractor records which may have a bearing on matters of interest to the Owner in connection with the contractor's dealings with the Owner (all foregoing hereinafter referred to as "records") to the extent necessary to adequately permit evaluation and verification of any or all of the following:
 - a) Compliance with contract requirements for deliverables
 - b) Compliance with approved plans and specifications
 - c) Compliance with Owner's business ethics expectations
 - d) Compliance with contract provisions regarding the pricing of change orders
 - e) Accuracy of contractor representations regarding the pricing of invoices
 - f) Accuracy of contractor representations related to claims submitted by the contractor or any of his payees.
3. Contractor shall require all payees (examples of payees include subcontractors, material suppliers, insurance carriers, etc.) to comply with the provisions of this article by including the requirements hereof in a written contract agreement between Contractor and payee. Contractor will ensure that all payees (including those entering into lump sum contracts) have the same right to audit provisions contained in this contract.
4. Owner's authorized representative(s) shall have reasonable access to the Contractor's facilities, shall be allowed to interview all current or former employees to discuss matters pertinent to the performance of this contract and shall be provided adequate and appropriate workspace, in order to conduct audits in compliance with this article.
5. If an audit inspection or examination in accordance with this article, discloses overpricing or overcharges to the Owner (of any nature) by the Contractor and/or the Contractor's Subcontractors in excess of \$100,000 in addition to making adjustments for the overcharges, the reasonable actual cost of the Owner's audit shall be reimbursed to the Owner by the Contractor. Any adjustments and/or payments which must be made as a result of any such audit or inspection of the Contractor's invoices and/or records shall be made within a reasonable amount of time (not to exceed 90 days) from presentation of Owner's findings to Contractor.

Section CC

Right of Audit – Records to Be Provided to Owner’s Representatives Upon Request

In addition, to the normal paperwork documentation the Contractor typically furnishes to the Owner, in order to facilitate efficient use of Owner resources when reviewing and/or auditing the Contractor’s billings and related reimbursable cost records, the Contractor agrees to furnish (upon request) the following types of information in the specified computer (PC) readable file format(s):

Type of Record	PC Readable File Format
Monthly Job Cost Detail	.pdf and Excel
Detailed job Cost History To Date	.pdf and Excel
Monthly Labor Distribution detail (if not already separately detailed in the Job Cost Detail)	.pdf and Excel
Total Job to date Labor Distrubution detail (if not already included in the detailed Job Cost History to date)	.pdf and Excel
Employee Timesheets documenting time worked by all individuals who charge reimbursable time to the project	.pdf
Daily Foreman Reports listing names and hours and tasks of personnel who worked on the project	.pdf
Daily Superintendent Reports	.pdf
Detailed Subcontract Status Reports (showing original subcontract value, approved subcontract change orders, subcontractor invoices, payment to subcontractors, etc.	.pdf and Excel
Copies of Executed Subcontracts with all Subcontractors	.pdf
Copies of all executed change orders issued to Subcontractors	.pdf
Copies of all documentation supporting all reimbursable job costs (subcontractor payment applications, vendor invoices, internal cost charges, etc.)	.pdf

SECTION 01 10 00

SUMMARY OF WORK

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Project, **2024 Cy Lakes HS Renovation**, with campus locations at the following addresses:
- 5750 Greenhouse Rd., Katy, Texas 77449
- for the Cypress-Fairbanks Independent School District.
- B. The Project(s) consists of but is not limited to:
General facility renovations and additions to include expanded fine arts, CTE, tennis courts, athletic storage building, greenhouse building, miscellaneous site improvements. Interior renovations include but are not limited to new A/V systems, acoustical treatments, refinish gym floors and locker rooms, renovate press boxes, replace exterior waterproofing sealants, electrical upgrades to segregate generator loads, back up power to IDF/MDF, CO detection system, replace refrigerant monitoring system, reinsulate hydronic system piping and associated ceiling work for that scope, dedicated HVAC for IDF/MDF, additional lock down buttons, replace door hardware, additional card readers, renovate reception/waiting area, impact resistant glass/film and other miscellaneous work.
- C. Project Schedule:
1. Substantial Completion date: July 26, 2026
 2. General phasing requirements refer to Part 3.1.B below.

1.2 CONTRACTS AND USE OF SITE

- A. Contractor Use of Premises:
1. Confine operations at site to areas permitted by law, permits, and Contract Documents, or as required to maintain campus operations (as approved by Owner).
 2. Do not unreasonably encumber site with materials or equipment. Refer to Contractor lay-down areas indicated on plans. If not indicated on plans provided, Contractor to submit for approval proposed Contractor designated areas, including but not limited to: lay-down, staging, parking, restroom, trailer, dumpster, field office, etc.
 3. Assume full responsibility for protection and safekeeping of products stored on premises.
 4. Obtain and pay for use of additional storage or work areas as needed for operations.
 5. Contractor shall establish secured staging area for work and coordinate and provide for safe passage and exit from existing building areas during construction, in compliance with all applicable codes and requirements of Owner.
 6. During phased construction, Contractor shall provide maps of building to Owner for each phase, showing construction area and impact to other areas of the building.
 7. Contractor shall coordinate all construction activities with school district officials.
 8. Owner reserves the right to perform construction operations with its own forces or to employ separate contractors on portions of the Project. General Contractor shall coordinate with Owner-performed work in terms of providing site access, workspace, and storage space, cooperation of work forces, scheduling, and technical requirements.
 9. Noise Control: Contractor shall coordinate equipment locations and timing of work activities so as to avoid conflict with the building occupants and/or avoid interference with facility meetings, events, or other activities.

10. Utilities. The contractor is to coordinate all utilities permanent and temporary and make arrangements for installation for any service easements once the Owner provides information that a blanket or final easement exists.
 11. Project Fencing:
 - a. Upon mobilization, the contractor shall build a wire mesh fence (or other type) as directed by Owner, at least six (6) feet high as shown on site plan and/or discussed during the pre-construction meeting.
 - b. Site fencing shall include emergency service and trucking gated in locations shown on the site plan and/or discussed during the pre-construction meeting.
 - c. Contractor shall properly maintain fencing and gates until Substantial Completion and only remove with concurrence from the Owner.
- B. Owner Occupancy:
1. Refer to AIA Document A201™-2017, as amended.
- C. Owner-Furnished/Owner-Installed Items:
1. The Owner reserves the right to place and install equipment in construction areas of the building prior to Substantial Completion, provided that such occupancy does not interfere with completion of the Work. Such placing of equipment shall not constitute acceptance of the total Work. Contractor shall protect Owner's property.
- D. Owner-Furnished/Contractor-Installed Items:
1. The Owner may provide items to the Contractor for installation in accordance with manufacturer's recommendation and instructions.
 2. The Owner will arrange and pay for delivery of Owner-furnished items in accordance with the Contractor's Construction Schedule and will inspect deliveries for damage.
 3. If Owner-furnished items are damaged, defective or missing, through no fault of the Contractor, the Owner will arrange for replacement.
 4. The Contractor is responsible for designating the delivery dates of Owner-furnished items in the Contractor's Construction Schedule and for receiving, unloading and handling Owner-furnished items at the site. The Contractor is responsible for protecting Owner-furnished items from damage, including damage from exposure to elements, and to repair or replace items damaged as a result of his operations.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Refer to Specification Sections.

PART 3 - EXECUTION

3.1 CONSTRUCTION SCHEDULE

A. GENERAL DESCRIPTION OF WORK TO BE PERFORMED UNDER THIS CONTRACT

The Work to be performed under this contract shall commence on Notice to Proceed and shall be Substantially Complete as stipulated by AIA Document A101™-2017, as amended.

B. GENERAL CONSTRUCTION PHASING REFERENCING CFISD NEEDS BELOW, SHALL BE INCORPORATED INTO THE CONTRACT, INCLUDING BUT NOT LIMITED TO:

For the summer of 2025:

- Contractors may take over the building June 2, 2025.

- All athletic areas are to remain fully occupiable for the duration of the summer. Any work in the athletic areas will need to be coordinated with the campus. For gym work, only one gym can be under construction at any given time.
- All athletic, fine arts, dance, and cafeteria areas must be fully occupiable no later than July 15, 2025.
- The balance of the building shall be fully occupiable and turned back over to the district no later than July 27, 2025.
- Occupiable includes, but is not limited to, all life safety, MEP, architectural finishes in place, clean, and functioning as intended.
- Only work that can be removed and re-installed by these dates shall be performed during the summer.
- No partially complete work will be allowed after these dates unless approved in advance by the Owner.
- After these dates, all work shall be performed after hours, nights and weekends, while fully coordinating with the campus.

For the summer of 2026:

- Contractors may take over the building June 1, 2026.
- All athletic areas are to remain fully occupiable for the duration of the summer. Any work in the athletic areas will need to be coordinated with the campus. For gym work, only one gym can be under construction at any given time.
- All athletic, fine arts, dance, and cafeteria areas must be fully occupiable no later than July 15, 2026.
- The balance of the building shall be **SUBSTANTIALLY COMPLETE**, fully occupiable, and turned back over to the district no later than July 26, 2026.
- Occupiable includes, but is not limited to, all life safety, MEP, architectural finishes in place, clean, and functioning as intended.
- Only work that can be removed and re-installed by these dates shall be performed during the summer.
- No partially complete work will be allowed after these dates unless approved in advance by the Owner.
- After these dates, all work shall be performed after hours, nights and weekends, while fully coordinating with the campus.

Furniture Campus

This campus is receiving new student and administrative furniture via separate contract. However, General Contractor to comply with the following:

General Contractor to coordinate with CFISD and CFISD's vendor to provide interior and exterior clear unobstructed paths and access points for deliveries, product staging, product assembly, setup and disposal.

These areas must be available no later than July 15, 2025 and July 15, 2026 respectively.

- Delivery points will be accessible, clear and drivable by numerous eighteen wheeler trucks over a period of several weeks at middle and high schools.
- Staging/assembly areas include but are not limited to commons cafeteria, gyms, large group instruction, larger hallways (not impeding HCFMO fire egress), etcetera.
- Phased installation may include but not be limited to first setting up administration areas then academic classrooms, and finally ancillary support spaces last possibly spilling over from Summer into Thanksgiving week, Winter Break and Spring Break week if necessary
- As a guide, it is anticipated middle school furniture requires 2-3 weeks and high schools 3-4 weeks for phased installations.

END OF SECTION

SECTION 01 11 23

CODES, REGULATIONS AND STANDARDS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Quality Assurance
- B. References Standards
- C. Definitions
- D. Format and Specification Context Explanations
- E. Abbreviations
- F. Drawing Symbols
- G. General Requirements

1.2 QUALITY ASSURANCE

- A. General:
 - 1. For products or Workmanship specified by a standard of an association, trade, or Federal standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable code authorities having jurisdiction.
 - 2. The contractual relationship of the parties to the Contract should not be altered from the Contract Documents by mention or inference otherwise in any reference standard.
 - 3. Obtain copies of standards when required by Contract Documents.
 - 4. Maintain copy of standards at jobsite during submittals, planning, and progress of the specific Work for which the standards pertain, until the date of Substantial Completion.
 - 5. In the absence of specific instructions in the specifications, materials, products, equipment and their installation shall conform to the applicable codes, regulations and standards specified therein. When a conflict exists between the applicable code, regulation and standard and that specified, the more stringent code regulation or standard shall prevail, except as authorized by applicable authorities having jurisdiction.
- B. Industry Standards: Where compliance with two (2) or more industry standards or sets of requirements is specified and overlapping of those different standards or requirements establishes different or conflicting minimums or levels of quality, the most stringent requirement is intended and will be enforced, unless specifically detailed language written into the Contract Documents clearly indicates that a less stringent requirement is to be fulfilled. Refer questions to the Architect for a decision before proceeding.
- C. Contractor's Option: Except for overlapping or conflicting requirements, where more than one (1) set of requirements are specified for a particular unit of Work, the option shall be Contractor's regardless of whether or not it is specifically indicated as such.
- D. Minimum Quality/Quantity: In every instance, the quality level or quantity shown or specified is intended to be the minimum for the Work to be performed or provided. Except as otherwise specifically indicated, the actual Work shall either comply exactly with the minimum (within specified tolerances). In complying with requirements, indicated numeric values are either minimums or

maximums as noted or as appropriate for context of requirements. Refer instances of uncertainty to Architect for decision before proceeding.

- E. Specialists; Assignments: In certain instances, specification text requires (or implies) that specific Work is to be assigned to specialists. Such Work shall be accomplished by the specified specialist. These requirements should not be interpreted so as to conflict with applicable regulations, union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of Work is recognized as “expert” for the indicated construction processes or operations. Notwithstanding any such designation, the final responsibility for fulfillment of all Contract requirements remains with the Contractor.

1.3 REFERENCE STANDARDS

- A. Dates of codes, regulations and standards specified shall be the latest date of issue of that code, regulation or standard prior to the date of issue of this Project Manual or Document, except as modified or otherwise directed by the applicable codes and their supplements and amendments adopted by the code authorities having jurisdiction.
 - 1. Date of Issue - The “date of issue” as it appears in the statement above, means the date which appears on the cover of the Project Manual or Document corresponding to the date of issue of the Contract Documents.
 - 2. Code Authorities: The “code authorities” as it appears in the statement above, means the International Building Code (IBC) with City of Houston Amendments, Harris County Regulations, and those authorities responsible for code enforcement.

1.4 DEFINITIONS

- A. General Explanation: A substantial amount of specification language consists of definitions for terms found in other Contract Documents, including those in the AIA A201 General Conditions of the Contract for Construction as amended, Supplementary Conditions, the Drawings, and the Specifications. Drawings must be recognized as being diagrammatic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in the Contract Documents are defined in the General Conditions, Supplementary Conditions, and in this Section. Definitions and explanations contained in this Section are not necessarily either complete or exclusive but are general for this Work to the extent that they are not stated more explicitly in another element of the Contract Documents. In the event of a conflict in definitions or explanations within the Contract Documents or whenever there is need of clarification or interpretation of definitions within or between the Contract Documents, notify the Architect immediately and proceed as directed. Except in cases where definitions are determined by code authorities having jurisdiction, the Architect’s interpretation of all definitions will take precedence.
- B. General Requirements: The provisions or requirements of Division 1 - Sections apply to entire Work of Contract and, where indicated, to other elements which are included in the Project.
- C. Special Conditions: Wherever the term “Special Conditions”, appears in the Contract Documents, it refers collectively to all requirements of the Owner in addition to the sections in Division 1, General Requirements, and to Articles contained in the General Conditions and Supplementary Conditions.
- D. Architect: Wherever the term “Architect” appears in the Contract Documents, it means NATEX Architects or their authorized representative(s).
- E. Bid, Competitive Sealed Proposal (CSP), Response, Offer, etc.: Wherever the term “Bid”, “Competitive Sealed Proposal (CSP)”, “Response”, “Offer”, “Proposal”, or any derivative thereof, or similar term appears in the Contract Documents, they mean one and the same, and shall mean Competitive Sealed Proposal, which by definition allows the Owner to accept the “best value” for the school district based on factors other than cost in selecting the Contractor.

- F. Contractor, General Contractor, etc.: Wherever the term “Contractor”, “General Contractor”, “Prime Contractor”, “Bidder”, “Bidder/Vendor”, “Vendor”, “Installer”, “Integrator”, “Subcontractor”, “Respondent”, “Offeror”, or any derivative thereof, or similar term appears in the Contract Documents, they mean one and the same, and shall refer to the entity (person or firm) licensed and meeting all applicable regulations of the State of Texas and Department of Labor to perform the Work, or their authorized representative(s).
1. Responsibilities: To avoid any misunderstanding or lack of interpretation, the responsibility for performing the Work is totally that of the entity defined above, and the resolutions proposed in his shop drawings and related documentation shall be demonstrated throughout the Work and specified warranty period.
 2. In the event of a controversy involving the Contract Documents or interpretation of Project requirements, the decision of the Architect will take precedence.
- G. Consultant: Wherever the term “Consultant”, or any derivative thereof appears in the Contract Documents, it means the following:
1. Owner's Consultants:
 - a. Third Party Plan Reviewer: Winning Way
 - b. Materials Testing: Ninyo & Moore
 - c. Roof Inspection: Terracon
 - d. Mechanical Testing and Balancing: EAB
 - e. Commissioning: Terracon
 2. Architect’s Consultants:
 - a. Civil Engineer: Brooks & Sparks
 - b. Structural Engineer: Dally & Associates
 - c. MEP Engineer: Salas O’Brien
 - d. Landscape Consultant: N/A
 - e. Roofing Consultant: N/A
 - f. Food Service Consultant: FDP, Inc.
 - g. Asbestos Abatement Consultant: EFI Global, Inc.
 - h. Geotechnical Engineer: Terracon, Inc.
 - i. Acoustical Engineer: N/A
 - j. Irrigation Consultant: Landesign Group
 - k. Theatrical Acoustical Consultant: Salas O’Brien
- H. Indicated: Wherever the term “indicated”, or any derivative thereof appears in the Contract Documents, it means a cross-reference to graphic representations, notes, or schedules on Drawings, to other paragraphs or schedules in the Specifications, and to similar means of recording requirements in the Contract Documents. Where terms such as “shown”, “noted”, “scheduled”, and “specified” are used in lieu of “indicated”, it is for the purpose of helping reader locate cross-reference, and no limitation of location is intended except as specifically noted.
- I. Directed, Requested, Etc.: Where not otherwise explained, terms such as “directed”, “requested”, “authorized”, “selected”, “approved”, “required”, “accepted”, and “permitted” or any derivative thereof appears in the Contract Documents, it means as “directed by the Architect”, “requested by the Architect”, and similar phrases with actions taken by the Architect. However, no meaning or otherwise shall be interpreted to extend the Architect’s responsibility into Contractor’s area of construction supervision.
- J. Approve: Wherever the term “Approve”, or any derivative thereof appears in the Contract Documents, it means only the Architect, or an individual designated by him as his representative, can approve or disapprove contract actions. Even if the specifications indicate that an individual other than the Architect, such as the “Engineer” or “Consultant” will approve or disapprove an action, it is understood that only the Architect has this authority unless the individual is so designated by him in writing. Even when an individual is so designated, the Contractor may appeal the action

to the Architect and the Architect's decision will be final. In no case will "approval" by the Architect be interpreted as a release of the Contractor from responsibility to fulfill requirements of the Contract Documents.

- K. **Furnish:** Wherever the term "Furnish", or any derivative thereof appears in the Contract Documents, it means supply or deliver to Project site, ready for unloading, unpacking, assembly, erection, placing, installing, anchoring, applying, curing, finishing, protecting, cleaning and similar operations, as applicable in each instance.
- L. **Install:** Wherever the term "Install", or any derivative thereof appears in the Contract Documents, it means performing the operations at the Project site, of unloading, unpacking, assembly, erection, placing, installing, anchoring, applying, curing, finishing, protecting, cleaning and similar operations, as applicable in each instance.
- M. **Provide:** Wherever the term "Provide", or any derivative thereof appears in the Contract Documents, it means furnish and install at the Project site, complete and ready for intended use, as applicable in each instance.
- N. **Project, Site:** Wherever the term "Project", "Site", or similar such term appears in the Contract Documents, it means the space available to the Contractor for performance of the Work, either exclusively or in conjunction with others performing Work as part of the Project. The extent of project or site is shown on the Drawings and may or may not be identical with description of land upon which Project is to be built.
- O. **District, School District, Owner, etc.:** Wherever the term "District", "School District", "Owner", "Cy-Fair ISD", "CFISD", or similar such term appears in the Contract Documents, it means Cypress-Fairbanks Independent School District, 11430 Perry Road, Houston, Texas 77064, (281) 897-4057, or its authorized representative(s).
- P. **Installer:** Wherever the term "Installer", or any derivative thereof appears in the Contract Documents, it means the entity (person or firm) engaged by the Contractor or its subcontractor or sub-subcontractor for performance of a particular unit of Work at the Project, including installation, erection, application and similar required operations. It is a general requirement that such entities (Installers) be expert in operations they are engaged to perform.
- Q. **Specialist:** Wherever the term "Specialist", or any derivative thereof appears in the Contract Documents, it means an individual or firm of established reputation (or if newly organized, whose personnel have previously established a reputation in the same field), which is regularly engaged in, and which maintains a regular force of Workmen skilled in either (as applicable) manufacturing or fabricating items required by the Contract, installing items required by the Contract, or otherwise performing Work required by the Contract. Where the Contract Specification requires installation by a specialist, that term shall also be deemed to mean either the manufacturer of the item or firm who will perform the Work under the manufacturer's direct supervision.
- R. **Testing Laboratory:** Wherever the term "Testing Laboratory", or any derivative thereof appears in the Contract Documents, it means an independent entity engaged to perform specific inspections or tests of the Work, either at the Project site or elsewhere; and to report and (if required) interpret results of those inspections or tests.

1.5 FORMAT AND SPECIFICATION CONTEXT EXPLANATIONS

- A. **Underscoring:** Is used strictly to assist reader of specification text in scanning text for key words (for quick recall). No emphasis on or relative importance is intended where underscoring is used.

- B. Capitalization: Except for manufacturer, product, or trademark names, capitalization is used strictly to assist reader of specification text in scanning text for key words (for quick recall). No emphasis on or relative importance is intended where capitalization is used.
- C. Imperative language: Is used generally in specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities which must be fulfilled indirectly by the Contractor, or when so noted, by others.
- D. Section Numbering: Is used to facilitate cross-reference in Contract Documents. Sections are placed in Project Manual in numeric sequence; however, numbering sequence is not complete, and listing of sections at beginning of Project Manual must be consulted to determine numbers and names of specification sections in Contract Documents.
- E. Page Numbering: Pages are numbered independently for each section. The section number is shown preceded by the project number and followed by the page number at the bottom of each page, to facilitate the location of text. The project number is given to identify the project, for which specification was written, should the section become separated from the Project Manual.
- F. Specifying Methods: The techniques or methods of specifying to record requirements varies throughout text, and may include “prescriptive, “open-generic descriptive”, “compliance with standards”, “performance”, or a combination of these. The method used for specifying one unit of Work has no bearing on requirements for another unit of Work.

1.6 ABBREVIATIONS

- A. The language of Specifications and other Contract Documents is of the abbreviated type in certain instances and implies words and meanings which will be appropriately interpreted. Actual Work abbreviations of a self-explanatory nature have been included in texts. Specific abbreviations have been established, principally for lengthy technical terminology and primarily in conjunction with coordination of specification requirements with notations on drawings and in schedules. These are frequently defined in section at first instance of use. Trade association names and titles of general standards are frequently abbreviated. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of the Contract Documents so indicates. A list of typical abbreviations includes but is not limited to the following trade associations and organizations. Refer to Drawings and other Contract Documents for other abbreviations.

AA	Aluminum Association
AAMA	Architectural Aluminum Manufacturer's Assn.
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACIL	American Council of Independent Laboratories
AGA	American Gas Association
AGC	Associated General Contractors of America
AHA	American Hardboard Association
AHGA	American Hotdip Galvanizers Association
AI	Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron & Steel Institute
AITC	American Institute of Timber Construction
ANSI	American National Standards Institute
APA	American Plywood Association
ARI	Air Conditioning & Refrigeration Institute
ASA	Acoustical Society of America
ASA	American Subcontractors Association
ASC	Adhesive & Sealant Council, Inc.

ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASPE	American Society of Professional Engineers
ASAHC	American Society of Architectural Hardware Consultants
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
ASPI	American Wood Preserver's Institute
ASTM	ASTM International
AWI	Architectural WoodWork Institute
AWS	American Welding Society
BIA	Brick Institute of America
BRI	Building Research Institute
CRA	California Redwood Association
CLFMI	Chain Link Fence Manufacturers Institute
CRSI	Concrete Reinforcing Steel Institute
CSI	Construction Specifications Institute
DHI	Door and Hardware Institute
EPA	Environmental Protection Agency
FTI	Facing Tile Institute
FGMA	Flat Glass Marketing Association
GA	Gypsum Association
HPMA	Hardwood Plywood Manufacturers Association
IBC	International Building Code
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronic Engineers
JSMA	Joint Sealer Manufacturers Association
MFMA	Maple Flooring Manufacturers Association
ML/SFA	Metal Lath/Steel Framing Association
NAAMM	National Association of Architectural Metal Manufacturers
NAMM	National Association of Mirror Manufacturers
NBLP	National Bureau of Lathing & Plastering
NCPI	National Clay Pipe Institute
NCMA	National Concrete Masonry Association
NEMA	National Electrical Manufacturers Assn.
NESC	National Environmental Systems Contractors
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NHLA	National Hardwood Lumber Association
NOMMA	National Ornamental Metal Manufacturers Assn
NPVLA	National Paint, Varnish and Lacquer Assn.
NRMCA	National Ready Mixed Concrete Assn.
NRCA	National Roofing Contractors Association
NSPE	National Society of Professional Engineers
NWMA	National WoodWork Manufacturers Assn., Inc.
OSHA	Occupational Safety and Health Administration
PDCA	Painting and Decorating Contractors of America
PI	Perlite Institute, Inc.
PCA	Portland Cement Association
RFCI	Resilient Floor Covering Institute
RVFC	Rubber and Vinyl Floor Council
SBCCI	Southern Building Code Congress International, Inc.
SFPA	Southern Forest Products Association
SHLMA	Southern Hardwood Lumber Manufacturing Assn.
SDI	Steel Deck Institute
SDI	Steel Door Institute
SJI	Steel Joist Institute

SSPC	Steel Structures Painting Council
TCA	Tile Council of America, Inc.
UBC	Uniform Building Code
UL	Underwriter's Laboratories, Inc.
VBI	Venetian Blind Institute
VFI	Vinyl Fabrics Institute
WCLIB	West Coast Lumber Inspection Bureau
WRCLA	Western Red Cedar Lumber Association
WWPA	Western Wood Products Association

1.7 DRAWING SYMBOLS

- A. General: Except as otherwise indicated, graphic symbols used on drawings are those symbols recognized in the construction industry for purposes indicated. Where not otherwise noted, symbols defined by "Architectural Graphic Standards", published by the American Institute of Architects (AIA) and John Wiley & Sons, Inc., latest edition. Refer instances of uncertainty to Architect for clarification before proceeding.
- B. Mechanical/Electrical Drawings: Graphic symbols used in Mechanical/Electrical Drawings are generally aligned with symbols recommended by American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE). Where appropriate, those symbols are supplemented by more specific symbols as recommended by other recognized technical organizations, including, but not limited to American Society of Mechanical Engineers (ASME), American Society of Professional Engineers (ASPE), Institute of Electrical and Electronic Engineers (IEEE) and similar organizations. Refer instances of uncertainty to Architect for clarification before proceeding.

1.8 GENERAL REQUIREMENTS

- A. Color, Texture, or Pattern Requirements:
1. When color, texture, or pattern is specified, the item, product, or material shall be furnished in the specified color, texture, or pattern, as applicable.
 2. When more than one (1) approved manufacturer is named in the Specifications, Contractor may select any of the approved manufacturers and submit the full range of colors, textures, and patterns (standard and special) available of that manufacturer for the Architect's review and selection.
 3. When the term "match existing", or any derivative thereof appears in the Contract Documents, it means that the sample must match the Owner's existing Work in every respect as to color, texture, and pattern, as applicable.
 4. When the term "match Architect's approved sample", or any derivative thereof appears in the Contract Documents, it means that the Architect has selected a sample which must be matched in every respect as to color, texture, and pattern, as applicable.
 5. When an item or product is specified of a manufacturer for which only one (1) color, texture, or pattern is available, and a color, texture, or pattern other than that one is specified, Contractor shall bring it to the attention of the Architect for a decision prior to proceeding with the Work. Do not proceed with the Work until Architect has approved the color, texture, and pattern, as applicable.
 6. When an item or product is specified of a manufacturer for which no color, texture, or pattern is specified, and colors, textures, and patterns are available, Contractor shall bring it to the attention of the Architect and submit the full range of colors, textures, and patterns (standard and special) available of that manufacturer for the Architect's review and selection. Do not proceed with the Work until Architect has selected and approved the color, texture, and pattern, as applicable.
 7. When due to the nature of the item, product, or material, i.e., face brick, tile pavers, natural stone, etc, Contractor shall submit sample or samples which exhibits the full range of characteristics (colors, i.e. lights and darks, as well as textures, and patterns) for which the item, product, or material is available. The Architect will select the color, texture, and pattern,

- as applicable, from those available and request a sample panel exhibiting the approved characteristics. The approved color range, texture, and pattern, as applicable will then become the standard for which all Work on the project will be judged. Architect will be final judge as to having performed Work in conformance with approved characteristics.
8. Under no circumstances are colors, textures, patterns, or any other characteristics for which an item, product, or material are available to be selected by anyone other than the Architect or Owner.
 9. Non-conforming Work shall be removed from the site and replaced with new conforming Work at no additional expense to Owner.
- B. Continuity of Building Envelope, Full Height Partitions, and Fire Rated Construction:
1. Continuity of Building Envelope:
 - a. All materials such as exterior sheathing, membrane flashings, vapor barriers, insulations, dampproofing, waterproofing, roofing, flashings, etc. and all penetrations, holes, gaps, joints, and openings through such materials shall be sealed to ensure continuity of building envelope, whether indicated or not to eliminate moisture penetration.
 - b. Refer instances of uncertainty to Architect for clarification before proceeding with Work.
 2. Full Height Partitions:
 - a. All full height partitions shall be from floor to bottom of deck structure and shall be made to fit around steel joists, beams, etc., whether indicated or not.
 - b. Seal joints at top of partitions, in flutes of steel deck, and around structural elements with a compressible filler and/or sealant to accommodate movement due to expansion, contraction, and deflection, whether indicated or not. Treat seals in joints of fire rated partitions as specified below for fire rated construction, whether indicated or not.
 - c. Refer instances of uncertainty to Architect for clarification before proceeding with Work.
 3. Fire Rated Construction:
 - a. All seals in fire rated construction, whether at top, bottom, or penetrations through fire rated construction, shall be made with firestopping and firesafing materials to maintain fire rating integrity of construction and satisfy authorities having jurisdiction, whether indicated or not.
 - b. Refer instances of uncertainty to Architect for clarification before proceeding with Work.
- C. Plumbing Line Protection:
1. Placing or washing materials, including, but not limited to the following, down any plumbing line or fixture is strictly forbidden.
 - a. Concrete, cement, sludge, mortar, grout, plaster, or any other cementitious material
 - b. Paint, paint thinner, turpentine, kerosene, gasoline, oil, or any other petroleum or hazardous products.
 2. Cleaning painting equipment, including brushes in new or existing plumbing fixtures is strictly prohibited.
 3. Contractor shall certify that all affected plumbing lines and fixtures are clean, free flowing and running. Plumbing lines and fixtures damaged as a result of any of the above shall be repaired or replaced at no expense to Owner. Contractor shall bear responsibility and all costs of fines, penalties, and legal fees attributed to violations as levied by authorities having jurisdiction.
- D. Support from Structure: Ducts, pipes, conduits, equipment, and other items indicated to be supported from the structure shall be accomplished using approved hangwires, hangers, or devices of type, size and material recommended to suit the application and installed in accordance with recommendations of the hanger or device manufacturer, Architect and/or Structural Engineer, or code authorities having jurisdiction, whichever is the more stringent requirement. Nothing shall be hung from the structure unless directed to do so by the Architect and/or Structural Engineer.

- E. Ducts, Pipes, Conduits, and Wires: Shall be concealed in walls, chases, and enclosed areas out of view, unless specifically indicated as exposed or where exposure is required for proper function of item, such as air registers, air returns, louvers, grilles, vents, thermostats, electrical receptacles, telephone/data terminals and jacks, light switches, etc. Refer instances of uncertainty to Architect for clarification before proceeding.
- F. Fasteners:
 - 1. Unless specifically indicated or directed otherwise, all fasteners in Work exposed to view, shall be concealed in the finished Work.
 - 2. No fasteners shall show through or telegraph through exposed face of finished Work and all finished surfaces shall be free of all evidence of the existence of fasteners.
 - 3. Fasteners shall be spaced to accurately and rigidly secure Work in place.
 - 4. If not shown or otherwise required or recommended by manufacturer, standard, or code authorities having jurisdiction, fastener spacing shall not exceed 12 inches on center.
 - 5. Non-conforming Work shall be removed from the site and replaced with new conforming Work at no additional expense to Owner.
- G. Exposed Metal Work:
 - 1. Unless specifically indicated or directed otherwise, all exposed metal Work shall be flat with all surfaces free of distortions, oil canning, waves, dents, scratches, weld marks, and other surface defects detrimental to good appearance or function.
 - 2. All steel exposed to exterior shall be hot-dip galvanized, phosphate treated for paint retention and shop prime painted.
 - 3. Non-conforming Work shall be removed from the site and replaced with new conforming Work at no additional expense to Owner.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01 11 26

OWNER/ARCHITECT PROVIDED DOCUMENTS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 COPIES OF SUPPLEMENTARY CONTRACT DOCUMENTS

- A. The Owner and Architect have included the following Supplementary Contract Documents for the Offerors information. The Owner and Architect **do not** guarantee the accuracy, completeness, or suitability of this information, and the Offerors should verify the existing conditions prior to the Proposal date.
1. Topographic Survey:
 1. Entitled: Cypress Lakes High School Survey
 2. Prepared for:
 3. Prepared by: Westbelt Surveying
 4. Dated: August 22, 2024
 2. Geotechnical Investigation Report – Refer to Section 02 32 00
 1. Entitled: Geotechnical Engineering Report, CFISD Cypress Lakes High School Building Additions
 2. Prepared for: Cypress-Fairbanks Independent School District c/o NATEX Architects
 3. Prepared by: Terracon Consultants, Inc.
 4. Dated: September 27, 2024
 5. Report No. 92245368
- B. As-Built Drawings for each school may be accessed at the below link. It is contractors' responsibility to become familiar with provided as-builts as well as attend on site walk thrus and any other documents to provide a complete bid.
1. Link shall be provided to all registered bidders.
- C. Existing Conditions Photographs for each school: the link below has been provided to aid the contractor with becoming familiar with the existing conditions in addition (and not in place of) all offered school visits during bidding. It is the contractor's responsibility to become familiar with provided information, documents and photographs to provide a complete bid. Photographs provided were taken at least a year ago and therefore some existing conditions may have changed since the photographs were taken.
1. Link to Existing Photos of School to be provided to all registered bidders for their information purposes.
- D. The boring log from the above-mentioned soils report is included in Section 02 32 00, Geotechnical Investigation.
- E. Any of the above documents bound in the drawing or specifications are included for reference purposes only.
- F. Neither Architect nor Owner guarantees their contents as to accuracy, completeness, or suitability.
- G. Copies may be examined at the Architect's office.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01 22 00

MEASUREMENT AND PAYMENT (UNIT PRICES)

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

Refer to Document AB for Substitutions of Materials and Equipment

1.1 SECTION INCLUDES

- A. Measurement and payment criteria applicable to portions of the Work performed under a unit price payment method.
- B. Defect assessment and non-payment for rejected work.

1.2 AUTHORITY

- A. Measurement methods delineated in the individual specification sections complement the criteria of this Section. In the event of conflict, the requirements of the individual specification section govern.
- B. Take all measurements and compute quantities. The Architect will verify measurements and quantities.

1.3 UNIT QUANTITIES SPECIFIED

- A. Quantities indicated in the Contract Documents are for bidding and contract purposes only. Quantities and measurements supplied or placed in the Work and verified by the Architect determine payment.
- B. If the actual Work requires more or fewer quantities than those quantities indicated, provide the required quantities at the unit sum/prices contracted.

1.4 MEASUREMENT OF QUANTITIES

- A. Measurement Devices:
 - 1. Weigh Scales: Inspected, tested and certified by the applicable State Weights and Measures Department within the past year.
 - 2. Platform Scales: Of sufficient size and capacity to accommodate the conveying vehicle.
 - 3. Metering Devices: Inspected, tested and certified by the applicable State department within the past year.
- B. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.
- C. Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness.
- D. Measurement by Area: Measured by square dimension using mean length and width or radius.
- E. Linear Measurement: Measured by linear dimension, at the item centerline or mean chord.
- F. Stipulated Sum/Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as a completed item or unit of the Work.

1.5 PAYMENT

- A. Payment Includes: Full compensation for all required labor, labor burden, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.
- B. Final payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities confirmed and accepted by the Architect multiplied by the unit/sum price for Work which is incorporated in or made necessary by the Work.

1.6 DEFECT ASSESSMENT

- A. Replace the Work, or portions of the Work, not conforming to specified requirements.
- B. The individual specification sections may modify these options or may identify a specific formula or percentage sum/price reduction.
- C. The authority of the Architect to assess the defect and identify payment adjustment is final.

1.7 NON-PAYMENT FOR REJECTED PRODUCTS

- A. Payment will not be made for any:
 - 1. Products wasted or disposed of in a manner that is not acceptable.
 - 2. Products determined as unacceptable before or after placement.
 - 3. Products not completely unloaded from the transporting vehicle.
 - 4. Products placed beyond the lines and levels of the required Work.
 - 5. Products remaining on hand after completion of the Work.
 - 6. Loading, hauling and disposing of rejected Products.

PART 2 – DESCRIPTION OF UNIT PRICES

2.1 GENERAL

- A. For the work described unit pricing shall be used to determine the additional cost or credit to the contract amount, or added to or deducted from the Owner’s contingency for changes in the scope of work made during the progress of the work as directed by Architect.
- B. The same price shall be used for adding or deducting from the scope of work. No exceptions.
- C. The following unit prices shall be included in the proposal form and shall be included in the Owner-Contractor agreement.

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

- A. Unit Prices shall be used, where applicable, to make adjustments to the cost of the work due to changes. All Unit Prices submitted shall be complete “turn-key” prices for fully-functioning systems, and shall include all costs for overhead, profit, labor, labor burden, material, equipment, and any other incidentals related to the completion of the Work, and shall remain firm for the duration of the contract. Unit prices listed are for additive and/or deductive work.

UNIT PRICE 1: ELECTRICAL DUPLEX RECEPTACLE

Provide unit price for a new 20A, 120V duplex electrical receptacle and cover plate, flush mounted in a CMU, metal stud, or demountable wall construction, circuited to an existing electrical panel within 150 feet of the outlet using a branch circuit consisting of 2 #10 AWG and 1 #10 AWG ground in 3/4 inch EMT conduit. All conduits to be concealed in wall construction. Unit price shall include a 20 amp circuit breaker to be installed in existing panel space. \$ _____/ea

UNIT PRICE 2: DATA DROP

Provide unit price for a data drop, flush mounted in a CMU, metal stud or demountable wall construction., wired to an IDF/MDF Room. The data drop shall consist of a single gang wall box, cabling wiring device, cover plate, 3/4 inch conduit from outlet to above accessible ceiling, plenum-rated cabling routed above accessible ceiling to the nearest MDF or IDF location within 250 feet of the outlet. Termination and testing to be included in the unit price. . \$ _____/ea

UNIT PRICE 3: 4" CONDUIT WITH PULL STRING

Provide unit price per LF, Schedule 40 conduit with pull string installed underground at a depth of five feet below finish floor elevation. \$ _____/LF

UNIT PRICE 4: DATA CABLING TO TEACHER STATION

Provide one data drop, including data jack, faceplate, and CAT 6 cable home run to nearest IDF or MDF data rack. Assume length less than 300 FT. Include J-box and conduit from data outlet to ceiling cavity in this unit price. . \$ _____/ea

UNIT PRICE 5: 4 1/2" THICK CONCRETE WALK PER SQUARE FOOT

This unit cost shall establish the amount to the contract price for the Contractor to add or deduct 4 1/2" thick concrete walk (minimum 100 SF) per Square Foot. \$ _____/SF

UNIT PRICE 6: 7" THICK CONCRETE DRIVE PER SQUARE FOOT

This unit cost shall establish the amount to the contract price for the Contractor to add or deduct 7" thick concrete drive (minimum 100 SF) per Square Foot. \$ _____/SF

UNIT PRICE 7: CHAIN LINK FENCE

This unit cost shall establish the amount to be added or deducted from the contract price for the Contractor to add/deduct chain link fence.

- | | | | |
|----|--------------------------------|-----------|-------------|
| 1. | 4 foot high fence | \$ _____/ | linear foot |
| 2. | 4 foot high x 3 foot wide gate | \$ _____/ | per leaf |
| 3. | 4 foot high x 6 foot wide gate | \$ _____/ | per leaf |
| 4. | 6 foot high fence | \$ _____/ | linear foot |
| 5. | 6 foot high x 3 foot wide gate | \$ _____/ | per leaf |
| 6. | 6 foot high x 6 foot wide gate | \$ _____/ | per leaf |

UNIT PRICE 8: LIFE SAFETY DEVICES (including all associated cabling and programming)

This unit cost shall establish the amount to be added or deducted from the contract price for the Contractor to add /deduct Fire Alarm devices.

- | | | | |
|----|--------------------------------|----------|------|
| 1. | Exterior Horn To Speaker | \$ _____ | each |
| 2. | Interior Horn To Speaker | \$ _____ | each |
| 3. | Interior Visual Strobe | \$ _____ | each |
| 4. | Interior Speaker/Visual Strobe | \$ _____ | each |

5.	Smoke Detector	\$ _____	each
6.	Heat Detector	\$ _____	each
7.	Manual Pull Station	\$ _____	each
8.	Stopper 2 Pull Station Cover	\$ _____	each
9.	Annunciator Panel	\$ _____	each
10	Duct Detector	\$ _____	each
11	Relay	\$ _____	each
12	Supervisory	\$ _____	each
13	Waterflow	\$ _____	each
14	Amplifier	\$ _____	each
15	Remote Power Supply	\$ _____	each

UNIT PRICE 9: 4” RESILIENT BASE 100 LINEAR FEET

This unit cost shall establish the amount to be added or deducted to the contract price for the Contractor to properly remove existing base and install 4” resilient base. \$ _____/LF

UNIT PRICE 10: GRAPHIC SIGNS

This unit cost shall establish the amount to be added or deducted to the contract price for the Contractor to remove existing signage and install new as described below:

1.	Sign Type A	\$ _____ /	each
2.	Sign Type B	\$ _____ /	each
3.	Sign Type C	\$ _____ /	each
4.	Sign Type D	\$ _____ /	each
5.	Sign Type E	\$ _____ /	each
6.	Sign Type F	\$ _____ /	each
7.	Max Occupancy Signage	\$ _____ /	each
8.	FDC Connection Signage	\$ _____ /	each
9.	Wayfinding Signage (2 lines text)	\$ _____ /	each
10.	Wayfinding Signage (3 lines text)	\$ _____ /	each

11.	Wayfinding Signage (4 lines text)	\$ _____ /	each
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UNIT PRICE 11: PAINTING

This unit cost shall establish the amount to be added or deducted to the contract price for the Contractor to paint 100 square feet of wall (minimum 400 square feet of wall). \$ _____/SF

UNIT PRICE 12: EXIT SIGN

This unit cost shall establish the amount to be added to the contract price to provide and install one (1) exit sign. Price shall include wiring to nearest available emergency circuit, up to 200 feet.

UNIT PRICE 13: ORNAMENTAL FENCE

This unit cost shall establish the amount to be added or deducted from the contract price for the Contractor to add/deduct ornamental fence.

- | | | | |
|----|--------------------------------|-----------|-------------|
| 1. | 6 foot high fence | \$ _____/ | linear foot |
| 2. | 6 foot high x 4 foot wide gate | \$ _____/ | per leaf |
| 3. | 6 foot high x 6 foot wide gate | \$ _____/ | per leaf |

UNIT PRICE 16: SECURITY FILM

This unit cost shall establish the amount to provide and install Security Film per specification 08 87 00 Security Glazing Film \$ _____/square foot

END OF SECTION

SECTION 01 23 00

ALTERNATES

PART 1 - GENERAL

1.1 ALTERNATE PRICES

- A. Contractor shall state, in the spaces provided in the proposal form, Alternate Prices for the work described below. The responsibility of determining quantity of Alternates rests with the Contractor. Base Proposal and Alternates shall include cost of all supporting elements required, so that no matter what combination of Base Proposal and Alternates are accepted, that portion shall be a complete entity. Work for all Alternates shall be in strict accordance with the specification sections noted and applicable to the specific work.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 ALTERNATES

- A. **Alternate Number 1: Base Bid Adjustment**
This alternate shall establish the adjustments to the General Contractor's Base Proposal submitted at 2:00 pm, if necessary. This alternate shall be accepted whether it is an add or a deduct and will be used as part of the evaluation process to determine the best value for the District.
- B. **Alternate Number 2: Fire Alarm replacement**
This alternate shall establish the amount to be added to the Base Proposal for the Contractor to provide a new Fire Alarm system per the specifications included listed as Alternate. Base bid includes any and all Fire alarm work needed for the base bid project, additions and renovations.
- C. **Alternate Number 3: Chiller by Carrier**
This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish and install HVAC chillers as manufactured by **Carrier** as shown on the drawings and listed in the specifications. There are no HVAC chillers included in the base bid.
- D. **Alternate Number 4: Chiller by Daikin**
This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish and install HVAC chillers as manufactured by **Daikin** as shown on the drawings and listed in the specifications. There are no HVAC chillers included in the base bid.
- E. **Alternate Number 5: Chiller by Trane**
This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish and install HVAC chillers as manufactured by Trane as shown on the drawings and listed in the specifications. There are no HVAC chillers included in the base bid.

3.2 GENERAL NOTES

- A. Unless otherwise indicated, scope of work for each alternate shall include material and labor, general conditions and all other costs associated with completing the work described.
- B. Alternates are not listed in any order of priority.

- C. Acceptance of alternates shall be the sole discretion of the Owner.
- D. See Section AB for alternate pricing timelines.

END OF SECTION

SECTION 01 29 73

SCHEDULE OF VALUES

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Refer to Instructions to Proposers for substitutions.
- B. 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.

1.2 QUALITY ASSURANCE

- A. Use required means to assure arithmetical accuracy of the sums described. All calculations shall be to two (2) decimal places.
- B. When so required by the Owner, provide copies of the subcontracts or other data acceptable to the Owner, substantiating the sums described.

1.3 SUBMITTALS

- A. Prior to the first Application for Payment, submit a proposed Schedule of Values to the Owner and Architect as outlined below:
 - 1. Meet with the Owner and Architect 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.

1.4 SCHEDULE OF VALUES

- A. The Schedule of Values shall be broken down into item costs for each specification section as a minimum with materials and labor separated. After review by the Owner and Architect, the Schedule of Values shall be broken down into further items as required. (See following list).
- B. Schedule of Values: Refer to the following sample.
- C. Indicate page subtotals on each page of Schedule of Values.
- D. Each page to be printed single-sided.
- E. Schedule of Values is to be submitted for approval per AIA Document A101, Article 3.3

PART 2 – PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 SCHEDULE OF VALUES

- A. Refer to sample attached herein.

**SECTION 01 29 73
SCHEDULE OF VALUES - SAMPLE**

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Matls	Total Completed	%						
			Previous App.	This App.									
	<p><i>NOTE: IF PROJECT CONSISTS OF BOTH NEW ADDITION(S) AND REMODEL (S), EACH SHALL HAVE A SEPARATE SCHEDULE OF VALUES. Listing shall include but not be limited to:</i></p> <p>Div. 1 - General Conditions Sitework Supervision Mobilization Contractor's Fee General Conditions Temp. Facilities Project sign Coordination drawings Final Cleaning As-Builts/Close-out/O&M Manuals/Record Drawings Permits Bonds Insurance Contractor's written Punch List</p> <p>Div. 2 - Existing Conditions</p> <p>Div. 3 - Concrete Drilled Piers Matls Drilled Piers Labor Caps & Beams Matls Caps & Beams Labor Slab on Grade Matls Slab on Grade Labor Cooling Tower Basin Matls Cooling Tower Basin Labor Misc. Bldg Concrete Matls Misc. Bldg Concrete Labor Rebar Matls Rebar Labor Lt. Wt. Insul Fill - Matls Lt. Wt. Insul Fill - Labor Close-out Documents Punch List</p>												

Div. 4 - Masonry

Brickwork - Matls
Brickwork - Labor
Concrete Masonry - Matls
Concrete Masonry - Labor
Str. Glazed Tile - Labor
Str. Glazed Tile - Matls
Masonry clean up/acid wash
Close-out Documents
Punch List

Div. 5- Metals

Structural Steel - Matls
Structural Steel - Labor
Misc. Steel - Matls

Steel Joists - Matls

Lt. Gauge Steel Framing - Matls
Lt. Gauge Steel Framing - Labor
Metal Decking - Matls
Metal Decking - Labor
Expansion Covers - Matls
Expansion Covers - Labor
Alternating Stairs Matls
Alternating Stairs Labor
Close-out Documents
Punch List

Div. 6 - Wood & Plastics

Rough Carpentry - Matls
Rough Carpentry - Labor
Millwork - Matls
Millwork - Labor

Div. 7 - Thermal & Moisture Protection

Waterproofing & Dampproofing Matls
Waterproofing & Dampproofing Labor
Building Insulation - Matls
Building Insulation - Labor
Fireproofing - Matls
Fireproofing - Labor
Metal Roof - Matls
Metal Roof - Labor
Metal Roof Guarantee
Modified Bitumen Roofing Base Sheet- Matls
Modified Bitumen Roofing Base Sheet - Labor
Modified Bitumen Roofing Cap Sheet - Matls

Modified Bitumen Roofing Cap Sheet - Labor
Modified Bitumen Roofing - Guarantee
Building Sheet Metal - Matls
Building Sheet Metal - Labor
Bldg. Sheet Metal Guarantee
Roof Curbs Matls
Roof Curbs Labor
Roof Hatches Matls
Roof Hatches Labor
Sealants Matls
Sealants Labor
Roof Accessories Matls
Roof Accessories Labor
Close-out Documents
Punch List

Div. 8 - Doors & Windows

Finish Carpentry/Door - Matls
Finish Carpentry/Door - Labor
Finish Hardware - Matls
Finish Hardware - Labor
Thresholds & Seals Matls
Thresholds & Seals Labor
Hollow Metal Doors & Frames - Matls
Hollow Metal Doors & Frames - Labor
Plastic Faced Doors - Matls
Plastic Faced Doors - Labor
Overhead Doors & Grilles - Matls
Overhead Doors & Grilles - Labor
Alum. Entrances & Storefronts - Matls
Alum. Entrances & Storefronts - Labor
Alum. Windows - Matls
Alum. Windows - Labor
Glass & Glazing - Matls
Glass & Glazing - Labor
Glass & Glazing - water test
Close-out Documents
Punch List

Div. 9 - Finishes

Lath & Plaster - Matls
Lath & Plaster - Labor
Gypsum Wallboard Systems - Matls
Gypsum Wallboard Systems - Labor
Ceramic Tile - Matls
Ceramic Tile - Labor
Quarry Tile - Matls
Quarry Tile - Labor
Terrazzo - Matls

Terrazzo - Labor					
Acoustic Clg. - Matls					
Acoustic Clg. - Labor					
Acoustic Wall Panels - Matls					
Acoustic Wall Panels - Labor					
Resilient Flooring - Matls					
Resilient Flooring - Labor					
Carpet - Matls					
Carpet - Labor					
Athletic Flooring - Matls					
Athletic Flooring Labor					
Floor Sealer - Matls					
Floor Sealer - Labor					
Painting - Matls					
Paint - Labor					
Close-out Documents					
Punch List					
Div. 10 - Specialties					
Tackboards - Matls					
Tackboards - Labor					
Toilet Partitions - Matls					
Toilet Partitions - Labor					
Louvers - Matls					
Louvers - Labor					
Aluminum Flag Pole - Matls					
Aluminum Flag Pole - Labor					
Graphics -Matls					
Graphics -Labor					
Lockers Matls					
Lockers Labor					
Locker combinations in Excel format					
Demountable Partitions - Matls					
Demountable Partitions - Labor					
Metal Shelving Matls					
Metal Shelving Labor					
Scoreboards - Matls.					
Scoreboards - Labor					
Toilet Room Accessories - Matls					
Toilet Room Accessories - Labor					
Visual Display Boards - Matls					
Visual Display Boards - Labor					
Cubicle Curtains & Track - Matls					
Cubicle Curtains & Track - Labor					
Fire Extinguisher Cabinets Matls					
Fire Extinguisher Cabinets Labor					
Close-out Documents					
Punch List					

Div. 11 - Equipment

Stage Curtains Matls
Stage Curtains Labor
Stage rigging Matls
Stage rigging Labor
Stage lighting Matls
Stage lighting Labor
Misc. Appliances Matls
Misc. Appliances Labor
Food Service - Submittals/coordination drawings
Food Service - Walk-ins Matls
Food Service - Walk-ins Labor
Food Service - Flatwork - Matls
Food Service - Flatwork - Labor
Food Service Eqpt - Labor
Food Service Eqpt - Matls
Food Service - Close-out Documents
Food Service - Training
Food Service - Kitchen Hoods - Matls
Food Service - Kitchen Hoods - Labor
Food Service - Ansul Syst. - Matls
Food Service - Ansul Syst. - Labor
Close-out Documents
Punch List

Div. 12 - Furnishings

Casework - Matls
Casework - Labor
Science Casework - Matls
Science Casework - Labor
Horizontal Blinds - Matls
Horizontal Blinds - Labor
Projection Screen - Matls
Projection Screen - Labor
Close-out Documents
Punch List

Div. 13 - Special Construction

Div. 14 - Conveying Systems

Elevator - Matls
Elevator - Labor
Elevator - Maintenance Agreement

Div. 21 - Fire Suppression

Fire Sprinkler Syst. - Eng/Submittals
Fire Sprinkler Syst. - Underground piping/Vault -
Matls
Fire Sprinkler Syst. - Underground piping/Vault -

Labor
Fire Sprinkler Syst. - Above slab piping - Matls
Fire Sprinkler Syst. - Above slab piping - Labor
Fire Sprinkler Syst. - Trim-out - Matls
Fire Sprinkler Syst. - Trim-out - Labor
Fire Sprinkler Syst. - Start-up/Testing
Fire Sprinkler Syst. - Close-out Documents
Close-out Documents
Punch List

Div. 22 - Plumbing

Shop Drawings
Coordination Drawings
As-Builts/Close-out O&M Manuals
Sanitary Underground - Matls
Sanitary Underground - Labor
Storm Underground - Matls
Storm Underground - Labor
Domestic Water - Matls
Domestic Water - Labor
Plumbing Dissolution Matls
Plumbing Dissolution Labor
Gas Piping - Matls
Gas Piping - Labor
Grease Trap - Matls
Grease Trap - Labor
Fixtures - Matls
Fixtures - Labor
Rodding/Camera lines

Div. 23 - Heating Ventilating and Air Conditioning

Shop Drawings
As-Builts/Close-out O&M Manuals
Coordination drawings
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 - Matls					
Pumps - Labor					
Water Treatment - Matls					
Water Treatment - Labor					
Isolation - Matls					
Isolation - Labor					
Pipe Flex - Matls					
Pipe Flex - Labor					
Sheet Metal - Matls					
Sheet Metal - Labor					
Duct Insulation - Matls					
Duct Insulation - Labor					
Pipe Insulation - Matls					
Pipe Insulation - Labor					
Pipe, Valves, Fittings - Matls					
Pipe, Valves, Fittings - Labor					
Misc. - Labor					
Misc. - Matls					
Insulation - Matls					
Insulation - Labor					
Sanitary Above Slab - Matls					
Sanitary Above Slab - Labor					
Storm Above Slab - Labor					
Storm Above Slab - Matls					
Gas - Matls					
Gas - Labor					
Fixtures - Matls					
Fixtures - Labor					
Permits					
VAV Boxes - Matls					
VAV Boxes - Labor					
Refrigerant Monitor - Matls					
Refrigerant Monitor - Labor					
Unit Heaters - Matls					
Unit Heaters - Labor					
Startup					
Controls					
Eng/Submittals					
Valves/Dampers - Matls					
Valves/Dampers - Labor					
Box Controls - Matls					
Box Controls - Labor					
Modules -Matls					
Modules -Labor					
End Devices - Matls					
End Devices - Labor					
Low Voltage Wiring - Matls					
Low Voltage Wiring - Labor					

Startup/commissioning
Software Installation/Graphics upload to CFISD
server
Close-out Documents
Training
Punch List

Div. 26 - Electrical

Mobilization
Shop Drawings
As-Builts/Close-out/O&M Manuals
Underground - Matls
Underground - Labor
Conduit -Matls
Conduit - Labor
Wire - Matls
Wire - Labor
Feeder Wire - Matls
Feeder Wire -Labor
Switches/Recpt. Matls
Switches/Recpt. Labor
Switchgear - Matls
Switchgear - Labor
Temporary - Matls
Temporary - Labor
Gas Generator - Matls
Gas Generator - Labor
Fixtures - Matls
Fixtures - Labor
Low Voltage - Engineering/Submittals
Low Voltage Lighting- Devices - Matls
Low Voltage Lighting- Devices - Labor
Low Voltage Lighting - Wiring - Matls
Low Voltage Lighting - Wiring - Labor
Low Voltage Lighting - Programming/Start-up
Low Voltage Lighting- Training
Low Voltage Lighting - Close-out Documents
Voice System - Wiring - Matls
Voice System - Wiring - Labor
Video System - Trim-out - Matls
Video System - Trim-out - Labor
Video System - Testing
Master Clock - Matls
Master Clock - Labor
Close-out Documents
Punch List
Coordination Drawings

Div. 27 - Communications

Data System - Matls
Data System - Labor
Data System - Testing
Communications/PA - Control Panels - Matls
Communications/PA - Control Panels - Labor

Div. 28 - Electronic Safety and Security

Fire Alarm - Control Panel - Labor
Fire Alarm - Wiring - Matls
Fire Alarm - Wiring - Labor
Fire Alarm - Devices - Matls
Fire Alarm - Devices - Labor
Fire Alarm - Testing
Fire Alarm - Training
Fire Alarm - Close-out Documents
Security Systems - Submittals
Security Systems - Devices - Matls
Security Systems - Devices - Labor
Security Systems - Wiring - Matls
Security Systems - Wiring - Labor
Security Systems - Cameras Matls
Security Systems - Cameras Labor
Security Systems - DVR Equipment - Matls
Security Systems - DVR Equipment - Labor
Security Systems - Programming/Start-up
Security Systems - Training
Security Systems - Close-out Docs.
Video System - Close-out Docs

Div. 31 - Earthwork

Detention pond Final County inspection permit document
Demolition (as applicable)
Site Clearing & Grubbing
Earthwork - Matls
Earthwork - Labor
Finish Grading Matls
Finish Grading Labor
Stabilization Matls
Stabilization Labor
Site Drainage - Matls
Site Drainage - Labor

Div. 32 - Exterior Improvements

Chain Link Fence - Matls
Chain Link Fence - Labor
Paving - Matls
Paving - Labor
Sidewalks - Matls

	Sidewalks - Labor Erosion Control - Matls Erosion Control - Labor Building Pad - Matls Building Pad - Labor Paving Subgrade Signage/Striping Bike Racks Landscaping - Matls Landscaping - Labor Sod - Matls Sod - Labor Hydromulch - Matls Hydromulch - Labor Irrigation - Matls Irrigation - Labor Irrigation system testing/demonstration Div. 33 - Utilities Site Storm - Matls Site Storm - Labor Site Sanitary - Matls Site Sanitary - Labor U/G Fire Line - Matls U/G Fire Line - Labor Site Lighting - Matls Site Lighting - Labor Close-out Documents Punch List Alternates 1 2 3 4 5 Allowances: A. Owner's Betterment Allowance					
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General Note: Close-out lists shall include As-builts, O&M's, Demonstration/Training, and any attic owner's stock.

END OF SECTION

SECTION 01 31 13

PROJECT COORDINATION

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. General: notify the Architect whenever there is need of clarification or interpretation of the Contract Documents prior to commencement of work.
- B. Commencement of work without Architect's prior notification means Contractor's acceptance of responsibility.
- C. Commencement of work without Architect's prior notification implies Contractor's understanding of conditions, assemblies, methods, or procedures.
- D. The project superintendent shall notify the Owner on an ongoing basis of ongoing work.

1.2 PRE-INSTALLATION CONFERENCE

- A. General: Notify the Architect 48 hours in advance of certain stages of construction, and, as required by the Architect, organize a pre-installation meeting with each trade individually prior to commencement of their portion of the Work. At a minimum, representatives of the Architect, the General Contractor's project superintendent, and the Sub-contractor's Foreman and Project Manager shall be present at each meeting. The Engineer shall be notified as applicable.
- B. As indicated in each specific section of this Project Manual, or as required by the Architect, these stages generally include, but are not necessarily limited to the following:
 - 1. Division 2 - (Selective) Demolition.
 - 2. 05 50 00 - Miscellaneous metals, ladders, brackets, pipe rails, etc.
 - 3. Division 6 - Finish Carpentry and Millwork
 - 4. Division 7 - installation of waterproofing, vapor barriers, flashing and sheet metal.
 - 5. Division 7 - Installation of roofing system(s) and associated work.
 - 6. 07 21 00 - Concealment of insulation.
 - 7. Division 8 - Installation of doors, frames, windows, and storefronts.
 - 8. 08 71 00 - Installation of finish hardware
 - 9. Division 9 - Installation of plaster and gypsum board products.
 - 10. Division 9 - Installation of tile, flooring, and pavers.
 - 11. 09 51 00 - Installation of acoustical ceiling (grid and panels).
 - 12. 09 65 19 - Installation of resilient flooring and base.
 - 13. 09 91 00 - Painting and staining (each coat).
 - 14. Divisions 22, 23 and 26 - Completion of roughing-in of plumbing, heating, air conditioning and electrical work (prior to concealment).
 - 15. Division 23 - Installation of heating, ventilating and air conditioning.
 - 16. Division 26 - Installation of all electrical fixtures.
 - 17. Divisions 22, 23 and 26 - Any and all testing specified for equipment, mechanical, electrical and plumbing systems.
 - 18. 31 00 00 - Clearing and stripping of top soil within limits of grading.
 - 19. 31 00 00 - (Excavation and) Placing (of each lift of) select fill material, and site grading.
 - 20. 31 00 00, 31 23 23.13, and Divisions 22, 23 and 26 - Compaction, inspection, testing, and covering of underground utilities.
 - 21. Division 32 - Installation of site amenities, fencing, surfaces, landscaping, etc.

- C. In addition to notifying the Architect, notify the Structural Engineer (48 hours) prior to the following stages:
 - 1. Drilling, reinforcing, and placing of first piers and footings.
 - 2. Placing first reinforcing and grade beams.
 - 3. Erecting structural steel elements.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 PRE-CONSTRUCTION CONFERENCE

- A. The Contractor shall contact Architect at least ten (10) days prior to commencing construction in order for Architect to schedule a pre-construction meeting with Contractor, Architect, and Owner. This meeting must occur prior to commencement of any construction.

3.2 CONFERENCES AND MEETINGS

- A. Refer to Section 01 31 19, Project Meetings for requirements pertaining to Pre-construction Conference, Progress Meetings, and Pre-installation Conferences.

END OF SECTION

SECTION 01 31 19

PROJECT MEETINGS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDE

- A. The Architect will:
 - 1. Schedule each meeting (pre-construction conference, periodic project meetings, pre-installation meetings, and specially called meetings throughout the progress of the work).
 - 2. Prepare agenda for meetings.
 - 3. Preside at meetings, including all significant proceedings and decisions.
 - 4. record, reproduce, and distribute copies of meeting minutes within seven (7) days, excluding weekends and holidays, after each meeting to:
 - a. All participants in the meeting.
 - b. All parties affected by decisions made at the meeting.
- B. The Contractor shall:
 - 1. Make physical arrangement for meetings.
 - 2. Participate in all meetings and conferences.
 - 3. Schedule attendance of Job Superintendent, Project Manager, and other parties affecting or affected by decisions made at meetings and conferences as their interests require.
 - 4. Provide updated schedules.
 - 5. Provide status reports/logs of RFIs, CPRs, MCs, and shop drawings/submittals.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 PRE-CONSTRUCTION CONFERENCE

- A. Architect will:
 - 1. administer pre-construction conference for the establishment of communication methods, procedures and Owner requirements.
 - 2. administer site mobilization conference for clarification of Owner and Contractor.
- B. Location: At Project site or as designated by the Architect.
- C. Attendance:
 - 1. Contractor or Contractor's Representative
 - 2. Job Superintendent
 - 3. Project Manager
 - 4. Owner or Owner's Representative
 - 5. Major subcontractors
 - 6. Major suppliers
 - 7. Architect's Representative
 - 8. Consultants as needed
 - 9. Third-party Consultants
 - 10. Others as appropriate

- D. Meeting Agenda, may include, but is not limited to:
 - 1. Discussion on major subcontracts and suppliers and projected construction schedules.
 - 2. Critical work sequencing.
 - 3. Major equipment deliveries and priorities. Discussion of long lead time items.
 - 4. Project coordination and designation of responsible personnel.
 - 5. Procedures and processing of field decisions, proposal requests, requests for information (RFIs), submittals, minor changes, change orders and applications for payment.
 - 6. Method of distribution of contract documents.
 - 7. Procedures for maintaining record documents.
 - 8. Use of premises, office work and storage areas, on-site parking, and owner's requirements.
 - 9. Construction facilities and temporary utilities.
 - 10. Housekeeping procedures.
 - 11. Special owner requirements (specifications sections 01 35 23, 01 35 23.1 and 01 35 23.2)
 - 12. Lien release requirements

3.2 PRE-DEMOLITION CONFERENCE

- A. Owner will:
 - 1. Administer pre-demolition conference for the establishment of communication methods related to demolition procedures and Owner coordination and scheduling requirements for demolition scope.
- B. Location: At Project site or as designated by the Architect.
- C. Attendance:
 - 1. Contractor or Contractor's Representative
 - 2. Job Superintendent
 - 3. Project Manager
 - 4. Owner or Owner's Representative
 - 5. Major Subcontractors
 - 6. Demolition Subcontractors
 - 7. Architect's Representative
 - 8. Consultants as needed
 - 9. Third-Party Consultants
 - 10. Others as appropriate
- D. Meeting Agenda, may include, but is not limited to:
 - 1. Discussion on projected demolition schedules.
 - 2. Procedures for coordination of demolition sequencing and scheduling.
 - 3. Procedures for coordination associated with existing building components need to be returned to Owner.
 - 4. Project demolition coordination and designation of responsible personnel.
 - 5. Procedures for maintaining record documents.
 - 6. Special owner requirements (specifications section 01 36 13).

3.3 PROGRESS MEETINGS

- A. Architect will:
 - 1. Schedule project meetings throughout progress of the work at intervals to be determined.
 - 2. Set agenda and administer said meetings.
 - 3. Preside over meetings.
 - 4. Record meeting minutes, including all significant proceedings and decisions.
 - 5. Reproduce and distribute copies of meeting minutes within seven (7) days, excluding weekends and holidays, after each meeting to:
 - a. All participants in the meeting.
 - b. All parties affected by decisions made at the meeting.

- B. Contractor shall:
 - 1. Make physical arrangements for meetings.

- C. Attendance:
 - 1. Contractor or Contractor's Representative
 - 2. Job Superintendent
 - 3. Project Manager
 - 4. Owner or Owner's Representative
 - 5. Major subcontractors
 - 6. Architect's Representative
 - 7. Consultants as needed
 - 8. Others as appropriate

- D. Meeting Agenda, may include, but is not limited to:
 - 1. Review and approval of minutes of previous meeting.
 - 2. Review of work progress since previous meeting.
 - 3. Field observations, problems, and conflicts.
 - 4. Review of off-site fabrication and delivery schedules.
 - 5. Corrective measures and procedures to regain projected schedule.
 - 6. Review three week "look-ahead" construction schedule.
 - 7. Maintenance of quality standards.
 - 8. Response to request for information (RFIs) and status of outstanding RFIs.
 - 9. Status of submittals.
 - 10. Status of CPRs.
 - 11. Status of MCS.
 - 12. Other items and critical issues affecting work.

3.4 PRE-INSTALLATION CONFERENCES

- A. Architect will convene a pre-installation conference, when required in individual specification Section, prior to the Contractor commencing Work of the Section. The Contractor will produce agenda, Architect will distribute copies of the pre-installation conference minutes within seven (7) days, excluding weekends and holidays, after each conference to all participants in the meeting, the Owner and all parties affected by decisions made at the meeting.

- B. Attendance:
 - 1. Contractor's Superintendent(s)
 - 2. Subcontractor's Foreman
 - 3. Contractor's Project Manager(s)
 - 4. Architect's Representative
 - 5. Consultants as needed
 - 6. Owner or Owner's Representative
 - 7. Manufacturer's Representative
 - 8. Others affecting or affected by Work.
 - 9. Third party inspectors

- C. Meeting Agenda, may include, but is not limited to:
 - 1. Review of conditions of installation.
 - 2. Preparation and installation procedures.
 - 3. Coordinate with related work
 - 4. Review of the contract document requirements.
 - 5. Questions related to work required.
 - 6. Mockup samples or panels

3.5 MONTHLY PAY APPLICATION REVIEW MEETINGS

- A. The Owner, Architect, and Contractor shall schedule and conduct monthly Pay Application review meetings during the entire duration of construction prior to the submission of the notarized completed Contractor Application for payment to the Architect for certification. The Contractor shall produce a draft of the proposed Application for Payment for review by the Owner and Architect. The Contractor shall include and furnish the following documents for review:
 - a. Draft of the Contractor's Application for Payment (AIA Document G702)
 - b. Invoices for any stored materials included in the Application. Invoices shall include full descriptions and costs as required to facilitate on-site review
 - c. Release of Liens from Subcontractors and Sub-subcontractors for all work billed in previous certified Applications for Payment.
 - d. Owner reserves the right to require Release of Liens for any previously submitted notice of claim submitted by any Subcontractor, Sub-subcontractor, or suppliers.
 - e. Evidence of payment for any and all backcharges, overtime, etc. previously issued by Owner that would be past due by the time payment is made by Owner.
 - f. Pay Application review checklists fully completed.
 - g. Updated project schedule
 - h. Owner may withhold payment on line items for which a lien or claim (or similar notice of intent) has been filed, until satisfactory release has been received and accepted by Owner.
- B. Attendance:
 - a. Owner's representative
 - b. Architect
 - c. Contractor
 - d. Subcontractors as appropriate
- C. Meeting agenda may include, but is not limited to:
 - a. Review percentages of work completed and being billed to date.
 - b. Review of any stored materials being billed to date and all associated surety recommendations
 - c. Review of lien releases, notices of claims, etc.
 - d. Confirmation of approved CPRs
- D. The meeting date shall be determined by the Architect, Contractor, and Owner, and shall occur on that same date each month.

3.6 SAMPLE MEETING AGENDA

Refer to the following pages for a sample Pre-Construction Meeting agenda.

3.7 SUBMISSION OF FINALIZED APPLICATION FOR PAYMENT

Refer to AIA Document A201TM-2017, as amended, Article 9.

SAMPLE PRECONSTRUCTION MEETING AGENDA:

**PROJECT NAME
CYPRESS-FAIRBANKS INDEPENDENT SCHOOL DISTRICT**

**CYPRESS-FAIRBANKS I.S.D. BID NUMBER:
PRE-CONSTRUCTION CONFERENCE**

AGENDA

Date:

Time:

Location: Cypress-Fairbanks Independent School District
Facilities and Construction Office
11430 Perry Road
Houston, Texas 77064

I. INTRODUCTION OF PERSONNEL

- | | | | |
|----|------------------------|--------------------------|----------------|
| A. | OWNER: | Cypress-Fairbanks I.S.D. | (281) 897-4108 |
| 1. | Name | Title | Phone Number |
| B. | ARCHITECT: | | |
| 1. | Name | Title | Phone Number |
| C. | CONTRACTOR: | | |
| 1. | Name | Title | Phone Number |
| D. | THIRD PARTY INSPECTORS | | |
| 1. | Name | Title | Phone Number |

II. REVIEW CONSTRUCTION GUIDELINE REQUIREMENTS

III. SUB/TRADE START-UP MEETINGS

IV. REVIEW CONSTRUCTION PROGRESS MEETING PROCEDURES

V. SPECIAL OWNER REQUIREMENTS

VI. DOCUMENTS MODIFYING AND/OR CLARIFYING THE CONTRACT

- A. Minor Change Form
- B. Change Proposal Request Form
- C. Clarification
- D. Construction Change Directive
- E. Warranty Work Request
- F. Change Order Form
- G. Claims for additional time since last meeting (weather delays, etc.)

VII. SCHEDULE, SITE OPERATIONS SET-UP AND MOBILIZATION

VIII. DISCUSSION

IX. LIEN RELEASE LOG AND BACKCHARGE LOG REVIEW

X. CLOSEOUT REQUIREMENTS

MEETING ADJOURNMENT

PROJECT:

CONSTRUCTION GUIDELINE REQUIREMENTS

The Construction Guideline Requirements supplement the project documents and procedures established for the cooperation and coordination between the Contractor, Architect, and related activities scheduled throughout the construction project.

I. RECORD DOCUMENTS AT JOB SITE

- A. The Contractor shall maintain throughout the construction of the project a record set of documents at all times secured to the document table. These plans shall be updated to reflect any changes to the original drawings. Field clarifications, minor changes, addenda, and change orders are to be posted and/or noted on these drawings to document the actual project record conditions.
- B. The Contractor, at all times, shall maintain a record set of project specifications reflecting the information noted in Item 01.

II. TESTING PROCEDURES

- A. The Testing Laboratory shall be scheduled through the General Contractor to monitor the soils, concrete, rebar, structural steel, and other testing services required throughout the project. The General Contractor will be required to provide a 48-hour advanced notice to the testing laboratory for scheduled inspections.
- B. Concrete pours shall be scheduled by the General Contractor 48 hours in advance of the scheduled pour. The General Contractor will be responsible for scheduling both Architect's representative and the testing laboratory for observation and testing of the scheduled concrete pour. Unless prior approval has been arranged, all concrete pours are to be made in the presence of the testing laboratory and/or Architect's representative, following their review of all reinforcing steel and miscellaneous items.

III. FIELD INSPECTIONS

- A. Mechanical, Electrical, and Plumbing inspections shall be in compliance with the contract documents. Excavation, materials, installation, backfill, and cover-up shall be reviewed by a representative from Architect, the Owner, and/or an outside consultant in the required sequences for each scheduled activity. The General Contractor will be required to provide a 24-hour advance notice for each scheduled activity to be reviewed.

IV. SUBMITTALS

- A. Shop Drawings and/or submittals shall be submitted to the Architect in the required quantities (re: specs), with the Contractor's stamp affixed to all items and signed by the Contractor signifying he has reviewed each submittal and it meets exceeds all Contract requirements. Shop drawings or submittals not containing this information will be returned not approved. Commencement of work without reviewed and approved shop drawings will not be permitted. The Contractor will provide a list of shop drawings and/or submittals within 1 month of contract award noting the critical and/or priority items requiring immediate review and approval. Dates for submission of all items will also be provided. A complete set of shop drawings shall be maintained at the field office and their status reviewed at each construction progress meeting.

V. CHANGES IN THE WORK

- A. Change Requests involving additions, deletions, and/or revisions to the contract documents must be submitted by the Contractor to Architect's office in writing accompanied by an itemized material, labor, and equipment breakdown for review and approval prior to any changes occurring. Response to all minor changes and proposal requests must be submitted to Architect within 20 days for review and response.

VI. LIST OF SUBCONTRACTORS

- A. A list of each Subcontractor scheduled to perform work on the project should be submitted to Architect at the start of the project with Schedule of Values and before review of the first Application for Payment. (Use AIA Document G805)
- B. Prior to the commencement of work by each Subcontractor, a meeting will be scheduled to review the requirements, materials, and/or equipment specified in the contract documents.

VII. SCHEDULE OF VALUES

- A. The Schedule of Values shall be approved by Owner and Architect prior to submitting the first pay application. This Schedule shall include the monetary values for each item of construction, breaking out the labor and material for each activity. (Use AIA Documents G702 and G703)

VIII. PROGRESS SCHEDULE

- A. Progress Schedules shall be approved by Owner and Architect prior to submitting the first pay application. This schedule shall be a graphical projection of construction activities subdivided into various components and outlining the anticipated starting and completion dates. Indicate the "critical path" items and update the schedule monthly and recovery if required.

IX. CONTRACTOR'S APPLICATION FOR PAYMENT

- A. Pay applications will be reviewed monthly at the project site. The pay application will be in a preliminary draft for the review by Architect's and the Owner's representative. The reviewed, accepted, and/or modified pay application will be submitted to Architect's office for processing. Affected subcontractors and/or material suppliers are requested to be present at each pay application review. Progress schedules are to be revised and updated monthly and submitted with each preceding application for payment.
- B. Stored materials are required to be in accordance with Section 9.3.2.

X. PROGRESS MEETINGS

- A. Progress meetings will be held to discuss job progress, coordination, schedule, and anticipated conflicts. Those in attendance will be the Owner, Architect, General Contractor, affected subcontractors, and/or particular consultants. Frequency of the progress meetings will be determined by job conditions. The Architect will keep accurate minutes of the meetings and distribute copies to all in attendance.

XI. LINES OF COMMUNICATION

- A. The Architect is the Owner's representative and all communications between the Owner and General Contractor shall be channeled through the Architect. Subcontractors shall correspond with the Owner and/or the Architect through, or in the presence of, the General Contractor.
- B. The Superintendent shall be fully knowledgeable of the contract documents. Review and approval by the Superintendent of all items prior to observations by the Architect and/or Owner's representative is essential in avoiding project delays and re-inspection of nonconforming work.

XII. ADDITIONAL SERVICES

- A. Additional architectural or engineering services and testing or retesting to analyze and inspect nonconforming work shall be at the Contractor's expense.

XIII. APPROPRIATE CONDUCT

- A. Appropriate conduct and language must be exercised by all construction workers. Appropriate clothing must be worn at the job sites by all workers. Misconduct involving a worker will constitute immediate dismissal and removal of said worker from the project site.
- B. The Contractor shall comply with all Special Owner Requirements per Specification Section 01 35 23 herewithin.

XIV. SUBSTITUTIONS

- A. Substitutions not approved prior to proposal will not be considered.

XV. SUBSTANTIAL COMPLETION AND CLOSE OUT

- A. The General Contractor shall submit in written form a list of items requiring completion (per contract requirement) and/or correction along with a written request for substantial completion.
- B. The General Contractor shall submit all of the required documents, information, and materials to the Architect to expedite project close-out as outlined in the Project Close-Out Specifications.

PROJECT:

CONSTRUCTION TRADE START-UP MEETING GUIDELINES

The Architect shall direct the General Contractor to arrange a time and location 48 hours prior to a new trade commencing work for the purpose of reviewing and discussing the project documents and specifications governing the particular Subcontractor's work.

The reviews should include, but not be limited to, the following:

1. Determine if all appropriate shop drawings, samples, and/or literature has been submitted, reviewed, and approved.
2. Determine if the Subcontractor has all the current documents to begin and complete his work in compliance with the contract.
3. Inform the Subcontractor/Foreman that if inspections will be needed, the Contractor must provide the Architect with a 48-hour advance notice.
4. Review with the Contractor and Subcontractor any storage or temporary staging areas required and whether there will be conflicts with other trades.
5. Determine if Subcontractor/Foreman has knowledge of what area his work will commence and the sequence to be followed.
6. Examine thoroughly each part and section of the specifications, noting materials, workmanship, manufacturer's recommendations, installation, etc.
7. Alert the Contractor and Subcontractor to special conditions outlined in the project documents and/or project specifications required by the Architect, Owner, or related Consultants.
8. Emphasize that clean-up is a very important item in the overall construction of the project and that an unsightly project will not be tolerated.
9. Inquire if there are any questions relating to the specific areas covered or questions about areas not specifically covered.
10. Review coordination drawings required by Contract.

PROJECT:

JOB PROGRESS MEETING GUIDELINES

The Architect shall consult with the Owner's representative to determine at what intervals progress meetings will occur. The Architect shall inform the General Contractor of the time, date, and locations of the Construction Progress Meetings and the regularity of the proposed scheduled meetings.

ARCHITECT

1. The Architect shall prepare a Record of Attendance sign-in sheet for those attending the progress meeting.
2. The Architect shall preside over the order of the meeting. The Architect shall then recognize the General Contractor's representative, who will address the items outlined under the Contractor.
3. Following the completion of the Contractor's agenda, comments will be received and/or offered by the Owner, Architect, Contractor, and any member in attendance at the progress meetings.
4. The Architect shall submit to the Owner and Contractor notes describing the accounts of the progress meeting, including the time, date, and location of the next scheduled meeting.
5. The Architect, upon reviewing the previous meeting minutes with the Owner and General Contractor, shall amend, add to, or accept as submitted. The meeting notes will then be mailed to the Owner and Contractor for their record copy of the accepted meeting notes.

CONTRACTOR

1. The Contractor, at the beginning of each progress meeting, shall submit an agenda outlining those scheduled to attend, an updated progress schedule, and any other matters of interest requiring discussions and/or immediate response affecting the overall construction progress.
2. The progress meetings shall be attended by the Project Manager, Field Superintendent, representatives from trades in progress or trades to begin work prior to the next scheduled meeting. Materials suppliers and/or other representatives impacting the current or near-current construction schedule shall also be in attendance.
3. The Contractor shall review and update the construction schedule by noting progress, work in progress, and anticipated work to begin. Areas of delays in deliveries, materials, equipment, manpower, utilities, pending architectural responses, and/or pending Owner responses that may affect the construction progress shall be addressed in conjunction with the construction progress schedule.

END OF SECTION

SECTION 01 31 29

NOTIFICATION OF ARCHITECT REQUIREMENTS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. In general, the Contractor shall notify the Architect whenever there is need of clarification of interpretation of the Contract Documents.
- B. The Contractor shall notify the Architect 48 hours in advance of certain stages of construction. The project superintendent shall notify the Owner's Representative on an ongoing basis of ongoing work. These stages shall include, but are not necessarily be limited to the following:
1. Division 2, Division 31 - Clearing of site.
 2. Div 31-33 - Stripping of top soil within limits of grading.
 3. Div 31-33 - (Excavation and) Placing (of each lift of) select fill material.
 4. Div 31-33 - Compaction, inspection, testing, and covering of underground utilities.
 5. 31 63 29 - Drilled and reamed foundation piers.
 6. 31 23 00 - Excavation of grade beams.
 7. 03 30 00, 04 22 13 - Placing of concrete.
 8. 07 81 00 - Concealment of insulation.
 9. 07 84 00 - Installation of firestopping and firesafing.
 10. 07 52 19 - Modified Bitumen Membrane Roofing System
 11. 07 92 00 - Installation of building and glazing sealants.
 12. 08 80 00 - Installation of glazing and glazed systems.
 13. 09 21 16 - Installation of gypsum wallboard.
 14. 09 30 13 - Installation of ceramic tile.
 15. 09 51 00 - Installation of acoustical ceiling (grid and panels).
 16. 09 65 19 - Installation of resilient flooring and base.
 17. 09 68 00 - Installation of carpeting.
 18. Division 09 - Painting and staining (each coat), Elastomeric coatings, etc.
 19. Division 02 - Abatement work
 20. Division 23 - Installation of heating, ventilating and air conditioning system.
 21. Division 23 - HVAC system startup
 22. Division 22 - Installation of plumbing fixtures.
 23. Divisions 21-26 - Any and all testing and training specified for equipment, mechanical, electrical and plumbing systems.
 24. Divisions 21-26 - Completion of roughing-in of plumbing, heating, air conditioning and electrical work (prior to concealment).
 25. Division 26 - Initiation of permanent power
 26. Division 26 - Installation of all electrical fixtures.
 27. Division 27-28 - Installation of all data, low voltage, security, special systems, fire alarm, and misc. technology systems.
 28. Notify the Architect and the Owner: All pre-construction or trade startup meetings.
 29. Owner shall be given notification/opportunity to conduct inspections prior to wall or ceiling cover up.
- C. In addition to notifying the Architect, the Contractor shall also notify the Structural Engineer (48 hours) prior to the following stages:
1. Drilling, reinforcing, and placing of first piers and footings.
 2. Placing first reinforcing and grade beams.
 3. Erecting structural steel elements.

- D. Above ceiling inspections shall be completed prior to cover up. All systems are to be reviewed at the same inspection. All systems shall be 100 percent complete prior to inspection.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 PRE-CONSTRUCTION CONFERENCE

- A. The Contractor shall contact Architect at least ten (10) days prior to commencing construction in order for Architect to schedule a pre-construction and/or trade startups meeting with Contractor, Architect, Owner, and third-party firms. This meeting must occur prior to commencement of any construction.

3.2 CONFERENCES AND MEETINGS

- A. Refer to Section 01 31 19, Project Meetings for requirements pertaining to Pre-construction Conference, Progress Meetings, and Pre-installation Conferences.

END OF SECTION

SECTION 01 32 16

CONSTRUCTION PROGRESS SCHEDULE

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Refer to Instructions to Proposers for substitutions.

1.2 SUBMITTALS

- A. Schedules:
 - 1. Preliminary Analysis: Within fourteen days after receipt of Notice to Proceed, submit a preliminary construction schedule for review.
 - 2. Construction Schedule: Within four weeks after receipt of Notice to Proceed, submit one reproducible and four prints of the construction schedule.

1.3 RELIANCE UPON SCHEDULE

- A. The construction schedule as approved by the Architect will be an integral part of the Contract, and will establish conditions for various activities and phases of construction.

PART 2 - PRODUCTS

2.1 CONSTRUCTION SCHEDULE

- A. Diagram: Graphically show the order of all activities necessary to complete the work and the sequence in which each activity is to be accomplished.
- B. General Requirement:
 - 1. Contractor shall provide a completed Project Schedule as outlined below 14 days after Contract Award for review and comment by Owner and Architect
 - 2. Activities shown on the schedule shall include, but not necessarily be limited to:
 - a. Project mobilization.
 - b. Submittals and approvals of shop drawings and samples.
 - c. Phasing of construction.
 - d. Procurement of equipment and critical materials.
 - e. Fabrication and installation of special material and equipment.
 - f. Final clean-up.
 - g. Final inspection and testing.
 - h. Air and water balancing.
 - i. Demonstrations for Owner and Owner's staff.
 - j. Punch lists.
 - k. Project closeout.
 - l. Commissioning Schedule
 - 3. The project Schedule shall be divided by trade/spec section and by area of the building with each section to include such items as material delivery dates, below-grade finish/install, above-grade finish/install, trimout, etc. Detail to include specific components of the trade being scheduled (for example: painting would show clean/prep. Block fill, first coat, finish coat, etc.).
 - 4. Project Schedule shall include the amount of anticipated weather days allocated for the Project at the appropriate months, and should also include such milestones as permanent power, chiller startup, etc. where applicable.

5. Contractor shall complete the subcontract trades buyout process 30 days after the Contract award.
6. Contractor shall ensure that all required submittals are submitted for review no later than 60 days after Contract award.
7. Project schedule shall be initially scheduled to allow Initial Completion 60 days prior to Substantial Completion. The 60-day period between Initial Completion and Substantial Completion shall be allocated for such items as the following:
 - a) *Initial Final Clean*
 - b) *Trial owner's systems testing*
 - c) *Owner's tests and inspections*
 - d) *Owner's systems demonstrations*
 - e) *Establishment of required stand of grass*
 - f) *Correction of Contractor's punch list*
 - g) *Owner/Architect punch list*
 - h) *Correction of Owner/Architect punch list*
 - i) *Final clean to deliver building after all tests and inspections*
 - j) *Substantial Completion*
 - k) *Test and Balancing*
 - l) *Commissioning*
8. Schedule shall also include a review of O&M manuals 30 days prior to Substantial Completion and shall include submission of a closeout document binder mock-up.

2.2 CONSTRUCTION SCHEDULE LIMITATIONS

- A. Work performed under this Contract shall be performed in accordance with the following paragraphs so that the Owner can accept the project as substantially complete as noted below.
- B. The project schedule begins upon Notice to Proceed and continue uninterrupted with the following requirements:
 1. The entire project shall be substantially complete by dates noted in the Standard Form of Agreement between Owner and Contractor (AIA Document A101™-2017, as amended) subject to Liquidated Damages as listed in General Conditions of the Contract for Construction as amended (AIA Document A201™-2017, as amended) and Supplemental Conditions (Section CB).
- C. Certificates of Substantial Completion may be issued for any of the above mentioned areas of work which are complete prior to the completion of the entire project, provided that all contract requirements for Substantial Completion are met for that portion of the Work. However, warranties shall commence on date of Substantial Completion of entire project. Maintenance required by equipment manufacturers shall be performed by Contractor through the agreed-upon Substantial Completion date, unless specified otherwise in the Contract Documents.
- D. For work during Summer: Any construction related activities after (Last Day of School) and before the start of the next school year, must occur during CFISD normal working hours of Monday through Thursday (10-hour days) or the contractor must request and pay for overtime request to have the building open per Special Owner Requirements Section 01 35 21.1. This requirement will also apply to any work during the school year outside the normal CFISD working hours. The 4-day/10-hour day schedule will only be applicable during scheduled summer break.

END OF SECTION

SECTION 01 32 23

SURVEY AND LAYOUT DATA

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 QUALITY CONTROL

- A. Conform to State of Texas laws for surveys requiring licensed surveyors. Employ a surveyor acceptable to Owner's Representative if required by the Contract.

1.2 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit name, address, and telephone number of Surveyor to Owner's Representative before starting survey work.
- C. Submit documentation verifying accuracy of survey work on request.
- D. Submit certificate signed by Surveyor, that elevations and locations of the Work are in conformance with the Contract.

1.3 PROJECT RECORD DOCUMENTS

- A. Maintain a complete and accurate log of control and survey work as it progresses.
- B. Prepare a certified survey setting forth dimensions, locations, angles, and elevations of construction and site work upon completion of foundation walls and major site improvements.
- C. Submit record documents under provisions of Division 1.

1.4 EXAMINATION

- A. Verify locations of survey control points prior to starting the Work.
- B. Notify Owner's Representative immediately if any discrepancies are discovered.

1.5 SURVEY REFERENCE POINTS

- A. The Owner will establish survey control datum as indicated on Drawings. Inform Owner's Representative in advance of time additional horizontal and vertical control points will be established so verification deemed necessary by Owner's Representative may be done with minimum inconvenience to the Owner or Contractor.
- B. Locate and protect survey control points prior to starting site work; preserve permanent reference points during construction.
- C. Notify Owner's Representative a minimum of 48 hours before relocation of reference points is needed due to changes in grades or other reasons.
- D. Promptly report loss or destruction of reference points to Owner's Representative.

- E. Reimburse the Owner for cost of reestablishment of permanent reference points disturbed by construction operations.

1.6 SURVEY REQUIREMENTS.

- A. Utilize recognized engineering survey practices.
- B. Establish a minimum of two permanent benchmarks on site, referenced to established control points. Record horizontal and vertical location data on Project record documents.
- C. Establish elevations, lines and levels to provide quantities required for measurement and payment and for appropriate controls for the Work. Locate and lay out the following with appropriate instruments:
 - 1. Site improvements including grading, fill and topsoil placement, utilities, and footings and slabs.
 - 2. Grid or axis for structures.
 - 3. Building foundation, column locations, and ground floor elevations.
- D. Periodically verify layouts.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 33 00

SUBMITTALS

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Refer to Section AB for substitutions.

1.2 PROCEDURES

- A. Transmit each item with approved form identifying project, contractor, subcontractor, major supplier; identify pertinent drawing sheet and detail number and specification section number, as appropriate. Identify deviations from Contract Documents.
- B. Apply Contractor's stamp, signed, to each item submitted, certifying that review and verification of products, field dimensions, adjacent construction work and coordination of information is in accordance with the requirements of the work and Contract Documents.
- C. Revise and resubmit submittal as required; identify all changes made since previous submittal.
- D. After review, distribute copies to all concerned parties.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- A. Refer to AIA Document A201™-2017, General Conditions of the Contract for Construction; as amended, 3.12.13 for the number of copies required. Transmit Consultant and Engineering submittals directly to respective consultants with a transmittal to the Architect.
- B. The Contractor shall provide composite drawings within 4 weeks of Notice To Proceed, showing how all piping, ductwork, lights, conduit, and 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 1/4 inch per foot minimum scale and shall include invert elevations and sections required to meet the intended purpose.
- C. Manufacturer's Instructions: When work is specified to comply with manufacturer's printed instructions, obtain and distribute copies of such instructions to parties involved in the installation, including two copies to Architect at least two weeks prior to start of such work.
- D. All dimensions indicated on the drawings are based on the specific models and manufacturers of products, equipment, fixtures, and miscellaneous items specified. If the Contractor uses an approved product by another listed manufacturer which is different than the specific model and manufacturer listed in these specifications, then the Contractor shall be solely responsible for the coordination of any dimensional changes required, including structural, relocation of walls, equipment, fixtures, ceilings, and miscellaneous items. When dimensional changes are required in these situations, the Contractor shall submit a proposed modification drawing to the Architect for approval prior to proceeding with the work. All causes and effects of the dimensional change shall be indicated on the Contractor's drawing submittal.

1.4 SAMPLES

- A. Submit full range of manufacturer's standard colors, textures, and patterns for Architect's selection. Submit samples for selection of finishes in accordance with approved schedule, and in such sequence as to cause no delay in the work or in the work of any other Contractor. All color samples to be physical samples, not digital unless requested by Architect.

- B. Submit samples to illustrate functional characteristics of the product, with integral parts and attachment devices. Coordinate submittal of different categories for interfacing work.
- C. Submittals shall contain:
 - 1. Date of submission and dates of any previous submissions
 - 2. Project title and number
 - 3. Contract identification
 - 4. Names of Contractor, Supplier, Manufacturer
 - 5. Identification of sample, with specification section number
 - 6. Note any deviation from contract documents
- D. Resubmission Requirements for Samples:
 - 1. Make any corrections or changes in the submittals required by the Architect and resubmit until approved.
 - 2. Submit new samples as required for initial submittal.
- E. Submit the number specified in the respective Specification section; minimum of two, one will be retained by Architect. Reviewed samples may be used in the work if so indicated in the specification section.

2. MANUFACTURER'S CERTIFICATES AND WARRANTIES

- A. Submit required certificates and warranties in duplicate.

END OF SECTION

SECTION 01 35 23

SPECIAL OWNER REQUIREMENTS

This Section has been added to identify and reinforce specific items that are currently defined in depth in the specifications, and that are of great importance to Cypress-Fairbanks Independent School District. The Owner of the Construction Company making an offer on the project must sign this document and an original, notarized copy will be attached to the Construction Contract.

1. **Substantial Completion: Refer to the General Conditions of the Contract for Construction as amended, Paragraph 9.8.**
2. **Documentation of Existing Conditions**
 - a. Conditions of improvements (roads, landscape areas, signage, building exterior and interior, etc.) at the building site where work is scheduled to occur are considered to be in good condition. The Contractor shall document through the use of digital video, any existing defects in areas where work will actually be performed, including but not limited to, staging areas and areas of circulation around the site, prior to the start of any construction. Contractor shall also test and document building and site systems (fire alarm, sound, irrigation, etc.) These systems are considered to be in good operating condition unless documented otherwise. A copy of all digital video (flash drive) must be filed with the Owner prior to the start of any construction. Any and all defects not specifically identified prior to construction shall be repaired/replaced by the contractor to the satisfaction of the Owner, at no additional cost.
3. **Application for Payment:**
 - a. Pay application(s) must be correctly completed and executed by the Contractor. All numerical columns and tabulations should be correctly totaled to the nearest cent. With each pay application, Contractor shall also submit partial lien releases from all sub-contractors and major suppliers on the form included in this Project Manual, for work performed through the previous accounting period, an updated construction schedule and construction progress photographs. All lien notices received by the Owner from the previous pay period must be cleared by submission of an unconditional release of lien prior to submission and approval of current applications for payment. Noncompliance with these requirements will result in the return of the Application for Payment(s) to the Contractor for correction and resubmittal. Final application for payment shall only be submitted to the Owner upon completion of all close out requirements including but not limited to receipt of Record Documents, Operation and Maintenance Manuals, Owner Orientation and Training Meetings, Consent of Surety, Contractor Final Release of Lien, Contractor's Affidavit of Payment of Debts and Claims, and unconditional final lien releases from all subcontractors, sub-subcontractors and major suppliers and any other closeout requirements per the contract documents.
 - b. **If errors are discovered by the Owner in certified applications for payment, the Owner shall reject the application and return it to the contractor for correction. The specified time period for payment of such applications will start over on the date the Owner receives the corrected certified application for payment from the Architect.**
4. **Construction Schedule:**
 - a. Refer to Section 01 32 16. The Contractor shall provide a detailed construction schedule at the start of the project and shall submit an updated schedule at the weekly construction meetings. This schedule will also identify the estimated percentage of work completed to date for each item of work along with percentage of work remaining to be completed. This information will be used in the verification of the Contractor's Application for Payment. Application for Payment will not be reviewed, approved, and processed without submittal of the initial schedule and subsequent updated schedules throughout the duration of the project.

5. Use of Alcohol and Tobacco Products:

- a. Smoking and the use of all tobacco and alcohol products are prohibited at all times on Cypress-Fairbanks ISD property, including the field office. The Contractor will be fined \$250.00 for each infraction of this policy. In addition, the Owner reserves the right to have the Contractor's personnel dismissed from the District property. This policy is strictly enforced by all employees of Cypress-Fairbanks ISD.

6. Reinspection Fees:

- a. During the course of the project, should additional inspections be required by the Owner or Consultants to review problems directly created by and attributable to the Contractor, then all associated expenses including mileage shall be deducted from funds remaining to be paid to the Contractor. The Owner or Architect will verbally inform the General Contractor of the intent to request additional reinspection fees at the time of the occurrence and will provide written invoicing within thirty (30) working days after the date of the occurrence.

7. Job Superintendent:

- a. The Contractor will be required to keep the job superintendent on the job site full-time during the course of the job until completion of all punch list items. In the event the job superintendent is absent from the job site at any time during the project contract time or during punch list completion and a previously agreed upon substitute is not provided, the Owner may fine the Contractor \$250.00 per occurrence.
- b. The Owner is to be notified at the beginning of the workday if the job superintendent is out sick. If the superintendent is out for any other reason, the Owner is to be notified at least twenty-four (24) hours in advance. In both cases, the Owner is to be informed of the name of the acting job superintendent.
- c. Subcontractors, Sub-subcontractors are not allowed to work unsupervised on the jobsite at any time during the performance of the work including overtime and weekends.
- d. Where multiple sites are part of the construction contract, the Contractor shall furnish a full-time superintendent for each project campus work is to be performed unless otherwise specified or agreed to by the Owner.

8. Site/Building Rules and Regulations

- a. The Contractor shall adhere to the following building rules and regulations during the performance of the work within this contract. The Owner will back charge the Contractor in the amount of \$250.00 per occurrence for any violations of any of these rules and regulations. In addition, the Owner reserves the right to remove the person committing the violation permanently from the project site.
 1. No foul language or spitting will be allowed on district property and within the interior of the buildings.
 2. The possession of tobacco products, firearms, alcohol, or illegal drugs is strictly prohibited on school property and is a state and federal law and subject to criminal charges for any such violation.
 3. Workers must be fully clothed. Shorts and tank tops are not allowed on school property.
 4. The Contractor's personnel shall demonstrate professional behavior and respect toward all school district personnel and property. Physical, verbal, or visual contact with students is strictly prohibited.
 5. Any worker with a history of felony convictions or warrants is strictly prohibited from working on district property. The District has the right to perform criminal checks on any worker the Contractor and/or its subcontractors proposes to use on the project prior to

- issuance of security identification badges. The Owner reserves the right to check such records anytime during construction if the Owner deems it necessary for the safety and protection of the students and staff.
6. The Contractor's personnel are not allowed to park on any grass area, under shade trees, sidewalks, or non-vehicular paved areas. The Contractor will be held liable for any resultant damages resulting from the violation of this requirement.
 7. Authorization must be obtained in advance with the campus administrator or the Facilities Planning and Construction Department to enter or access any existing facility campus.
 8. The Contractor, subcontractors or sub-subcontractors shall keep the premises and site free from accumulation of waste, materials or rubbish caused by the work under this contract at each site. Boxes must be broken down prior to removal from the building. Upon completion of the contract work, and prior to the final inspection, have the premises in a neat and clean condition.
 9. The Contractor shall take all precautions necessary for the safety of, and provide protection to prevent damage, injury or loss to:
 - a. All employees on the project and all other persons who may be affected thereby.
 - b. All the work with all the materials to be incorporated therein, whether in storage on or off the site.
 - c. All property at the site and adjacent thereto including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and any other school property.
 10. A competent supervisor who understands the full scope of the work shall be on-site at all times while work is being performed and remain on-site until all punch list items have been completed as specified here within this specification section.
 11. The Contractor shall be responsible to Cypress-Fairbanks I.S.D. for acts and omissions of the Contractor's employees, subcontractors and their agents and employees, and other persons performing portions of the work under the contract.
 12. The Contractor shall not perform any work within the confines of a secured building on a renovation/addition project or after Substantial Completion on a new Project without the District having one District custodian present during performance of the work. The contractor must reimburse Cypress-Fairbanks I.S.D. Operations Department for the overtime costs associated with the after-hours work as specified within this specification section. Refer to Special Owner Requirements Overtime Section 01 35 23.1.
 13. All exterior doors must be kept closed at all times.
 14. All workers must wear badges at all times when on CFISD property. Refer to Special Owner Requirements Badging Section 01 35 23.2
 15. All deliveries shall be received and signed for by the Contractor and not by Cypress-Fairbanks ISD personnel. The Contractor shall post signs, in a location agreed upon by the Owner's Representative, stating where deliveries are to be received and who is to sign for them.

Signature form follows on next page.

By signature of this document, I hereby state that I (or designated representative of this Company as indicated below) have reviewed the project sites, reviewed the Contract Documents, and read the Specifications including the General Conditions as Amended, Supplementary Conditions and Special Owner Requirements in their entirety and do fully understand and agree to fully abide by all requirements established herein.

Respectively Submitted,

By: _____
Signature

Printed Name

Title

Company Name

Street Address

City, State, Zip Code

(Seal - if Proposer is a Corporation)

Date _____ State of _____ County of _____

Subscribed and sworn to before me this _____ day of _____

Notary Public:

My Commission expires:

NOTE: Form must be notarized and attached to the Construction Contract.

END OF SECTION

SECTION 01 35 23.1

**BUILDING OVERTIME REQUESTS
SPECIAL OWNER REQUIREMENTS**

This Section has been added to identify and reinforce specific items that are currently defined in depth in the specifications, and that are of great importance to Cypress-Fairbanks Independent School District. The Owner of the Construction Company making an offer on the project must sign this document and an original, notarized copy will be attached to the Construction Contract.

Contractor Overtime and Building Access

- A. Owner’s building personnel will be present at all times during the performance of the Work by the Contractor should Work be necessary during non-normal hours, weekend, School District employee Holidays and after the date of substantial completion. If the Contractor needs access to the sites other than normal campus working hours, notification shall be provided to the Owner’s Representative through the Facilities Planning and Construction Office Project Manager. The attached “Contractor Overtime Building Access Request Form” within this section shall be submitted for all overtime requests to obtain Owner approval.
- B. Overtime requests/scheduling: Contractor shall request with the attached form and submit by noon, a minimum of three (3) days in advance of the anticipated Work an overtime request. These requests shall be a minimum of four (4) hour charge. If Contractor does not work the entire time of requested overtime hours, the Contractor will still be responsible for paying the total requested overtime hours billing. With each request, Contractor will be billed 30 minutes to allow Operations to open and secure the building as well as 30 minutes for lunch.
- C. The Contractor shall compensate the Owner at the rate of twenty-two (\$22.00) dollars per hour for non-normal and weekend hours, and thirty-three (\$33.00) dollars per hour for School District employee Holidays.
- D. Overtime cancellations: Contractor shall request and submit by noon, a minimum of two (2) days in advance of the anticipated Work an overtime cancellation request should scheduled work and overtime not occur. If Contractor fails to cancel, they will be charged the four (4) hour minimum charge.
- E. Invoices will be submitted by the Owner to the Contractor on a monthly basis and are payable upon receipt to Cypress-Fairbanks I.S.D. Operations Department. Payment must be received within thirty (30) days of the invoice date. Owner reserves the right to refuse future overtime requests as well as the rejection of any current application for payment until such time outstanding payments are received.
- F. Hours:
 - 1. Normal School hours: 6:30 AM – 11:30 PM Monday – Friday
 - 2. Summer hours: 6:00 AM – 4:30 PM Monday - Thursday
 - 3. Not including District recognized employee Holidays per academic year calendars on District’s website: Spring Break Week, Thanksgiving Week and Winter Break
6:00 AM – 2:30 PM
 - 4. Food Production, school kitchens:

Elementary	7:00 AM – 3:30 PM for most, verify with Owner
Middle	6:30 AM – 3:00 PM for most, verify with Owner
High	6:00 AM – 2:30 PM for most, verify with Owner
- G. Package renovation and construction projects containing multiple district campuses will require overtime requests/cancellations be submitted for each building as needed.
- H. Overtime agreements made that differ from the above noted guidelines will not be accepted or honored.
- I. For site work only, the Contractor is required to complete the overtime form and submit it to the District. There will be no charge for site work only to the Contractor. The District will notify all parties to inform them work is being scheduled to be performed on our site.

Signature page continued below.

By signature of this document, I hereby state that I (or designated representative of this Company as indicated below) have reviewed the project sites, reviewed the Contract Documents and read the Specifications including the General Conditions as Amended, Supplementary Conditions and Special Owner Requirements in their entirety and do fully understand and agree to fully abide by all requirements established herein.

Respectively Submitted,

By: _____
Signature

Printed Name

Title

Company Name

Street Address

City, State, Zip Code

(Seal - if Proposer is a Corporation)

Date _____ State of _____ County of _____

Subscribed and sworn to before me this _____ day of _____

Notary Public:

My Commission expires:

NOTE: Form must be notarized and attached to the Construction Contract.

**CONTRACTOR
 OVERTIME / BUILDING ACCESS REQUEST FORM
 CYPRESS-FAIRBANKS INDEPENDENT SCHOOL DISTRICT**

<u>CONTRACTOR:</u>	<u>CYPRESS-FAIRBANKS ISD USE ONLY:</u>
1. Date of Request: _____	1. Total Overtime Hours Requested: _____
2. Project: _____	2. Total Overtime Amount Due Cy-Fair ISD: _____
3. CFISD Project Number: _____	3. Date Submitted to Operations: _____
4. Campus: _____	4. Date Submitted to Security: _____
5. Requested Date: _____	5. Date Submitted to Facilities Use: _____
6. Requested Hours: _____ (Minimum 4 hours must be requested)	6. Comments:
7. General Contractor/Subcontractors Working and contact mobile phone numbers: _____ _____	
8. Project Manager and Superintendent's Name and contact mobile phone numbers: _____ _____	
9. Requested By: _____	

On a monthly basis and prior to contract closeout and final payment by the Owner, the Contractor hereby agrees to reimburse Cypress-Fairbanks ISD the amount of twenty two (\$22.00) dollars per hour for non-normal days & weekend hours and thirty three (\$33.00) dollars per hour for School District employee Holidays for the above requested overtime hours. Reimbursement will be made by separate check made payable to the Cypress-Fairbanks ISD Operations Department within thirty (30) days of invoice date. If Contractor does not work the entire time of requested overtime hours, the Contractor will still be responsible for the total requested overtime hours. With each request, Contractor will be billed 30 minutes to allow Operations to open and secure the building and also includes 30 minutes for lunch.

Acknowledged and Agreed to by: _____
 Contractor's Signature Date

 Printed Name

Approved by: _____
 CFISD Project Manager's Signature Date

 Printed Name

END OF SECTION

Section 01 35 23.2

Special Owner Requirements - Badging Process

For Contractors, Sub-Contractors, Service Providers, & Vendors

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

Refer to enclosed instructions and Form AP packet for necessary submission information and procedures.

1.1 SECTION INCLUDES

- A. This Section has been added to identify and reinforce specific items that are currently defined in depth in the specifications, and that are of great importance to Cypress-Fairbanks Independent School District. The Owner of the Construction Company making an offer on the project must sign these documents and an original, notarized copy will be attached to the Construction Contract.
- B. Mandatory photo identification badge with the workers name and name of the Construction Company, which shall be worn at all times *[required after Substantial Completion for new buildings; required at all times for renovations]* shall be provided by the Owner and payable by the General Contractor. The General Contractor shall provide a list of all employees, suppliers, etc., that will be on the job site for more than 1 hour per day. The Owner reserves the right to reject issuing a security badge to any contractor employee as deemed appropriate to protect the Owner's interest. The Owner reserves the right to dismiss any worker not wearing proper identification, from the project site. Back charges are applicable for any infraction of this requirement.
- C. Lists must be forwarded to the Facilities Planning & Construction Department 72 hours or earlier in advance of going to the site.
- D. List shall be submitted on forms contained in Form AP packet.
- E. Should a Contractor want to add names to their original list, they must be added on a separate list.
- F. A maximum of 5 groups of **3-4 workers** may report to the Facilities Planning and Construction Department to have photos taken and pick-up the identification badges, based upon the agreed upon schedule. If more than the maximum number of workers show up, they will be asked to wait, or to return at a later time.
- G. Badges will include the General Contractor, Subcontractor or Sub-subcontractor name, expiration date of the project, and photo identification of the authorized person. The expiration date will typically be 6 months after the scheduled contract substantial completion date, but not longer than one year from date of issuance. Upon expiration, the contractor shall repeat the application process. There is no charge for renewal badges provided that the worker returns his previous badge. Otherwise, the \$10.00 charge applies.
- H. Badges must be worn at all times by all General Contractor, Subcontractor or Sub-subcontractor personnel on school district property during the construction of the project.
- I. The Contractor will be invoiced by Facilities Planning, & Construction and will be responsible for payment within 30 days of the invoice date.
- J. Should a person lose a badge and need a replacement, this procedure will be used to obtain the replacement badge. A \$10.00 charge for the replacement badge will be applicable for all lost badges.
- K. The Contractor shall contact Facilities Planning, & Construction with any questions during the process. The Contractor shall not contact Cypress-Fairbanks Police Department directly.

- L. Contractor shall return all project badges to CFISD. This included but is not limited to the Contractor, Sub-contractor, sub-sub-contractor, etc. Should badges not be returnable, Contractor shall submit letter in writing noting badges are lost for CFISD records as well as be assessed a fee of \$10.00 for each badge not returned to CFISD. If Contractor fails to pay such fees, the Owner will deduct such charges from the final payment.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

- 3.1 Refer to and follow the attached instructions.

END OF SECTION

SECTION 01 36 13

RENOVATION PROJECT PROCEDURES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

- A. This Section contains general provisions and requirements pertaining to all remodeling, removal, and relocation of Work in the existing building and becomes a part of each Section and Division performing remodeling, removal and relocation Work for this Project with the same force and effect as if written in full therein.
- B. Take all necessary precautions to keep students and other trespassers out of the Work areas. Secure Work areas from entry when Work is not in progress.
- C. Perform all alterations, remodeling, demolition, removal and relocation of Work in strict accordance with Owner's instructions and applicable Federal, State and local health and safety standards, codes and ordinances. Where conflicts occur, the more restrictive requirement shall govern.
- D. Refer to section 01 71 50 Preventive Housekeeping and Final Carpet Cleaning.

1.2 RELATED WORK

- A. Section 02 41 01 - Demolition

1.3 EXISTING CONDITIONS

- A. Obvious existing conditions, installations and obstructions affecting the Work shall be taken into consideration as necessary Work to be done, the same as though they were completely shown or described.
- B. Items of existing construction indicated to remain upon completion of the Contract, but which require removal to complete the Work, shall be carefully removed and replaced as required. The replaced Work shall match its condition at the start of the Work unless otherwise required.
- C. Visit the site to determine by inspection all existing conditions, including access to the site, the nature of structures, objects and materials to be encountered, and all other facts concerning or affecting the Work. Information on the Drawings showing existing conditions does not constitute a guarantee that other items may not be found or encountered.
- D. Utilities: Do not interrupt existing utilities serving occupied or used facilities, except when authorized by the Architect/Owner in writing two (2) weeks in advance. Provide temporary services during interruptions to existing utilities.

PART 2 - PRODUCTS

2.1 SALVAGED MATERIALS

- A. The Owner reserves the right of first refusal on all salvage items. Remove remaining items from the site as Work progresses. Storage or sale of items on site is not permitted. Burning or burying of removed materials on site is not permitted.
- B. Store salvaged items in a dry, secure place on site.

- C. Salvaged items not required for use in repair of existing Work shall remain the property of the Owner.
- D. Do not incorporate salvaged or used material in new construction except where specified in the Contract Documents

2.2 PRODUCTS FOR PATCHING, EXTENDING AND MATCHING

- A. Contract Documents do not define products or standards of workmanship present in existing construction. Determine products by inspection and by use of the existing. Provide same or similar quality products or types of construction as that in existing structure when needed to patch or extend existing Work.
- B. If reasonably matching products are not obtainable, improve appearance by minor relocating of some existing products and grouping new ones in some pattern arranged by the Architect.

PART 3 - EXECUTION

3.1 PROTECTION OF WORK TO REMAIN

- A. Protect existing Work from damage. Use barricades, tarpaulins, temporary walls, plywood, planking, masking, or other suitable means and methods as approved by the Architect.
- B. If Work to remain in place is damaged, restore to original condition at no additional cost to the Owner.
- C. Concealed Conditions: If conditions cause changes in the Work from requirements of the Contract Documents, the Contract Sum will be adjusted in accordance with the General Conditions.

3.2 PROCEDURES

- A. Refinishing At Removed Work: Cut below surface of substrate materials and patch over area of removal with finish materials so removal is not apparent.
- B. Remove and replace existing ceilings, and cut, patch, or replace existing walls, partitions and floors as may be necessary for access to valves, piping, conduit and tubing by mechanical and electrical trades as directed and approved by the Architect, and performed by the appropriate subcontractor for the Work involved, or by other properly qualified subcontractors.
- C. Patch and extend existing Work using skilled mechanics who are capable of matching existing quality and workmanship. Quality of patched or extended Work shall be not less than that specified for new Work.
- D. Cutting:
 - 1. Concrete and Masonry: Saw cut where feasible.
 - 2. Plaster: Cut back to sound plaster on straight lines, and back-bevel edges of remaining plaster. Trim and prepare existing lath for tying of new lath.
 - 3. Woodwork: Cut back to a joint or panel line. Undamaged removed materials may be reused.
 - 4. Resilient Tiles: Remove in whole units to natural breaking points or straight joint lines with no damaged or defective existing tiles remaining where joining new construction.
 - 5. Salvaged Materials: Carefully remove to avoid damage, thoroughly clean and reinstall as indicated, or as directed.
 - 6. Doors: Remove in such a manner as to facilitate filling in of openings or installation of new Work, as required by Drawings. **Refer to Finish Hardware Section for specific**

- requirements for salvage of existing finish hardware.** Provide construction cores as required to maintain security and access control.
7. Structural Elements: Remove only as shown on the Structural Drawings. If not specifically shown, but removal is required, perform such removal or alteration only upon written approval of the Architect. Do not damage or alter any structural element of the existing building.
- E. Patching:
1. Match existing Work where possible; if unavailable, use salvage material for patching and provide totally new material in areas where salvage has been removed; consult with the Architect concerning locations for salvaging materials.
 2. Repairs or continuations of existing Work shall be relatively imperceptible in the finished Work when viewed under finished lighting conditions from a distance of six (6) feet.
 3. Patching, Repairing and Finishing of Existing Work: Perform in compliance with the applicable requirements of the Specification Section covering the Work to be performed and the requirement of this Section.
- F. Erect scaffolding as necessary to gain access to the various parts of the Work. Provide structurally sound, rigidly braced and properly constructed scaffolding, shoring, and bracing as necessary to positively protect the affected elements and building, and to support the activities or workmen and loads. Design and construction of scaffolds and supports shall be in accordance with applicable safety regulations. Material used shall be adequate to support anticipated loads with a properly calculated margin of safety.
- G. Noise Producing Equipment: Minimize use of noise producing equipment. Limit excessive noise to periods of vacancy or provide sound control. Arrange schedules in advance with the Architect and Owner.

3.3 EXISTING FURNITURE AND EQUIPMENT

- A. Owner Salvaged Items: Personal items in areas subject to remodeling will be removed by Owner before construction in those areas commences. Contractor shall notify Owner if any personal items remain; Owner shall remove such items.
- B. Furniture Items - Renovation: Contractor shall be responsible for any furniture relocation, storage, and move-back necessary to complete scope of work. Contractor to coordinate activities with Owner. Contractor is solely responsible for protecting furniture and equipment and is therefore solely responsible for any damage to said items and ensuing costs in restoring damaged items to same condition or replacing lost or damaged items beyond repair, unless specified as an allowance (Section 01 21 00).

3.4 PAINTING

- A. Preparation: Prepare patched areas as required for new Work. Wash existing painted surfaces with neutral soap or detergent, thoroughly rinse, and sand when dry.
- B. Painting and Finishing: Conform to the applicable provisions of the Painting Section. Prepare bare areas and patches in existing painted surfaces with specified primer and intermediate coats, sanded smooth and flush with adjoining surfaces.

3.5 DISPOSAL OF DEBRIS

- A. Remove daily material, debris and rubbish resulting from Work of this Section from the building and site as it accumulates. Keep all areas of Work in "broom clean" condition as the Work progresses.

3.6 JOB SUPERINTENDENT

- A. If renovation project includes Work at more than one site, Contractor shall have supervision at all sites as follows:

Cy Lakes HS shall have at least one full-time Superintendent.

3.7 FINAL CLEANING

- A. At completion of renovation and remodeling Work in each area, provide final cleaning of all surfaces and return all areas affected by construction to a condition suitable for use by the Owner. Final cleaning shall include dusting of all surfaces; thorough cleaning of all surfaces including the removal of smudges, marks, stains, fingerprints, soil, dirt, paint spots, lint, discolorations, and other foreign materials; vacuuming of carpets; cleaning of all new carpeting by manufacturer-approved contractor; wet-mop cleaning of tile, and waxing of VCT, terrazzo surfaces per CFISD-approved methods. Refer to section 01 71 50 for Preventive Housekeeping and Final Carpet Cleaning.

END OF SECTION

SECTION 01 36 13.1

CUTTING AND PATCHING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Execute cutting (including excavating and backfilling), fitting or patching of the work, required to:
 - 1. Make several parts fit properly.
 - 2. Uncover work to provide for installation of ill-timed work.
 - 3. Remove and replace defective work.
 - 4. Remove and replace work not conforming to requirements of the contract documents.
 - 5. Remove samples of installed work as specified for testing.
 - 6. Install specified work in existing construction.
- B. In addition to contract requirements, upon written instruction of the Architect:
 - 1. Uncover work to provide for observation of covered work.
 - 2. Remove samples of installed materials for testing.
 - 3. Remove work to provide for alteration of existing work.
- C. Do not endanger any work by cutting or altering the work or any part of it.
- D. Do not cut or alter the work of another Contractor without written consent of the Architect.
- E. Prior to cutting that affects structural safety of the project or the work of another Contractor, secure written approval of the Architect.

1.2 PAYMENT FOR COSTS

- A. Costs caused by ill-timed or defective work or work not conforming to the contract documents, including the cost of additional services of the Architect, Third-Party Consultants, and Owner, will be borne by the Contractor.
- B. Work done on written instructions of the Owner or Architect, other than defective or nonconforming work, will be paid by the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials required for replacement of the work removed must conform to the specifications for the type of work to be done.

PART 3 - EXECUTION

3.1 PREPARATION:

- A. Provide shoring, bracing and support as required to maintain the structural integrity of the project.
- B. Provide protection for other portions of the project.
- C. Provide protection from the elements.

3.2 PERFORMANCE

- A. Execute fitting and adjustment of products to provide finished installation to comply with specified tolerances and finishes.
- B. Execute cutting and demolition by methods which will prevent damage to other work and will provide proper surfaces to receive installation of repairs and new work.
- C. Execute excavation and backfilling by methods which will prevent damage to other work and will prevent settlement.
- D. Restore work which has been cut or removed; install new products to provide complete work in accordance with requirements of the contract documents.
- E. Refinish entire surfaces as necessary to provide an even finish. On continuous surfaces, refinish to the nearest intersections. For an assembly, refinish the entire item.

END OF SECTION

SECTION 01 45 00

QUALITY CONTROL

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Quality Assurance: Requirements for material and product quality and control of installation
- B. Tolerances
- C. References and Standards
- D. Mock-ups
- E. Testing Laboratory Services
- F. Inspection Services
- G. Manufacturers' field services

1.2 RELATED SECTIONS

- A. Section 01 41 00 - Regulatory Requirements
- B. Section 01 45 23 - Testing and Inspecting Services
- C. Section 01 33 00 - Submittal Procedures
- D. Section 02 32 00 - Geotechnical Report
- E. The work of this Section shall be included as a part of all Sections of work, whether referenced therein or not.

1.3 DESCRIPTION OF REQUIREMENTS

- A. Unless specifically noted otherwise, perform all work shown, mentioned, or reasonably inferred and comply with all work restrictions.
- B. Many of the requirements specified elsewhere are included herein for reference and convenience. Where a conflict occurs between the Contract Documents, either within themselves or each other, the more stringent requirement or the most expensive combination of materials and workmanship shall prevail.
- C. Contractor shall:
 - 1. Perform work in accordance with the General Conditions, as specified herein, and with the quality control requirements of each Specification Section.
 - 2. Perform work in the highest quality workmanship, unless specified otherwise.
 - 3. Join materials with a uniform and accurate fit so they meet with neat straight lines, free of smears, overlaps or irregularities, as applicable to the work.
 - 4. Install all exposed materials appropriately level, plumb, and at accurate angles as shown and flush with adjoining materials.

5. Attach materials with sufficient strength, and with number and spacing of fasteners and attachments that will not fail until materials joined are broken or permanently deformed.
6. Use concealed fasteners, unless shown or directed otherwise.

1.4 QUALITY ASSURANCE AND CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturer's instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform work by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.5 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

1.6 REFERENCES AND STANDARDS

- A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date of Owner-Contractor Agreement except where specific date is established by code.
- C. Obtain copies of standards where required by product specification sections.
- D. When specified reference standards conflict with contract documents, request clarification from Architect/Engineer before proceeding.
- E. Neither contractual relationships, duties, responsibilities of parties in contract nor those of Architect/Engineer shall be altered from contract documents by mention or inference otherwise in reference documents.
- F. Refer to Section 01 41 00, Codes, Regulations and Standards, for additional information concerning applicable reference and standards requirements.

1.7 MOCK-UP REQUIREMENTS

- A. Tests will be performed under provisions identified in this section and identified in respective product specification sections.
- B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- C. Accepted mock-ups shall be the comparison standard for remaining work.
- D. Where mock-up has been accepted by Architect/Engineer and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so by Architect.
- E. Mock-up may be approved in phases as portions are completed.
- F. Project Mock-up Requirements: Provide an actual sample mockup wall with multiple panels with the following properties:
 - 1. Size: Minimum 8 feet wide by 8 feet tall. Size may vary according to specific project requirements. Brace and support as required to withstand structural windloads.
 - 2. Materials: actual exterior finishes including, but not limited to face brick, cast stone, and plaster, actual building materials and assemblies indicating brick patterns on masonry and stud back-up as occurs with dampproofing and flashing as detailed, actual portion of aluminum storefront indicating jam, sill and head attachment and flashing details, and where appropriate, provide mock-up of special finish details, insets and reliefs, reveals, expansion and control joints, brick ledges, brick head and sills, pipe penetrations and waterproofing materials. Provide roof edge flashing and gutter section (as applicable) in pre-finished color as selected by Architect to cap the mock-up panel. Include a sealant joint at least 16 inches long. Brick and Mortar color shall be selected by Architect prior to mock-up assembly.
 - 3. Drawing: Refer to mock-up diagram on Drawings for minimum project requirements. Mock-up drawing is for reference only. Actual mock-up drawing will be submitted by the Architect after submittals have been approved.

1.8 TESTING SERVICES

- A. Owner will appoint, employ, and pay for specified services of an independent firm to perform testing.
- B. The independent firm will perform tests and other services specified in individual specification sections and as required by the Architect/Engineer, Owner, or authority having jurisdiction.
- C. Testing and source quality control may occur on or off the project site. Perform off-site testing as required by the Architect/Engineer or the Owner.
- D. Reports will be submitted by the independent firm to the Owner, Architect/Engineer, and Contractor, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
- E. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
 - 1. Notify Architect/Engineer and independent firm 48 hours prior to expected time for operations requiring services, or as specified in individual specification sections.
 - 2. Make arrangements with independent firm and pay for additional samples and tests required.
- F. Testing does not relieve Contractor to perform work to contract requirements.

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- G. Re-testing required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions by the Architect/Engineer. Payment for re-testing will be charged to the Contractor by deducting testing charges from the Contract Sum/Price.
- H. Refer to Section 01 45 29, Inspection and Testing Laboratory Services, for additional information concerning testing, and submittal procedures and requirements for Testing Reports.

1.9 INSPECTION SERVICES

- A. Owner will appoint, employ, and pay for specified services of an independent firm to perform inspection.
- B. The independent firm will perform inspections and other services specified in individual specification sections and as required by the Architect/Engineer, Owner, or authority having jurisdiction.
- C. Inspecting may occur on or off the project site. Perform off-site inspecting as required by the Architect/Engineer or the Owner.
- D. Reports will be submitted by the independent firm to the Owner, Architect/Engineer, and Contractor, indicating inspection observations and indicating compliance or non-compliance with Contract Documents.
- E. Cooperate with independent firm; furnish safe access and assistance by incidental labor as requested.
 - 1. Notify Architect/Engineer and independent firm 48 hours prior to expected time for operations requiring services, or as specified in individual specification sections.
- G. Inspecting does not relieve Contractor to perform work to contract requirements.
- H. Refer to Section 01 45 29, Inspection and Testing Laboratory Services, for additional information concerning inspections, and submittal procedures and requirements for Inspection Reports.

1.10 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as required, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Architect/Engineer within ten (10) days after receipt of Notice to Proceed, in advance of required observations. Observer subject to approval of Architect/Engineer and Owner.
- C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- D. Refer to Section 01 33 00, Submittal Procedures, for additional information concerning submittal procedures and requirements for Manufacturers Field Reports.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing site conditions and substrate surfaces are acceptable for subsequent work. Beginning new work means acceptance of existing conditions.
- B. Verify existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Verify utility services are available, of correct characteristics, and in correct locations.

3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

END OF SECTION

SECTION 01 45 29

INSPECTION AND TESTING LABORATORY SERVICES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION (refer to Document AB for substitutions).

- A. All third-party inspection and testing laboratory services will be provided and paid for by the Owner or by allowance in this contract. An inspection and testing lab will be selected by the Owner and the Contractor will be notified as soon as possible.
- B. The Owner will pay for the initial inspection and testing laboratory services of materials that comply with the requirements of the Contract Documents. The Contractor shall pay for re-inspection and re-testing of materials that do not comply with the requirements of the Contract Documents, and for re-inspection and re-testing due to “no-shows” and cancellations by Contractor or Subcontractors.
- C. The Contractor shall coordinate and cooperate with the inspection and testing laboratory in all matters pertaining to the work. The Owner retains the option to add to or delete any or all inspection and testing specified herein.
- D. The third-party inspection and testing laboratory services are for the Owner’s benefit. These services shall in no way relieve Contractor of Contractor’s responsibility to provide quality control of all materials incorporated into the Work.
- E. Contractor may be subject to reimbursing owner if the Contractor’s means and methods are shown to cause an overrun in the Owner’s contract with testing lab.
- F. Prior to or during the pre-construction meeting, Contractor shall coordinate with the District’s selected testing lab in order to ensure proposal costs are not exceeded and schedule is congruent to testing proposed. Failure to coordinate may result in backcharges if overages are realized.
- G. Contractor shall submit a construction schedule at time of bid for the testing lab’s use.
- H. Contractor shall allow for in their proposal the coordination and supervision of tests to be performed by an independent laboratory as selected by the Owner.

1.2 RELATED REQUIREMENTS

- A. Conditions of the Contract: Inspections and testing required by laws, ordinances, rules, regulations, orders or approvals or public authorities.
- B. Respective Sections of Specifications. Certification of products.
- C. Each Specification Section Listed: Inspection and laboratory test required and standards for inspection and testing.
- D. Testing laboratory inspection, sampling and testing are required for, but not limited to the following:
 - 1. Division 31 - Earthwork
 - 2. Section 03 30 00 - Cast-In-Place Concrete
 - 3. Section 05 31 23– Steel Roof Decking
 - 4. Section 04 20 00 - Unit Masonry
 - 5. Section 05 12 00 - Structural Steel
 - 6. Section 07 52 19 - Modified Bituminous Membrane Roofing System

7. Division 23 - Mechanical (Inspection and testing of welds and bolts on mechanical piping)
As requested by the Owner, Architect, or Engineer.

1.3 AUTHORITIES AND DUTIES OF THE LABORATORY

- A. The inspection and testing laboratory is not authorized to revoke, alter, relax, enlarge, or release any requirement of the Specifications, or to approve or accept any portion of the Work. When it appears that the material furnished or work performed by the Contractor fails to fulfill specification requirements, the inspection and testing laboratory shall promptly notify the Owner, General Contractor, Architect, Engineers, supplier and/or subcontractor providing or preparing the materials or work being tested of such deficiencies.
- B. The inspection and testing laboratory shall promptly distribute copies of the laboratory test and inspection reports. Standard distribution shall include copies of all reports to the Owner, Architect, and General Contractor. The Structural Engineer, Civil Engineer, MEP Engineer, concrete supplier, and any outside consultants shall receive copies of the testing results regarding their particular phase of the Project. Consult with Owner to determine Owner's preference of distribution (hard copy, electronic, etc.).
- C. The testing laboratory shall provide testing services under a separate agreement with the Owner or Architect, who shall be responsible for the costs of initial testing – pass or fail.
 1. The Contractor shall be responsible for costs of all re-tests required to achieve passing results.
 2. The Contractor shall be responsible for charges of the testing lab for expenses incurred for cancelled and/or mis-scheduled testing requests.
 3. The testing lab shall invoice Contractor direct for all re-tests of failed initial tests; and send copies of the invoices to the Architect and Owner for record.
 4. The testing lab and Contractor shall be responsible to negotiate and execute a separate agreement if required by the testing lab for charges described above.
- D. The testing lab is required to furnish a report of the status of testing performed as it relates to anticipated expenses described in the Agreement with the testing lab. Reports shall be furnished at most bi-monthly to the Owner and Architect.
 1. Report information shall include verification that Owner paid testing progress corresponds with anticipated expenses.
 2. The testing lab shall be required to notify the Architect and Owner immediately in writing if/when the testing lab anticipates exceeding the line item and or lump sum fee agreed by Owner.
 3. Such notification must occur prior to expensing 75% of the testing lab fee.

1.4 TESTING LABORATORY GUIDELINES AND PROCEDURES

- A. Technicians scheduled to perform specific inspection and 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 Project site.
- B. Concrete design mixes will receive a cursory review with any discrepancies reported to the Architect/Engineer. No compensation will be considered for these reviews.
- C. Nuclear density testing will be based on a daily rental rate for the actual testing equipment, compensation on a per test basis will not be considered.
- D. Report distribution shall include the Owner, Architect, Contractor, Civil Engineer, Structural Engineer, and others requesting or requiring review of the specific testing results.

- E. Cylinders will be pick-up by the technician performing test the next day in order to have them cure under laboratory conditions.
- F. Structural steel inspections shall include a plant visit reviewing shop fabrication, welding, and an overall review of the shop fabrication quality control standards.
- G. The Contractor shall bear the responsibility of scheduling all the inspection and testing services. The Contractor and the testing laboratory shall assume full responsibility to coordinate the inspection and testing services. Cancellations and or failed test will be reimbursable to the Owner by the Contractor. Contractor will provide and maintain a sign-in sheet for testing lab services.
- H. Technician time for services performed will be reimbursed at a regular time rate. Compensation at the overtime rate will be considered for any hours over eight hours spent at the job site on a single day, field testing services performed on a Saturday or Sunday, and any field services performed on a recognized holiday.

PART 2 - PRODUCTS

Not Used

PART 3 – EXECUTION

3.1 GENERAL

- A. Inspection and 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. Where requirements of this Section are in conflict with requirements noted on the Contract Drawings or other Sections of the Specifications, the more stringent requirement shall apply, unless directed otherwise by Architect.
- C. Should any unusual conditions be encountered during any operations, the laboratory shall be contacted immediately so that additional inspection and testing, as applicable, can be provided.
- D. The Owner reserves the right to add to or delete any or all inspection and testing specified herein.

3.2 SITE GRADING

- A. Testing Services:
 - 1. Perform field tests for moisture density properties.
 - a. In each compacted fill layer, provide one (1) field test for every 5,000 square feet of area, but not less than three (3) tests.
 - b. At paved area, provide one (1) field test for every 5,000 square feet, but not less than three (3) tests.

3.3 COMPACTING FILL AND BACKFILL

- A. Testing Services:
 - 1. Perform field test for moisture density properties:
 - a. Within the building line provide one (1) field test in each compacted layer for every 5,000 square feet of area, but not less than three (3) tests.

3.4 PAVING

- A. Testing Services:
 - 1. Perform field tests for moisture density properties:
 - a. Provide field testing of the sub-grade as described in Paragraph 3.2, A, 2 above.
 - b. Paving sub-base, provide one (1) field test for every 5,000 square feet of area of crushed limestone or caliche sub-base, if any.
 - c. Lime treated sub-grade, provide one (1) field test for every 5,000 square feet of area of lime treated sub-grade, if any, for content of lime and sub-grade compaction.
 - d. Cement soil stabilization, if any, provide one (1) field test for every 5,000 square feet of area of cement stabilized sub-grade for content of cement and sub-grade compaction.

3.5 PIPED SITE UTILITIES

- A. Inspection and Observation Services:
 - 1. Inspection of trenches for proper alignment and grade.
 - 2. Inspection of pipe bedding and supports.
 - 3. Inspection of pipe, joints, jointing material, and thrust blocks prior to installation of pipe.
 - 4. Inspection of installation of pipe and joints.
 - 5. Observation of testing of piped utilities performed by Contractor.

3.6 EARTHWORK

- A. Inspection and Observation Services:
 - 1. Refer to and include, as applicable, work of Paragraphs 3.2, 3.3, 3.4, and 3.5 above.
 - 2. When perimeter and underfloor drainage systems are specified or required, inspect installation of such systems for conformance with specified materials and detail requirements.
 - 3. When temporary drainage and dewatering systems are used to keep excavations dry, inspect the systems for adequacy. Ground water should be maintained at least two (2) feet below bottom of excavation.
 - 4. Review the equipment and methods used in placement and compaction of fill materials and inspect materials used and compaction of fills in general earthwork and in backfilling around structures, and in backfilling in utility trenches.
 - 5. Notify the Contractor in writing and the Architect/Owner immediately if footings and slabs-on-grade are placed on unfinished soil or frozen ground and when footings and slabs-on-grade are not protected from frost damage.
 - 6. Notify the Architect/Owner when soil with allowable bearing capacity noted is encountered at elevation above the bottom of footing shown.
 - 7. Notify the Architect/Owner and Contractor if soil with required bearing capacity noted is not encountered at bottom of footing elevation shown. Bottom of footing shall be adjusted as recommended and approved by the Structural Engineer and Architect.
 - 8. Review rock excavation techniques, if required, and monitor blasting induced ground motions, as appropriate.
 - 9. Review calculations and shop drawings for sheeting, shoring, and underpinning prepared by the Contractor, if required.
- B. Testing Services:
 - 1. References (As applicable for tests):
 - a. ASTM International (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, 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 (1) in place density test for each 2,500 square feet (280 square yards) of existing subgrade material.
 7. Perform Moisture-Density curve in accordance with ASTM D698 or AASHTO T99 for one (1) 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 (1) test for each 2,500 square feet (280 square yards) of each lift of compacted fill.
- C. Reports: Submit reports to Architect/Owner 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 (3) 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/Owner by telephone within one (1) 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.

3.7 DRILLED AND UNDERREAMED (BELLED) PIERS

- A. Inspection and Observation Services:
1. Provide full time services for the review of all drilled pier foundation inspections. Including a daily report noting grid lines and locations of each pier drilled. After the foundation shaft has been drilled, the lab shall test an undisturbed sample and verify that it meets or exceeds the design specification.
 2. The drilling and verification of suitable soil for bearing capacity. Notify the Architect when soil with allowable bearing capacity noted is encountered at elevation above the bottom of pier shown. Notify the Architect and Contractor if soil with required bearing capacity noted is not encountered at bottom of pier elevation shown. Bottom of pier shall be adjusted as recommended and approved by the Structural Engineer and Architect.
 - a. Drilled shaft has been drilled plumb and within specified vertical and horizontal tolerances specified by the Structural Engineer.

- b. Drilled shaft and underreamed bells are excavated to specified depths and/or if conditions differ from those presented, to notify the Structural Engineer.
- c. Drilled shaft and underreamed bell bottoms are kept dry at all times, cleaned of excess cuttings, or all obstructions prior to placing reinforcing steel and concrete. If groundwater seepage occurs, it shall be removed prior to concrete placement or controlled with temporary steel casing to maintain the shaft integrity up to the concrete placement.
- d. Concrete reinforcing steel shall be checked for type, size, adequate placement and lap lengths, and doweled bars.

3.8 CONCRETE REINFORCING STEEL AND EMBEDDED METAL ASSEMBLIES

- A. Inspection and Observation Services:
 - 1. Inspect all concrete reinforcing steel prior to placing of concrete for compliance with Contract Documents and approved shop drawings. All instances of noncompliance with Contract Documents and approved shop drawings shall be immediately brought to the attention of the Contractor for correction and then, if uncorrected, reported to the Architect/Owner.
- B. Reports:
 - 1. Observe and Report on the Following:
 - a. Number and size of bars.
 - b. Bending and lengths of bars.
 - c. Splicing.
 - d. Clearance to forms including chair heights.
 - e. Clearance between bars or spacing.
 - f. Rust, form oil, and other contamination.
 - g. Grade of steel.
 - h. Securing, tying, and chairing of bars.
 - i. Excessive congestion of reinforcing steel.
 - j. Installation of anchor bolts and placement of concrete around such bolts.
 - k. Fabrication of embedded metal assemblies, including visual inspection of all welds.
 - l. 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. Testing Services:
 - 1. Will be required of all suspect materials or workmanship at the discretion of the Architect, Engineer, or Owner.

3.9 REINFORCING STEEL MECHANICAL SPLICES

- A. Inspection and Observation Services:
 - 1. Visually inspect and report on the completed condition of each mechanical splice of reinforcing steel.
 - 2. Each mechanical splice shall be visually inspected to ensure compliance with the I.C.B.O. reports and the manufacturer's published criteria for acceptable completed splices.
 - 3. Special emphasis shall be placed on inspection of the end preparation of each bar to be spliced, as required by the I.C.B.O. Report.

- B. Reports: Submit reports to Architect with the following information:
 - 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. Reasons for rejection shall be shown on each report.

3.10 CAST-IN-PLACE CONCRETE

- A. Inspection and Observation Services:
 - 1. Review concrete design mixes proposed for use on the Project.
 - 2. Provide full time services for all structural building concrete in drilled piers, grade beams, slab on grade, columns, concrete paving, and other miscellaneous structural concrete. Refer to and include work for reinforcement steel specified in Paragraphs 3.8 and 3.9 above.
 - 3. On the first day's batching of each type and each strength of concrete, inspect and observe materials for concrete, batch weights, moisture content, and gradation of fine and coarse aggregate.
 - 4. Provide additional inspection if the Contractor elects to use concrete from more than one (1) source of supply simultaneously. All costs for such additional inspection shall be borne by the Contractor.
- B. Testing Services:
 - 1. References (As applicable for field and laboratory tests):
 - a. American Concrete Institute (ACI)
 - 1) 214, Recommended Practice for Evaluation of Strength Test Results of Concrete
 - 2) 318, Building Code Requirements for Reinforced Concrete
 - b. ASTM International (ASTM)
 - 1) C31, Practice for Making and Curing Concrete Test Specimens in the Field
 - 2) C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
 - 3) C138, Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
 - 4) C143, Slump of Hydraulic Cement Concrete
 - 5) C173, Air Content of Freshly Mixed Concrete by the Volumetric Method
 - 2. Compression Test Cylinders:
 - a. Make, transport, cure and test six (6) inch or (4) inch diameter by 12-inch-long test specimens taken from concrete being cast. Test cylinders will be made, handled, cured, and stored in accordance with ASTM C31, at the rate of four (4) cylinders minimum for each 50 cubic yards slab on grade or elevated slab four (4) cylinders minimum for each 100 cubic yards paving or fraction thereof of each class of concrete placed in any one (1) day.
 - b. Handle newly made cylinders carefully to avoid cracking the green concrete. Store these cylinders in a box at temperatures between 60 degrees F and 80 degrees F during first 24 hours. Contractor shall construct a suitable box and provide heat or cooling, if necessary, to maintain cylinders at proper temperature.
 - c. Place cylinders in laboratory storage, with molds removed, under moist curing conditions and temperature of 73 degrees plus or minus three (3) degrees F 24 hours after casting maintain these moist curing conditions until specimens are tested.
 - d. Of the test cylinders taken per 50 cubic yards or fraction thereof, test one (1) at seven (7) days and two (2) at 28 days after casting date. Store one (1) cylinder for testing at 56 days in the event the 28 days strength tests do not meet strength requirements. Test cylinders in accordance with ASTM C39. When Type III cement is used, test at three (3) days instead of seven (7) days.

- e. Each 28-day compression test report shall clearly indicate average strength results, concrete slump and air content, concrete and ambient air temperatures, and how much water was added on site by contractors as of the report date and for the class of concrete being reported.
 - f. Maintain a moving average for compressive strength based on the three (3) latest 28-day test results to check compliance with specification requirements. The figures for the standard deviation and moving average for strength will be kept continuously up to date and submitted on a weekly basis to the Architect and Engineer. Maintain a continuously up to date log in both graphical and tabulated form for each class of concrete.
 - 1) the average of the latest three (3) test results;
 - 2) the lowest average of three (3) consecutive test results recorded to date;
 - 3) the average of all sets of three (3) consecutive test results;
 - 4) the percentage of tests falling below specified strength;
 - 5) the lowest single test result.
 - g. Maintain a moving average for range of test results for quality control purposes as described in ACI 214, Chapter 4, Paragraphs 4.4 and 4.5. Graphical reports of moving average for range shall be submitted to the Architect and Engineer on a weekly basis.
 - h. Slump Tests: Conduct in accordance with ASTM C143; one (1) test shall be performed for each sampling for strength tests. Slump shall be considered acceptable if the field test is within the range of design slump plus or minus one (1) inch. For concrete placed by pumping, one (1) test shall be performed at the pump and one (1) at the point of deposit. Slump loss through pumping will be acceptable to the Architect and Engineer. Slump measured at the pump shall be evaluated for acceptance relative to the design slump in accordance with the criteria previously specified.
 - i. Air Content Tests: Conduct in accordance with ASTM C173; test air entrained concrete only, one (1) test shall be performed for each sampling for strength tests. Air content shall be considered acceptable if the field test is in the range of the design air content plus two (2) percent.
 - j. Unit Weight Tests: Conduct in accordance with ASTM C138; test each sample of lightweight concrete taken for strength tests. Unit weight shall be considered acceptable if the field test shows a fresh unit weight equal to the design unit weight plus or minus 2 pcf.
 - k. Chloride Tests: Perform one (1) total chloride ion test for each class of concrete placed each day. If the total chloride ion content is determined to be excessive by the Architect or Engineer, water soluble chloride ion tests shall be performed at the Contractor's expense.
3. Noncompliance: In the event the initial tests above indicate that concrete may not meet the specified requirements, the Architect or Engineer may, at his discretion, order additional tests be performed at the Contractor's expense. Load tests shall comply with requirements of ACI 318.

3.11 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
 - 4) E447, Standard Test Methods for Compressive Strength of Laboratory Constructed Masonry Prisms
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.
 - 1) 28 Day Compressive Strength
 - 2) Water Retention
 - b. 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 (1) test per 2,000 square feet of masonry.
4. Refer to and include work for reinforcing steel specified in Paragraphs 3.5 and 3.6 above.
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) Slump Test
 - 2) 28 Day Compressive Strength
 - 3) 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.
 - 4) Prism Test: Perform preconstruction 28-day compressive strength test on concrete masonry walls in accordance with ASTM E447, Method B.

3.12 STRUCTURAL STEEL

- A. Inspection Services:
1. General:
 - a. Review submittals from fabricator.
 - b. Review all shop and field welder's qualifications.
 2. Structural Steel, Steel Joists and Mechanical Piping:
 - a. Shop inspect each member for defects such as cracks, excessive camber, deformation, and specified surface preparation prior to shop priming or galvanizing.
 - b. Inspect shop priming for coverage and measure of mil thickness.
 - c. Perform visual inspection of all welds; measure 15 percent of welds.
 - d. Inspect size and placement of anchor bolts in concrete and masonry.
 - e. Verify that erector surveys plumbness of each column.
 - f. Verify that erector inspects alignment of beams, shelf angles, lintels, joists, joist girders, and other similar supporting members.
 - g. Perform visual inspection of bolts to determine that the method(s) used are in conformance with the Contract Documents.
 3. Metal Decks:
 - a. Field inspect material for type, gauge, finish and other requirements of the Contract Documents.
 - b. Field inspect installation methods including welding, alignment, joints, laps, and flatness, and all other requirements of the Contract Documents.

4. Steel Stud Shear Connectors:
 - a. Field inspect installation methods and welds.
 - b. Verify number of studs, stud placement and length for conformance with the Contract Documents.

- B. Testing Services:
 1. References (As applicable for tests required):
 - a. American Institute of Steel Construction (AISC)
 - 1) Specifications for Structural Joints Using ASTM A325 or A490 Bolts
 - b. ASTM International (ASTM)
 - 1) A6, General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use
 - 2) A325, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
 - 3) A490, Standard Specification for Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
 - b. American Welding Society (AWS)
 - 1) D1.1, Structural Welding Code, Steel
 2. Structural Steel:
 - a. Perform all tests required by Structural Welding Code and authorities having jurisdiction.
 - b. Ultrasonically test all edges of material greater than 1-1/2 inch thick that is to be welded for evidence of laminations, inclusions, or other discontinuities. The extent to which such defects will be permitted, and the extent of repair permitted shall be in accordance with ASTM A6.
 - c. The root layer of all multiple pass welds and the backside of groove welds made from both sides, after back gouging or chipping, shall be tested by magnetic particle or dye penetration if magnetic particle is not feasible.
 - d. Fillet welds for beam and girder shear connections (15 percent at random) shall be tested by magnetic particle for final pass only.
 - e. Fillet welds for plate girder flange/web connections shall be tested by magnetic particle for final pass only.
 - f. Ultrasonically test 100 percent of full penetration welds.
 - g. Ultrasonically test 100 percent of partial penetration column splice welds.
 - h. Test 100 percent of continuity plate fillet welds by magnetic particle for final pass.
 - i. Perform all equipment calibrations and production tests of high strength bolt connections as required by AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
 - j. Randomly sample bolts, nuts, and washers from the Project Site at a rate sufficiently to test and verify compliance with ASTM Standards.
 - k. When bolts are tightened by “turn-of-the-nut” method, check by calibrated torque wrench 25 percent of bolts in each shear connection, but not less than two (2) bolts per connection.
 - l. In addition, provide at least one (1) test per 50 linear inches of weld by each welder, except that 100 percent of full penetration welds shall be tested using approved radiographic, magnetic particle, or ultrasonic method. Tolerance for welds shall be in accordance with the requirements of AWS D1.1 and the Contract Drawings.
 - m. Perform tension tests on steel in accordance with ASTM A6, if required.
 - n. Perform load tests on structural members in place, if required.
 3. Steel Stud Testing:
 - a. Test not less than ten (10) percent of studs on any beam, plus all studs indicating imperfections. Studs will be considered imperfect if, after welding, visual inspection reveals:
 - 1) Studs lacking full 360-degree weld.
 - 2) Studs which have been repaired by welding.

- b. Studs shall be tested by striking with a hammer and bending to approximately 15 degrees off vertical. Bend studs lacking full 360 degrees weld in a direction opposite to the side lacking the weld. Replace studs that crack after this test either in the weld or the shank. Studs meeting this test will be considered acceptable and left in place.

3.13 SPRAYED-ON FIREPROOFING

- A. Inspection Services:
 1. Inspection of sprayed-on fireproofing to ascertain compliance with Contract Documents.
- B. Testing Services:
 1. References (As applicable for tests required):
 - a. ASTM International (ASTM)
 - 1) E605, Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members
 - 2) E736, Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members
 2. Perform tests on sprayed-on fireproofing for thickness and density in accordance with ASTM E605.
 3. Perform tests on sprayed-on fireproofing for cohesion and adhesion in accordance with ASTM E736.

3.14 LIGHTWEIGHT INSULATING CONCRETE FILL

- A. Inspection and Observation Services:
 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 Testing Lab to ascertain minimum withdrawal resistance of 40 pounds per square foot per fastener, based on ANSI/SPRI Protocol. Architect and Roofing Inspector to witness fastener pull tests.
- B. Testing Services:
 1. References (As applicable for tests required):
 - a. ASTM International (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, 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 (1) per 5,000 square feet
 - 2) Not less than one (1) for each day's work
 4. Test EPS insulation board for density in accordance with ASTM C578.

3.15 ROOFING SYSTEM

- A. Inspection and Observation Services:
 1. Attend pre-construction meeting prior to Contractor starting work.

2. Attend pre-installation meetings for decking, lightweight concrete, roofing, and sheet metal installations.
3. Review field mockups of sheet metal and other components as applicable.
4. Inspect on-site condition of stored roofing materials
5. Provide full-time roofing inspector during the following stages of construction:
 - Final stages of metal deck attachment
 - Lightweight concrete roof deck application
 - Modified bitumen roofing and metal roofing application
6. Provide spot inspections for sheet metal work and thru-wall flashing. Thru-wall flashing shall be left open by the Contractor until inspected, and sheet metal shall not be covered until inspected.
7. Witness water tests and pull tests completed by others.
8. Observe roof test cuts, and patching of cuts, performed by Contractor to ascertain that they are properly made.
9. 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.
10. Provide a written daily report in standardized format to Owner within 72 hours of inspection. The report shall describe all roofing-related activities as well as recommendations made to Contractor by the Inspector. The report shall also include a running list of items from previous reports that have not yet been addressed by Contractor. The reports shall also include an itemization of items that should be backcharged to the Contractor. Submit report to Contractor, Architect, and Owner.
11. Provide and maintain a sign-in sheet in the construction trailer. **Inspector shall sign in and out for every inspection, or Owner will not pay for that inspection.**
12. Attend the punch list walk and provide a written punch list of all roofing components to Architect and Owner.
13. Conduct a final inspection of all roofing components and provide Owner with a letter confirming that all punch list items are complete.
14. Review Siplast Warranty and provide a letter to the Owner confirming that it is correct and complete.

3.16 GLAZED SYSTEMS, TRANSLUCENT WALL PANEL SYSTEMS AND SKYLIGHTS

- A. Testing Services:
 1. Perform air and water infiltration testing on initial installation of each exterior glazed system, translucent wall panel system and skylight to ascertain compliance with specifications.

PART 4 – GENERAL – PROJECT CONSULTANT OBSERVATIONS

4.1 DESCRIPTION

- A. The Contractor shall include in his Proposal the coordination and scheduling of Observations to be performed by the Owner and Architect's project consultants, as they may apply to this work.
- B. All project consultant observation services shall be performed by designees of the relative consultant; upon which the Contractor may rely as to the capability and thoroughness of the observation being performed. Upon request by the Contractor, the names of inspectors performing specific observations shall be furnished by the Architect.
- C. The Owner shall pay for the observation services of the project consultants in accordance with the Owner / Architect Agreement and the requirements of the Contract Documents. Excessive observations and re-observations resulting from the Contractor's actions as described in paragraph 4.4 below, shall be paid for by the Contractor directly to the affected Consultant.

- D. The Contractor shall cooperate with the Owner's project consultants in all matters pertaining to required observations of the work as described in the Contract Documents. The Owner retains the option to add to or delete any or all observations specified herein; and thereby accept the relative work without observation.

4.2 RELATED REQUIREMENTS

- A. Conditions of the Contract, AIA Document A201 as amended, and Supplementary Conditions to the General Conditions for the Construction Contract, Specification section CA.
- B. Respective Sections of Specifications describing the required consultant observations.

4.3 AUTHORITIES AND DUTIES OF THE PROJECT CONSULTANT INSPECTORS

- A. The project consultant inspectors are not authorized to revoke, alter, relax, increase, or release the Contractor from any requirement of the Contract Documents without written notice furnished to the Contractor by the Architect. When it appears that the material, assembly or work performed by the Contractor fails to fulfill Contract requirements, the project consultant inspector shall promptly notify the General Contractor, Architect and Owner.
- B. The project consultant inspector(s) shall distribute copies of the observation reports within two (2) working days. Standard distribution shall include copies of all reports to the Owner, Architect, and General Contractor.

4.4 PROJECT CONSULTANT OBSERVATION GUIDELINES AND PROCEDURES

- A. Project Consultants shall make all observations required in the Contract Documents and requested by the Architect, Contractor and/or Owner.
- B. For each material, assembly or phase observation required in the Contract Documents, and upon request by the Contractor, the project consultant(s) shall perform the following observations as required in the Owner – Architect Agreement:
 - 1. Initial observation to determine compliance with the Contract Documents.
 - 2. Observation to determine deficiencies where the initial observation results do not show 100% compliance with the Contract Documents. At the consultant's discretion, this observation may be performed concurrent with the initial observation.

The above series of observations shall be at the expense of the Owner in accordance with the Owner/Architect Agreement. If re-observation is required to determine 100% compliance is required, it shall be at Contractor's expense.

- C. In the event the observation series described above does not result in 100% approval of the material, assembly or phase being inspected, all subsequent re-observations required to achieve 100% approval shall be at the sole expense of the Contractor to be paid to the project consultant (via Owner backcharge to the Contractor) based on the consultant's standard hourly rates for time expended, including travel to and from the site.
- D. Recognizing the size and complexity of work included in a project may be sufficiently large enough to require the project to be divided into scope areas, each such area shall be considered separate and stand-alone with respect to paragraph 4.4.B above. Requests by the Contractor for project consultant observations of partial scope areas shall be considered observations of the entire scope area with respect to paragraph 4.4.B above; and subsequent observations of the remaining portions of the same scope area shall be paid for by the Contractor (via Owner backcharge to the Contractor). Owner shall invoice the Contractor on a monthly basis, and payment shall be due upon the Contractor's receipt of the invoice.

- E. The Contractor shall bear the responsibility of requesting and scheduling all project consultant observations required by the Contract Documents. The Contractor shall give the project consultant a minimum of forty-eight (48) hours' notice prior to the requested observation. No extension of Contract Time shall be granted for untimely observations due to the Contractor's failure of proper observation request notification.
- F. Observations voluntarily made by project consultants at their discretion, not specifically requested by the Contractor, shall not count as one of the observations described in paragraph B above, nor shall the Contractor be liable for any related expenses.

4.5 PROJECT CONSULTANT OBSERVATIONS

- A. Earthwork
- B. Site Utilities prior to cover-up
- C. Concrete Reinforcing
- D. Cast-in-place concrete
- E. Structural steel
- F. All Building Envelope assemblies
- G. Mechanical rough-in prior to cover-up
- H. Plumbing rough-in prior to cover-up
- I. Electrical rough-in prior to cover-up
- J. Above ceiling prior to cover-up
- K. Start-up demonstrations of building systems and components
- L. Punch lists (treated separately for each architect and consultant). Refer to Specification Section CA, section 9.8
- M. Observation / review of O&M Manuals and other close-out documents
- N. Observation / review of Record Drawings

4.6 PROJECT CONSULTANT HOURLY RATES

- A. Refer to the A201 General Conditions of the Contract for Construction, as Amended Article 8 for applicable hourly rates.

PART 5 – GENERAL – GOVERNMENTAL INSPECTIONS

5.1 DESCRIPTION

- A. The Contractor shall include in his Proposal the application, coordination, scheduling and cost of all on-site inspections to be performed by governmental authorities having jurisdiction which are required for approval of the Work and occupancy of the building; including, but not limited to all City departments, all County departments, Flood Control Districts, Municipal Utility Districts, utility provider, Health Departments and Fire Marshal Offices.

- B. The Contractor shall make all corrective measures in accordance with instructions received from the governing authority inspector having jurisdiction, as required to receive 100% approval for the work being inspected.
- C. The Contractor shall bear all costs for initial inspections, re-inspections and any other expenses related to on-site inspections made by governing authority.
- D. No allowance shall be made for additional Contract Time, nor an increase in the Contract Sum for any unanticipated expenses or delays resulting from failed governmental inspection or resulting re-inspections required to obtain approval(s).

5.2 EXCLUSION

- A. The Contractor shall not be responsible for making application, coordination, inspections and receiving approval of the Work by the Texas Department of Licensing and Regulation relative to ADA and Texas Accessibility Standards.

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Refer to Instructions to Proposers for substitutions.
- B. Temporary facilities shall only be for the duration of construction, unless noted otherwise, and all temporary facilities shall be completely removed at the completion of the project. Any areas disturbed by the placement of temporary facilities shall be repaired/replaced to a finished condition consistent with the surrounding finished area.

1.2 UTILITIES

- A. The Contractor shall supply temporary job power, drainage outfall, sanitary sewer, and water hook-ups for site. The Contractor shall provide all wiring, lamps, distribution of power and similar equipment as required for construction, inspection, and testing of each project.
- B. The Contractor is responsible for overloading or excess use, or any damage resulting from overloading or excess use, or any damage resulting from his use of utilities.
- C. The General Contractor shall provide temporary heat to prevent freezing and maintain proper temperatures to avoid damage to materials in the building and allow work to continue in such weather conditions. The General Contractor shall provide and maintain such dependable source of supply, such as heat, as may be necessary until the building is accepted.
- D. The Contractor will be required to provide temporary water and electrical connections for field sprinkler systems after Substantial Completion of the fields. These connections must be maintained through the duration of the Contract, or until permanent connections are made.
- E. Any utility usage at existing buildings in excess of 110% of historical usage for the previous 12-month period shall be paid by the Contractor.

1.3 FIELD OFFICE

- A. The Contractor will be required to furnish a job trailer installed at a suitable location (on site at one campus), for use by the Contractor, Architect, and Owner.
- B. 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, Owner, and the 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 site telephone, internet, and other miscellaneous items as outlined below.
 - 1. Provide a separate lockable room (120 sq. ft.) in Contractor's job trailer to serve as an office for the Architect and Owner's representative or provide in a separate building in close proximity to Contractor's office.
 - 2. Contractor's office shall be of a size, and shall be furnished, so that it may be used for small progress meetings (seating for approximately 8 persons at table).
 - 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 internet connection.
 - 5. Furnishings Required:
 - a. 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. Architect's Office: One lay-out drafting table 36" x 72" x 36" high; one standard desk with three drawers; chair and drafting stool. Provide one drawing rack for 30" x 42" drawings.
- 6. Provide high speed data access with internet access and wireless access point/router.

1.4 SANITARY FACILITIES

- A. Furnish temporary sanitary facilities and maintain in compliance with regulations of State Department of Health and other authorities having jurisdiction (minimum of one water closet and hand sink).

1.5 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 are stored within the structure in a weathertight condition.
- D. Allow for temporary freeze protection as needed.
- E. Address any storage needs for owner equipment, furniture, etc.

1.6 SIGNS

- A. Within three weeks after receipt of Notice to Proceed, provide one project identification sign and install in a location designated by the Owner at each campus.
- B. Fabricate the sign with sturdy wood framing and 3/4-inch-thick exterior grade plywood, with aluminum overlay and applied digitally printed vinyl sign, a minimum area of 64 cumulative square feet (8' x 8'). No other signs, except as allowed herein, shall be allowed to be displayed on the site. Contractor shall submit a scaled shop drawing of the sign, including all lettering, to the Owner for approval prior to installation.
- C. Project sign shall incorporate design layout as provided by Architect, and shall include:
 - 1. The official title of the Project as listed on Contract Documents.
 - 2. The name of the Owner as listed on Contract Documents.
 - 3. The names and titles of School Board Members and School Administrators.
 - 4. The names and titles of Architect.
 - 5. Identification number of the Contractor.
- D. Erect signs on 4" (102 mm) x 4" (102 mm) supports set firmly into the ground and well braced. The bottom of the sign is to be a minimum of 4' above grade, unless otherwise instructed by the Architect.
- E. Other signs required at the site:
 - 1. Warning, directional, and identification signs as required to indicate construction office location, and to facilitate campus operations that are impacted by construction.
- F. Contractor shall provide necessary signage to accommodate all Owner needs necessitated by the Work including temporary walking/driving routes, deliveries, etc.
- G. Allow no other signs to be displayed at the project site, unless authorized by the Owner.
- H. Secure and pay for all sign permits as required by local authorities.
- I. The sign shall remain the property of the Owner, and upon final completion, the Contractor shall remove the sign and deliver it to a location designated by the Owner or dispose of sign if directed by Owner.

1.7 BARRIERS

- A. Provide temporary barricades on all portions of the site as required to secure the construction area and affected areas of building and site.
- 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.
- C. Provide temporary partitions as needed to separate work areas from building occupants.

1.8 SECURITY

- A. Determine if and when watchmen are necessary for protection to 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.

1.9 CLEANING

- A. **Trash Removal:** Clear the building and site daily of trash. 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. Subcontractors shall provide their own dumpsters for disposal of their debris.
- B. **Daily cleanup (renovation and new construction projects):** Daily cleanup is required both within construction area, and also for any areas on site that are used by Owner (sidewalks, drives, roads, corridors, etc.).
- C. **Disposition of Debris:** Remove debris from the 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.
- D. Refer to Section 01 71 50 for Preventive Housekeeping.

2.0 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 telephone, listing the telephone numbers for emergency medical services: physicians, ambulance services and hospitals.
- C. Provide and maintain one Automated External Defibrillator (AED) unit throughout duration of the project.

2.1 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 on CFISD property and in the vicinity of hazardous conditions.
 - 4. Closely supervise welding and torch-cutting operations in the vicinity of combustible materials and volatile conditions, including roofing torching operations.
 - 5. Supervise locations and operations of portable heating units and fuel.
- D. Maintain fire extinguishing equipment in working condition, with current inspection certificate attached to each extinguisher.
- E. Contractor shall coordinate and comply with all requirements of Owner's personnel, as well as those of governing authorities.

2.2 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. When permanent stair framing is in place, provide temporary treads, platforms and railings, for use by construction personnel.
- C. Maintain all equipment in a first-class, safe condition.

2.3 ACCESS ROADS AND PARKING AREAS

- A. Submit to CFISD for review and upon written approval, provide adequate temporary roads and walks to achieve all-weather car access into the site from public thoroughfares, and within and adjacent to the site, as necessary to provide interrupted access to field offices, work and storage areas. All temporary access roads and walks shall be removed upon completion of permanent facilities, or completion of construction.
- B. Provide adequate parking space for personnel and employees at the site, located to avoid interference with traffic adjacent school facilities and functions, work or storage areas, or with materials-handling equipment.
- C. Grade and provide drainage facilities to assure runoff of rainwater and to avoid blockage of flow from adjacent areas.

END OF SECTION

SECTION 01 55 26

TRAFFIC CONTROL AND REGULATION

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Requirements for signs, signals, control devices, traffic barriers, flares, lights and traffic signals; construction parking control, designated haul routes, and bridging of trenches and excavations.
- B. Qualifications and requirements for use of flagmen.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Price Contracts.
 - 1. Traffic control and regulation. Payment for traffic control and regulation is on a lump sum basis. Include preparation and submittal of traffic control plan if different than shown on Drawings, and provision of traffic control devices, equipment, and personnel necessary to protect the Work and public. Payment will be based on Contractor's Schedule of Values for traffic control and regulation.
 - 2. Flagmen. Payment for flagmen is on a lump sum basis. Partial payments will be based on Contractor's Schedule of Values for flagmen.
 - 3. New Portable Concrete Low Profile Traffic Barrier Provided. Payment is on a unit price basis for each linear foot of low profile traffic barrier provided, installed with hardware assemblies and connected together in accordance with the approved traffic control plan.
 - 4. Portable Concrete Low Profile Traffic Barrier picked up from Stockpile. Payment is on a unit price basis for each linear foot of low profile traffic barrier picked up from designated stockpile, moved onto the project, set at location and connected together.
 - 5. Portable Concrete Low Profile Traffic Barrier Installed. Payment is on a unit price basis for each linear foot of low profile traffic barrier delivered to the project location, installed with hardware assemblies and connected together in accordance with the approved traffic control plan.
 - 6. Portable Concrete Low Profile Traffic Barrier Moved and Reset. Payment is on a unit price basis for each linear foot of low profile traffic barrier disassembled, moved on the project, reset at the new locations and connected together. Include cost to repair roadway in the unit price.
 - 7. Portable Concrete Low Profile Traffic Barrier Removed. Payment is on a unit price basis for each linear foot of low profile traffic barrier removed from the project, including hardware assemblies, and stockpiling at location listed in Division 1. Include cost to repair roadway in the unit price.
 - 8. Refer to Division 1 for unit price procedures.
- B. Stipulated Price Contracts. Include payment for work under this section in the total Stipulated Price.

1.3 REFERENCES

- A. Texas Manual on Uniform Traffic Control Devices (TMUTCD)
- B. Article 4413 (29bb), commonly referred to as Private Investigators and Private Security Agencies Act, and Article 2.12, Texas Code of Criminal Procedure.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Traffic control plan:
 - 1. If using traffic control plan contained in the Contract without modification, submit a letter confirming use of the plan.
 - 2. If using a different traffic control plan, submit the plan for approval. The plan must conform to TMUTCD requirements and be sealed by a Registered Texas Professional Engineer.
- C. Submit copies of approved lane closure permits issued by all governmental authorities.
- D. Submit Schedules of Values for traffic control plan and flagmen within 30 days following Notice to Proceed.
- E. Submit records verifying qualifications of Uniformed Peace Officers and Certified Flagmen proposed for use on the Work.

1.5 FLAGMEN

- A. Use Uniformed Peace Officers and Certified Flagmen to control movement of vehicular and pedestrian traffic when construction operations encroach on public traffic lanes.
- B. Uniformed Peace Officer: Individual employed full-time as a peace officer who receives separate compensation as a privately employed flagman. Private employment may be an employee-employer relationship or on an individual basis. Flagman may not be in the employ of another peace officer nor be a reserve peace officer.
 - 1. Uniformed Peace Officers may be:
 - a. Sheriffs and their deputies;
 - b. Constables and deputy constables;
 - c. Marshals or police officers of an incorporated city, town or village; or
 - d. As otherwise provided by Article 2.12, Code of Criminal Procedure.
 - 2. The Uniformed Peace Officer must be a full-time peace officer, must work a minimum average of 32 paid hours per week, and must be paid a rate not less than the prevailing minimum hourly wage rate set by the federal Wage and Hour Act. The individual must be entitled to vacation, holidays, and insurance and retirement benefits.
- C. Certified Flagman: Individual who receives compensation as a flagman and meets the following qualifications:
 - 1. Formally trained and certified in traffic control procedures by the City's E. B. Cape Center.
 - 2. Speaks English. Ability to speak Spanish is desirable but not required.

3. Paid for flagman duty at an hourly rate not less than the wage rate set for Rough Carpenter under the City of Houston's Wage Scale for Engineering Construction.
- D. Certified Flagmen must wear a distinctive uniform, bright-colored vest, and be equipped with appropriate flagging and communication devices while at the Work site. They must also have in their possession while on duty, a proof of training identification card issued by the appropriate training institute.

PART 2 PRODUCTS

2.1 SIGNS, SIGNALS, AND DEVICES

- A. Comply with TMUTCD requirements.
- B. Traffic cones and drums, flares and lights: Conform to local jurisdictions' requirements.

2.2 PORTABLE LOW PROFILE CONCRETE BARRIERS

- A. The low profile concrete barrier is a patented design. Information concerning this barrier may be obtained from Texas Transportation Institute, Texas A&M University System, College Station, Texas 77843-3135, (409) 845-1712.

PART 3 EXECUTION

3.1 PUBLIC ROADS

- A. Submit requests forms for lane closure and sidewalk closure to the appropriate governmental authority at least three working days prior to need for blocking vehicular lanes or sidewalks. Do not block lanes or sidewalks without approved permits.
- B. Follow laws and regulations of governing jurisdictions when using public roads. Pay for and obtain permits from jurisdiction before impeding traffic or closing lanes. Coordinate activities with Owner's Representative.
- C. Give Owner's Representative one-week notice before implementing approved traffic control phases. Inform local businesses of impending traffic control activities.
- D. Notify police department, fire department, METRO, and local schools, churches, and businesses in writing a minimum of five business days prior to beginning work.
- E. Maintain 10-foot-wide all-weather lanes adjacent to the Work for emergency vehicle use. Keep all-weather lanes free of construction equipment and debris.
- F. Do not obstruct normal flow of traffic from 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m. on designated major arterials or as directed by Owner's Representative.
- G. Maintain local driveway access to residential and commercial properties adjacent to work areas at all times. Use all-weather materials approved by Owner's Representative to maintain temporary driveway access to commercial and residential driveways.
- H. Keep streets entering and leaving job site free of excavated material, debris, and foreign material resulting from construction operations in compliance with applicable ordinances.
- I. Remove existing signage and striping that conflict with construction activities or that may cause driver confusion.

- J. Provide safe access for pedestrians along major cross streets.
- K. Alternate closures of cross streets so that two adjacent cross streets are not closed simultaneously.
- L. Do not close more than two consecutive esplanade openings at a time without prior approval from Owner's Representative.

3.2 CONSTRUCTION PARKING CONTROL

- A. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and the Owner's operations.
- B. Monitor parking of construction personnel's vehicles in existing facilities. Maintain vehicular access to and through parking areas.
- C. Prevent parking on or adjacent to access roads or in non-designated areas.

3.3 FLARES AND LIGHTS

- A. Provide flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.

3.4 HAUL ROUTES

- A. Utilize haul routes designated by authorities or shown on Drawings for construction traffic.
- B. Confine construction traffic to designated haul routes.
- C. Provide traffic control at critical areas of haul routes to regulate traffic and minimize interference with public traffic.

3.5 TRAFFIC SIGNS AND SIGNALS

- A. Construct necessary traffic control devices for temporary signals required to complete the Work including loop detectors, traffic signal conduits, traffic signal wiring and crosswalk signals. Notify the governmental agency having jurisdiction a minimum of 60 days in advance of need for control boxes and switchgear. The Contractor will pay for all necessary service, programming or adjustments, to signal boxes and switchgear if required during construction.
- B. Install and operate traffic control signals to direct and maintain orderly traffic flow in areas under Contractor's control affected by Contractor's operations. Post notices, signs and traffic controls before moving into next phase of traffic control.
- C. Relocate traffic signs and signals as the Work progresses to maintain effective traffic control.
- D. Unless otherwise approved by Owner's Representative, provide driveway signs with name of business that can be accessed from each crossover. Use two signs for each crossover.
- E. Replace existing traffic control devices in Project area.
- F. Owner's Representative may direct Contractor to make minor adjustments to traffic control signage to eliminate driver confusion and maintain orderly traffic flow during construction at no additional cost to the Owner.

3.6 BRIDGING TRENCHES AND EXCAVATIONS

- A. When necessary, construct bridges over trenches and excavation to permit an unobstructed flow of traffic across construction areas and major drives. Use steel plates of sufficient thickness to support H-20 loading and install to operate with minimum noise.
- B. Shore trench or excavation to support bridge and traffic.
- C. Secure bridging against displacement with adjustable cleats, angles, bolts or other devices when:
 - 1. Bridging is placed over existing bus routes,
 - 2. More than five percent of daily traffic is comprised of commercial or truck traffic,
 - 3. More than two separate plates are used for bridging, and
 - 4. When bridge is to be used for more than five consecutive days.
- D. Extend steel plates used for bridging a minimum of 1 foot beyond edges of trench or excavation. Use temporary paving materials such as premix to feather edges of plates to minimize wheel impact on secured bridging.

3.7 REMOVAL

- A. Remove equipment and devices when no longer required.
- B. Repair damage caused by installation.
- C. Remove post settings to a depth of 2 feet.

3.8 TRAFFIC CONTROL, REGULATION AND DIRECTION

- A. Use Flagmen to control, regulate and direct an even flow and movement of vehicular and pedestrian traffic, for periods of time as may be required to provide for public safety and convenience, where:
 - 1. Multi-lane vehicular traffic must be diverted into single lane vehicular traffic,
 - 2. Vehicular traffic must change lanes abruptly,
 - 3. Construction equipment must enter or cross vehicular traffic lanes and walks,
 - 4. Construction equipment may intermittently encroach on vehicular traffic lanes and unprotected walks and crosswalks,
 - 5. Traffic regulation is needed due to rerouting of vehicular traffic around the Work site, and
 - 6. Where construction activities might affect public safety and convenience.
- B. Use of Flagmen to assist in the regulation of traffic flow and movement does not relieve Contractor of responsibility to take other means necessary to protect the Work and public.

3.9 INSTALLATION STANDARDS

- A. Place temporary pavement for single lane closures, in accordance with TMUTCD.
- B. Reinstall temporary and permanent pavement markings as approved by Owner's Representative. When weather conditions do not allow application according to manufacturer's requirements, alternate markings may be considered. Submit proposed alternate to Owner's Representative for approval prior to installation. No additional payment will be made for use of alternate markings.

3.10 MAINTENANCE OF EQUIPMENT AND MATERIAL

- A. Submit name, address and telephone number of individual designated to be responsible for maintenance of traffic handling at construction site to Owner's Representative. Individual must be accessible at all times to immediately correct deficiencies in equipment and materials used to handle traffic including missing, damaged, or obscured signs, drums, barricades, or pavement markings.
- B. Inspect signs, barricades, drums, lamps and temporary pavement markings daily to verify that they are visible, in good working order, and conform with traffic handling plans as approved by Owner's Representative. Immediately repair, clean, relocate, realign, or replace equipment or materials that are not in compliance.
- C. Keep equipment and materials, signs and pavement markings, clean and free of dust, dirt, grime, oil, mud, or debris.
- D. Obtain approval of Owner's Representative to reuse damaged or vandalized signs, drums, and barricades.

END OF SECTION

SECTION 01 57 23

TEMPORARY STORM WATER POLLUTION CONTROL

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Implementation of Storm Water Pollution Prevention Plans (SWP3) described in Division 1.
- B. Installation and maintenance of storm-water pollution prevention structures: diversion dikes, interceptor dikes, diversion swales, interceptor swales, down spout extenders, pipe slope drains, paved flumes and level spreaders. Structures are used during construction and prior to final development of the site.
- C. Filter Fabric Fences:
 - 1. Type 1: Temporary filter fabric fences for erosion and sediment control in non-channelized flow areas.
 - 2. Type 2: Temporary reinforced filter fabric fences for erosion and sediment control in channelized flow areas.
- D. Straw Bale Fence.

1.2 MEASUREMENT AND PAYMENT

A. UNIT PRICES

- 1. Payment for filter fabric fence is on a linear foot basis measured between limits of beginning and ending of stakes.
- 2. Payment for reinforced filter fabric fence is on a linear foot basis measured between limits of beginning and ending of stakes.
- 3. Payment for drop inlet baskets is on a unit price basis for each drop inlet basket.
- 4. Payment for storm inlet sediment traps is on a unit price basis for each storm inlet sediment trap.
- 5. Payment for storm-water-pollution-prevention structures is on a lump sum basis for the project. Earthen structures with outlet and piping includes diversion dikes, interceptor dikes, diversion swales, interceptor swales, and excavated earth-outlet sediment trap, embankment earth-outlet sediment trap, down spout extenders, pipe slope drains, paved flumes, stone outlet sediment trap, and level spreaders.
- 6. Payment for straw bale barrier, if included in Bid Form, is on a linear foot of accepted bale barriers, if not include in cost of storm-water-pollution-prevention structures.
- 7. Payment for brush berm, if included in Bid Form, is on a linear foot of accepted brush berm, if not include in cost of storm water-pollution-prevention structures.
- 8. Payment for sandbag barrier, if included in Bid Form, is on a linear foot basis measured between limits of beginning and ending of sandbags, if not include in cost of storm-water-pollution prevention structures.
- 9. Payment for sediment basin with pipe outlet or stone outlet, if included in Document 00410 - Bid Form, is on a square yard basis, if not include in cost of storm-water-pollution-prevention structures.
- 10. Payment for inlet protection barriers, if included in Document 00410 - Bid Form, is on a linear foot basis measured along outside face of inlet protection barrier, if not include in cost of storm-water-pollution prevention structures.
- 11. Refer to Division 1 for unit price procedures.

- B. Stipulated Price (Lump Sum) Contract. If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.3 REFERENCE STANDARDS

- A. ASTM
 - 1. A 36 - Standard Specification for Carbon Structural Steel.
 - 2. D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort [12,400 ft-lbf/ft³ (600 kN-m/m³)].
 - 3. D3786 - Standard Test Method for Hydraulic Bursting Strength for Knitted Goods and Nonwoven Fabrics.
 - 4. D 4355 - Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).
 - 5. D 4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
 - 6. D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
 - 7. D 4833 - Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
 - 8. D 6382 - Standard Practice for Dynamic Mechanical Analysis and Thermogravimetry of Roofing and Waterproofing Membrane Material.
- B. Storm Water Management Handbook for Construction Activities prepared by City of Houston, Harris County and Harris County Flood Control District.

1.4 SYSTEM DESCRIPTIONS

- A. Filter Fabric Fence Type 1 and Type 2: Install to allow surface or channel runoff percolation through fabric in sheet-flow manner and to retain and accumulate sediment. Maintain Filter Fabric Fences to remain in proper position and configuration at all times.
- B. Straw Bale Fence: Install to allow surface runoff percolation through straw in sheet-flow manner and to retain and accumulate sediment. Maintain Straw Bale Fence to remain in proper position and configuration at all times.
- C. Interceptor Dikes and Swales: Construct to direct surface or channel runoff around the project area or runoff from project area into sediment traps.
- D. Drop Inlet Baskets: Install to allow runoff percolation through the basket and to retain and accumulate sediment. Clean accumulation of sediment to prevent clogging and backups.
- E. Sediment traps: Construct to pool surface runoff from construction area to allow sediment to settle onto the bottom of trap.

1.5 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit manufacturer's literature for product specifications and installation instructions.
- C. Submit manufacturer's catalog sheets and other product data on geotextile or filter fabrics, outlet pipe, perforated riser and connectors.

- D. Submit proposed methods, equipment, materials, and sequence of operations for storm-water pollution prevention structures.
- E. Submit shop drawings for Drop Inlet Baskets.

PART 2 PRODUCTS

2.1 CONCRETE

- A. Concrete: Class B in accordance with Division 1 or as shown on the Drawings.

2.2 AGREGATE MATERIALS

- A. Use poorly graded cobbles with diameter greater than 3 inches and less than 5 inches.
- B. Provide gravel lining in accordance with Division 2 or as shown on the drawings.
- C. Provide clean cobbles and gravel consisting of crushed concrete or stone. Use clean, hard crushed concrete or stone free from adherent coatings, salt, alkali, dirt, clay, loam, shale, soft or flaky materials, or organic matter.
- D. Sediment Pump Pit Aggregate: Use nominal 2-inch diameter river gravel.

2.3 PIPE

- A. Polyethylene culvert pipe or PVC sewer pipe in accordance with Division 2 or as shown on the Drawings.
- B. Inlet Pipes: Galvanized steel pipe in accordance with Division 2 or as shown on the Drawings.
 - 1. Standpipe for Sediment Pump Pits: Galvanized round culvert pipe or round PVC pipe, minimum of 12-inch and a maximum of 24-inch diameter, perforate at 6 to 12 inch centers around circumference.

2.4 GEOTEXTILE FILTER FABRIC

- A. Woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material, in continuous rolls of longest practical length.
- B. Grab Strength: 100 psi in any principal direction (ASTM D-4632), Mullen burst strength >200 psi (ASTM D-3786), and equivalent opening size between 50 and 140.
- C. Furnish ultraviolet inhibitors and stabilizers for minimum 6 months of expected usable construction life at temperature range of 0 degrees F to 120 degrees F.
- D. Mirafi, Inc., Synthetic Industries, or equivalent.

2.5 FENCING

- A. Wire Fencing: Woven galvanized steel wire, 14 gauge by 6-inch square mesh spacing, minimum 24 inch roll or sheet width of longest practical length.

- B. Fence Stakes: Nominal 2 x 2 inch moisture-resistant treated wood or steel posts (min. of 1.25 lbs. per linear foot and Brinell Hardness greater than 140) with safety caps on top; length as required for minimum 8 inch bury and full height of filter fabric.

2.6 SANDBAGS

- A. Provide woven material made of polypropylene, polyethylene, or polyamide material.
 - 1. Minimum unit weight of four ounces per square yard.
 - 2. Minimum grab strength of 100 psi in any principal direction (ASTM D4632).
 - 3. Mullen burst strength exceeding 300 psi (ASTM D3786).
 - 4. Ultraviolet stability exceeding 70 percent.
 - 5. Size: Length: 18 to 24 inches. Width: 12 to 18 inches. Thickness: 6 to 8 inches. Weight: 50 to 125 pounds.

2.7 DROP INLET BASKET

- A. Provide steel frame members in accordance with ASTM A36.
- B. Construct top frame of basket with two short sides of 2 inch by 2 inch and single long side of 1 inch by 1 inch, 1/8 inch angle iron. Construct basket hangers of 2 inch by 1/4 inch iron bars. Construct bottom frame of 1 inch by 1/4 inch iron bar or 1/4 inch plate with center 3 inches removed. Use minimum 1/4 inch diameter iron rods or equivalent for sides of inlet basket. Weld minimum of 14 rods in place between top frame/basket hanger and bottom frame. Exact dimensions for top frame and insert basket will be determined based on dimensions of type of inlet being protected.

2.8 STRAW BALE

- A. Straw: Standard-baled agricultural hay bound by wire, nylon, or polypropylene rope. Do not use jute or cotton binding.
- B. Straw Bale Stakes (applicable where bales are on soil): No. 3 (3/8 diameter) reinforcing bars, deformed or smooth at Contractor's option, length as required for minimum 18 inch bury and full height bales.

PART 3 EXECUTION

3.1 PREPARATION, INSTALLATION AND MAINTAINANCE

- A. Provide erosion and sediment control structures at locations shown on the Drawings.
- B. Do not clear, grub or rough cut until erosion and sediment control systems are in place unless approved by Project Manger to allow installation of erosion and sediment control systems, soil testing and surveying.
- C. Maintain existing erosion and sediment control systems located within project site until acceptance of Project or until directed by Project Manger to remove and discard existing system.
- D. Regularly inspect and repair or replace damaged components of erosion and sediment control structures. Unless otherwise directed, maintain erosion and sediment control structure until project area stabilization is accepted. . Redress and replace granular fill at outlets as needed to

replenish depleted granular fill. Remove erosion and sediment control structures promptly when directed by Project Manger. Dispose of materials in accordance with Division 1.

- E. Remove and dispose sediment deposits at the designated spoil site for the Project. If a project spoil site is not designated on Drawings, dispose of sediment off site at approved location in accordance with Division 1.
- F. Unless otherwise shown on the Drawings, compact embankments, excavations, and trenches in accordance with Division 2.
- G. Prohibit equipment and vehicles from maneuvering on areas outside of dedicated right of way and easements for construction. Immediately repair damage caused by construction traffic to erosion and sediment control structures.
- H. Protect existing trees and plants in accordance with Division 1.

3.2 SEDIMENT TRAPS

- A. Install sediment traps so that surface runoff shall percolate through system in sheet flow fashion and allow retention and accumulation of sediment.
- B. Inspect sediment traps after each rainfall, daily during periods of prolonged rainfall, and at a minimum once each week. Repair or replace damaged sections immediately.
- C. Use fill material for embankment in accordance with Division 2.
- D. Excavation length and height shall be as specified on Drawings. Use side slopes of 2:1 or flatter.
- E. Stone outlet sediment traps:
 - 1. Maintain minimum of 6 inches between top of core material and top of stone outlet, minimum of 4 inches between bottom of core material and existing ground and minimum of 1 foot between top of stone outlet and top of embankment.
 - 2. Embed cobbles minimum of 4 inches into existing ground for stone outlet. Core shall be minimum of 1 foot in height and in width and wrapped in triple layer of geotextile filter fabric.
- F. Sediment Basin with Pipe Outlet Construction Methods: Install outlet pipe and riser as shown on the Drawings.
- G. Remove sediment deposits when design basin volume is reduced by one-third or sediment level is one foot below principal spillway crest, whichever is less.

3.3 FILTER FABRIC FENCE CONSTRUCTION METHODS

- A. Fence Type 1
 - 1. Install stakes 3 feet on center maximum and firmly embed minimum 8 inches in soil. If filter fabric is factory pre-assembled with support netting, then maximum support spacing is 8 feet. Install wood stakes at a slight angle toward the source of anticipated runoff.
 - 2. Trench in the toe of the fence lines so the downward face of the trenches is flat and perpendicular to direction of flow. V-trench configuration as shown on Drawings may also be used.

3. Lay fabric along edges of trenches in longest practical continuous runs to minimize joints. Make joints only at a support post. Splice with minimum 6-inch overlap and seal securely.
 4. Staple filter fabric to stakes at maximum 3 inches on center. Extend fabric minimum 18 inches and maximum 36 inches above natural ground.
 5. Backfill and compact trench.
- B. Fence Type 2
1. Layout fence same as for Type 1.
 2. Install stakes at 6 feet on center maximum and at each joint in wire fence, firmly embedded 1-foot minimum, and inclined it as for Type 1.
 3. Tie wire fence to stakes with wire at 6 inches on center maximum. Overlap joints minimum one bay of mesh.
 4. Install trench same as for Type 1.
 5. Fasten filter fabric wire fence with tie wires at 3 inches on center maximum.
 6. Layout fabric same as for Type 1. Fasten to wire fence with wire ties at 3 inches on center maximum and, if applicable, to stakes above top of wire fence it as for Type 1.
 7. Backfill and compact trench.
- C. Attach filter fabric to wooden fence stakes spaced a maximum of 6 feet apart or steel fence stakes spaced a maximum of 8 feet apart and embedded a minimum of 12 inches. Install stakes at a slight angle toward source of anticipated runoff.
- D. Trench in toe of filter fabric fence with spade or mechanical trencher so that downward face of trench is flat and perpendicular to direction of flow. A V-trench configuration may also be used. Lay filter fabric along edges of trench. Backfill and compact trench upon completion of Construction.
- E. Filter fabric fence shall have a minimum height of 18 inches and a maximum height of 36 inches above natural ground.
- F. Cut length of fence to minimize use of joints. When joints are necessary, splice fabric together only at support post with minimum 6 inch overlap and seal securely.
- G. Triangular Filter Fabric Fence Construction Methods
1. Attach filter fabric to wire fencing, 18 inches on each side. Provide a fabric cover and skirt with continuous wrapping of fabric. Skirt should form continuous extension of fabric on upstream side of fence.
 2. Secure triangular fabric filter fence in place using one of the following methods:
 - a. Toe-in skirt 6 inches with mechanically compacted material;
 - b. Weight down skirt with continuous layer of 3-inch to 5-inch graded rock; or
 - c. Trench-in entire structure 4 inches.
 3. Anchor triangular fabric filter fence structure and skirt securely in place using 6-inch wire staples on 2-foot centers on both edges and on skirt, or staked using 18-inch by 3/8-inch diameter re-bar with tee ends.
 4. Lap fabric filter material by 6 inches to cover segment joints. Fasten joints with galvanized shoat rings.
- H. Reinforced Filter Fabric Barrier Construction Methods
1. Attach woven wire fence to fence stakes.
 2. Securely fasten filter fabric material to wire fence with tie wires.

3. When used in swales, ditches or diversions, elevation of barrier at top of filter fabric at flow line location in channel shall be lower than bottom elevation of filter fabric at ends of barrier or top of bank, whichever is less, in order to keep storm water discharge in channel from overtopping bank.
4. Remove sediment deposits when silt reaches depth one-third height of barrier or 6 inches, whichever is less.

3.4 DIKE AND SWALE

- A. Unless otherwise indicated, maintain minimum dike height of 18 inches, measured from cleared ground at up slope toe to top of dike. Maintain side slopes of 2:1 or flatter.
- B. Dike and Swale Stabilization: When shown on the Drawings, place gravel lining 3 inches thick and compacted into the soil or 6 inches thick if truck crossing is expected. Extend gravel lining across bottom and up both sides of swale minimum height of 8 inches vertically, above bottom. Gravel lining on dike side shall extend up the up slope side of dike a minimum height of 8 inches, measured vertically from interface of existing or graded ground and up slope toe of dike, as shown on Drawings.
- C. Divert flow from dikes and swales to sediment basins, stabilized outlets, or sediment trapping devices of types and at locations shown on Drawings. Grade dikes and swales as shown on Drawings, or, if not specified, provide positive drainage with maximum grade of 1 percent to outlet or basin.
- D. Clear in accordance with Division 2.
- E. Carry out excavation for swale construction so that erosion and water pollution is minimal. Minimum depth shall be 1 foot and bottom width shall be 4 feet, with level swale bottom. Excavation slopes shall be 2:1 or flatter. Clear, grub and strip excavation area of vegetation and root material.

3.5 DOWN SPOUT EXTENDER

- A. Down spout extender shall have slope of approximately 1 percent. Use pipe diameter of 4 inches or as shown on the Drawings. Place pipe in accordance with Division 2.

3.6 PIPE SLOPE DRAIN

- A. Compact soil around and under drain entrance section to top of embankment in lifts appropriately sized for method of compaction utilized.
- B. Inlet pipe shall have slope of 1 percent or greater. Use pipe diameter as shown on the Drawings.
- C. Top of embankment over inlet pipe and embankments directing water to pipe shall be at least 1 foot higher at all points than top of inlet pipe.
- D. Pipe shall be secured with hold-down grommets spaced 10 feet on centers.
- E. Place riprap apron with a depth equal to pipe diameter with 2:1 side slopes.

3.7 PAVED FLUME

- A. Compact soil around and under the entrance section to top of the embankment in lifts appropriately sized for method of compaction utilized.
- B. Construct subgrade to required elevations. Remove and replace soft sections and unsuitable material. Compact subgrade thoroughly and shape to a smooth, uniform surface.
- C. Construct permanent paved flumes in accordance with Drawings.
- D. Remove sediment from riprap apron when sediment has accumulated to depth of one foot.

3.8 LEVEL SPREADER

- A. Construct level spreader on undisturbed soil and not on fill. Ensure that spreader lip is level for uniform spreading of storm runoff.
- B. Maintain at required depth, grade, and cross section as specified on Drawings. Remove sediment deposits as well as projections or other irregularities which will impede normal flow.

3.9 INLET PROTECTION BARRIER

- A. Place sandbags and filter fabric fences at locations shown on the SWP3.

3.10 DROP INLET BASKET CONSTRUCTION METHODS.

- A. Fit inlet insert basket into inlet without gaps around insert at locations shown on the SWP3.
- B. Support for inlet insert basket shall consist of fabricated metal as shown on Drawings.
- C. Push down and form filter fabric to shape of basket. Use sheet of fabric large enough to be supported by basket frame when holding sediment and extend at least 6 inches past frame. Place inlet grates over basket/frame to serve as fabric anchor.
- D. Remove sediment deposit after each storm event and whenever accumulation exceeds 1-inch depth during weekly inspections.

3.11 STRAW BALE FENCE CONSTRUCTION METHODS

- A. Place bales in row with ends tightly abutting adjacent bales. Place bales with bindings parallel to ground surface.
- B. Embed bale in soil a minimum of 4 inches.
- C. Securely anchor bales in place with Straw Bale Stakes driven through bales a minimum of 18-inches into ground. Angle first stake in each bale toward previously laid bale to force bales together.
- D. Fill gaps between bales with straw to prevent water from channeling between bales. Wedge carefully in order not to separate bales.
- E. Replace with new straw bale fence every two months or as required by Owner's Representative.

3.12 BRUSH BERM CONSTRUCTION METHODS

- A. Construct brush berm along contour lines by hand placing method. Do not use machine placement of brush berm.
- B. Use woody brush and branches having diameter less than 2-inches with 6-inches overlap. Avoid incorporation of annual weeds and soil into brush berm.
- C. Use minimum height of 18-inches measured from top of existing ground at upslope toe to top of berm. Top width shall be 24 inches minimum and side slopes shall be 2:1 or flatter.
- D. Embed brush berm into soil a minimum of 4-inches and anchor using wire, nylon or polypropylene rope across berm with a minimum tension of 50 pounds. Tie rope securely to 18-inch x 3/8-inch diameter rebar stakes driven into ground on 4-foot centers on both sides of berm.

3.13 STREET AND SIDEWALK CLEANING

- A. Keep areas clean of construction debris and mud carried by construction vehicles and equipment. If necessary, install stabilized construction exits at construction, staging, storage, and disposal areas, following Division 1.
- B. In lieu of or in addition to stabilized construction exits, shovel or sweep pavements as required to keep areas clean. Do not water hose or sweep debris and mud off street into adjacent areas, except, hose sidewalks during off-peak hours, after sweeping.

3.14 WASTE COLLECTION AREAS

- A. Prevent water runoff from passing through waste collection areas, and prevent water runoff from waste collection areas migrating outside collection areas.

3.15 EQUIPMENT MAINTENANCE AND REPAIR

- A. Confine maintenance and repair of construction machinery and equipment to areas specifically designated for that purpose, so fuels, lubricants, solvents, and other potential pollutants are not washed directly into receiving streams or storm water conveyance systems. Provide these areas with adequate waste disposal receptacles for liquid and solid waste. Clean and inspect maintenance areas daily.
- B. Where designated equipment maintenance areas are not feasible, take precautions during each individual repair or maintenance operation to prevent potential pollutants from washing into streams or conveyance systems. Provide temporary waste disposal receptacles.

3.16 VEHICLE/ EQUIPMENT WASHING AREAS

- A. Install wash area (stabilized with coarse aggregate) adjacent to stabilized construction exit(s), as required to prevent mud and dirt run-off. Release wash water into drainage swales or inlets protected by erosion and sediment controls. Build wash areas following Division 1. Install gravel or rock base beneath wash areas.
- B. Wash vehicles only at designated wash areas. Do not wash vehicles such as concrete delivery trucks or dump trucks and other construction equipment at locations where runoff flows directly into watercourses or storm water conveyance systems.
- C. Locate wash areas to spread out and evaporate or infiltrate wash water directly into ground, or collect runoff in temporary holding or seepage basins.

3.17 WATER RUNOFF AND EROSION CONTROL

- A. Control surface water, runoff, subsurface water, and water from excavations and structures to prevent damage to the Work, the site, or adjoining properties.
- B. Control fill, grading and ditching to direct water away from excavations, pits, tunnels, and other construction areas, and to direct drainage to proper runoff courses to prevent erosion, sedimentation or damage.
- C. Provide, operate, and maintain equipment and facilities of adequate size to control surface water.
- D. Dispose of drainage water to prevent flooding, erosion, or other damage to the site or adjoining areas. Follow environmental requirements.
- E. Retain existing drainage patterns external to the site by constructing temporary earth berms, sedimentation basins, retaining areas, and temporary ground cover as required to control conditions.
- F. Plan and execute construction and earth work to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation.
 - 1. Hold area of bare soil exposed at one time to a minimum.
 - 2. Provide temporary controls such as berms, dikes, and drains.
- G. Construct fill and waste areas by selective placement to eliminate surface silts or clays which will erode.
- H. Inspect earthwork periodically to detect start of erosion. Immediately apply corrective measures as required to control erosion.
- I. Dispose of sediments offsite, not in or adjacent to streams or floodplains, nor allow sediments to flush into streams or drainage ways. Assume responsibility for offsite disposal location.
- J. Unless otherwise indicated, compact embankments, excavations, and trenches by mechanically blading, tamping, and rolling soil in maximum of 8-inch layers. Provide compaction density at minimum 90 percent Standard Proctor ASTM D-698-78 density. Make at least one test per 500 cubic yards of embankment.
- K. Do not maneuver vehicles on areas outside of dedicated rights-of-way and easements for construction. Immediately repair damage to erosion and sedimentation control systems caused by construction traffic.
- L. Do not damage existing trees intended to remain.

3.18 REMOVAL OF CONTROLS

- A. Remove erosion and sediment controls when the site is finally stabilized or as directed by Owner's Representative.
- B. Dispose of sediments and waste products following Division 1.

END OF SECTION

SECTION 01 57 23.10

TPDES REQUIREMENTS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Documentation to be prepared and signed by Contractor before conducting construction operations, in accordance with the Texas Pollutant Discharge Elimination System (TPDES) Construction General Permit Number TXR 150000 (the Construction General Permit).
- B. Implementation, maintenance inspection, and termination 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 appropriate practices shown on the Drawings or specified elsewhere in the Contract.
- C. Review of the Storm Water Pollution Prevention Plan (SWP3) implementation in a meeting with the Owner's Representative prior to start of construction.

1.2 DEFINITIONS

- A. Commencement of Construction Activities: The exposure of soil resulting from activities such as clearing, grading, and excavating.
- B. Large Construction Activity: Project that:
 - 1. Disturbs five acres or more, or
 - 2. Disturbs less than five acres but is part of a larger common plan of development that will disturb five acres or more of land.
- C. Small Construction Activity: Project that:
 - 1. Disturbs one or more acres but less than five acres, or
 - 2. Disturbs less than one acre but is part of a larger common plan of development that will ultimately disturb one or more acres but less than five acres.
- D. TPDES Operator:
 - 1. The person or persons who have day-to-day operational control of the construction activities which are necessary to ensure compliance with the SWP3 for the site or other Construction General Permit conditions.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 SITE SPECIFIC STORM WATER POLLUTION PREVENTION PLAN (SWP3)

- A. Prepare a SWP3 following Part III of the Construction General Permit and the applicable local code. If conflicts exist between the Construction General Permit and the local regulations, the more stringent requirements will apply.

- B. Update or revise the SWP3 as needed during the construction following Part III, Section E of the Construction General Permit.
- C. Submit the SWP3 and any updates or revisions to the Owner's Representative for review and address comments prior to commencing, or continuing, construction activities.

3.2 NOTICE OF INTENT FOR LARGE CONSTRUCTION ACTIVITY

- A. Fill out, sign, and date TCEQ Form 20022 Notice of Intent (NOI) for Storm Water Discharges Associated with Construction Activity under the TPDES Construction General Permit (TXR 150000).
- B. Transmit the signed Contractor's copy of TCEQ Form 20022, along with a check for the required fee, made out to Texas Commission on Environmental Quality.
- C. Submission of the Notice of Intent form by the Contractor to TCEQ is required a minimum of two days before Commencement of Construction Activities.

3.3 CONSTRUCTION SITE NOTICE FOR SMALL CONSTRUCTION ACTIVITY

- A. Fill out, sign, and date the Construction Site Notice, Attachment 2 to TPDES General Permit TXR 150000, "Construction Site Notice."
- B. Transmit the signed Construction Site Notice to the Engineer at least seven days prior to Commencement of Construction Activity.

3.4 CERTIFICATION REQUIREMENTS

- A. Conduct inspections in accordance with TCEQ requirements. Ensure persons or firms responsible for maintenance and inspection of erosion and sediment control measures read, fill out, sign, and date the Erosion Control Contractor's Certification for Inspection and Maintenance. Use the EPA NPDES Construction Inspection Form

3.5 RETENTION OF RECORDS

- A. Keep a copy of this document and the SWP3 in a readily accessible location at the construction site from Commencement of Construction Activity until submission of the Notice of Termination (NOT) for Storm Water Discharges Associated with Construction Activity under TPDES Construction General Permit (TXR 150000). Contractors with day-to-day operational control over SWP3 implementation shall have a copy of the SWP3 available at a central location, on-site, for the use of all operators and those identified as having responsibilities under the SWP3. Upon submission of the NOT, submit all required forms and a copy of the SWP3 with all revisions to the Owner's Representative.

3.6 REQUIRED NOTICES

- A. Post the following notices from effective date of the SWP3 until date of final site stabilization as defined in the Construction General Permit:
 - 1. Post the TPDES permit number for Large Construction Activity, or a signed TCEQ Construction Site Notice for Small Construction Activity. A signed copy of the Contractor's NOI must also be posted.
 - 2. Post notices near the main entrance of the construction site in a prominent place for public viewing. Post name and telephone number of Contractor's local contact person, brief project description and location of the SWP3.

- a. If posting near a main entrance is not feasible due to safety concerns, coordinate posting of notice with the Owner's Representative to conform to requirements of the Construction General Permit.
- b. If Project is a linear construction project (e.g.: road, utilities, etc.), post notice in a publicly accessible location near active construction. Move notice as necessary.
3. Post a notice to equipment and vehicles operators, instructing them to stop, check, and clean tires of debris and mud before driving onto traffic lanes. Post at each stabilized construction exit area.
4. Post a notice of waste disposal procedures in a readily visible location on site.

3.7 ON-SITE WASTE MATERIAL STORAGE

- A. On-site waste material storage shall be self-contained and shall satisfy appropriate local, state, and federal rules and regulations.
- B. Prepare list of waste material to be stored on-site. Update list as necessary to include up-to-date information. Keep a copy of updated list with the SWP3.
- C. Prepare description of controls to reduce pollutants generated from on-site storage. Include storage practices necessary to minimize exposure of materials to storm water, and spill prevention and response measures consistent with best management practices. Keep a copy of the description with the SWP3.

3.8 NOTICE OF TERMINATION

- A. Submit a NOT to TCEQ and the Engineer within 30 days after:
 1. Final stabilization has been achieved on all portions of the site that are the responsibility of the Contractor; or
 2. Another operator has assumed control over all areas of the site that have not been stabilized; and
 3. All silt fences and other temporary erosion controls have either been removed, scheduled to be removed as defined in the SWP3, or transferred to a new operator if the new operator has sought permit coverage.

END OF SECTION

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SECTION 01 57 23.11

STABILIZED CONSTRUCTION EXIT

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Installation of erosion and sediment control for stabilized construction exits used during construction and until final development of the site.

1.2 SUBMITTALS

- A. Manufacturer's catalog sheets and other product data on geotextile fabric.
- B. Sieve analysis of aggregates conforming to requirements of this Specification.

1.3 UNIT PRICES

- A. Unless indicated in the Unit Price Schedule as a pay item, no separate payment will be made for work performed under this Section. Include cost of work performed under this Section in pay items for which this work is a component.
- B. When indicated in the Unit Price Schedule, include stabilized exits under payment for Street Cleaning as Required by NPDES, including stabilized construction roads, parking areas, exits, and truck washing areas will include and be full compensation for all labor, equipment, materials, supervision, and all incidental expenses for construction of these items, complete in place, including, but not limited to, embankment and excavation, maintenance requirements, repair and replacement of damaged sections, removal of sediment deposits, redressing of aggregates and stones, cleaning of streets, and removal of erosion and sediment control systems at the end of construction.

1.4 REFERENCES

- A. ASTM D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

PART 2 PRODUCTS

2.1 GEOTEXTILE FABRIC

- A. Provide woven or nonwoven geotextile fabric made of either polypropylene, polyethylene, ethylene, or polyamide material.
- B. 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.
- C. 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 6 months of expected usable life at a temperature range of 0°F to 120°F.
- D. Representative Manufacturers: Mirafi, Inc., or equal.

2.2 COARSE AGGREGATES

- A. Coarse aggregate shall consist of crushed stone, gravel, crushed blast furnace slag, or a combination of these materials. 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 PREPARATION AND INSTALLATION

- A. If necessary to keep the street clean of mud carried by construction vehicles and equipment, Contractor shall provide stabilized construction roads and exits at the construction, staging, parking, storage, and disposal areas. Such erosion and sediment controls shall be constructed in accordance with the requirements shown on the Drawings and specified in this Section.
- B. No clearing and grubbing or rough cutting shall be permitted until erosion and sediment control systems are in place, other than as specifically directed by the Owner's Representative to allow soil testing and surveying.
- C. Maintain existing erosion and sediment control systems located within the project site until acceptance of the project or until directed by the Owner's Representative to remove and discard the existing system.
- D. Regularly inspect and repair or replace components of stabilized construction exits. Unless otherwise directed, maintain the stabilized construction roads and exits until the project is accepted by the Owner. Remove stabilized construction roads and exits promptly when directed by the Owner's Representative. Discard removed materials off site in accordance with the requirements of Division 1.
- E. Remove sediment deposits and dispose of them at the designated spoil site for the project. If a project spoil site is not designated on the Drawings, dispose of sediment off site at location not in or adjacent to a stream or floodplain. Off-site disposal is 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 a 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 shall be prohibited by the Contractor from maneuvering on areas outside of dedicated rights-of-way and easements for construction. Damage caused by construction traffic to erosion and sediment control systems shall be repaired immediately.
- G. Conduct all construction operation under this Contract in conformance with the erosion control practices described in Division 1.

3.2 CONSTRUCTION METHODS

- A. Provide stabilized access roads, subdivision roads, parking areas, and other on-site vehicle transportation routes where shown on Drawings.
- B. Provide stabilized construction exits, and truck washing areas when approved by Owner's Representative, of the sizes and locations where shown on Drawings or as specified in this Section.
- C. Vehicles leaving construction areas shall have their tires cleaned to remove sediment prior to entrance onto public right-of-way. 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.
- D. Details for stabilized construction exit are shown on the Drawings. Construction of all other stabilized areas shall be to the same requirements. Roadway width shall be at least 14 feet for one-way traffic and 20 feet for two-way traffic and shall be sufficient for all ingress and egress. 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 14 days to minimize damage potential.
- E. 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 public right-of-way, receiving stream or storm water conveyance system.
- F. 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 control measures used to trap sediment. All sediment spilled, dropped, washed, or tracked onto public right-of-way shall be removed immediately.
- G. The length of the stabilized area shall be as shown on the Drawings, but not less than 50 feet. The thickness shall not be less than 8 inches. The width shall not be less than the full width of all points of ingress or egress.
- H. Stabilization for other areas shall have the same coarse aggregate, thickness, and width requirements as the stabilized construction exit, except where shown otherwise on the Drawings.
- I. Stabilized area may be widened or lengthened to accommodate truck washing area when authorized by Owner's Representative.
- J. Alternative methods of construction may be utilized when shown on Drawings, or when approved by the City Engineer. These methods 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.

END OF SECTION

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01 57 23.11 - 4 STABILIZED CONSTRUCTION EXIT

SECTION 01 57 23.12

CONTROL OF GROUND AND SURFACE WATER

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Dewatering, depressurizing, draining, and maintaining trenches, shaft excavations, structural excavations and foundation beds in stable condition, and controlling ground water conditions for tunnel excavations.
- B. Protecting work against surface runoff and rising floodwaters.
- C. Trapping suspended sediment in the discharge form the surface and ground water control systems.

1.2 MEASUREMENT AND PAYMENT

- A. UNIT PRICES
 - 1. Measurement for control of ground water, if included in Bid Form, will be on either a lump sum basis or a linear foot basis for continuous installations of well points, eductor wells, or deep wells.
 - 2. If not included in Bid Form, include the cost to control ground water in unit price for work requiring such controls.
 - 3. No separate payment will be made for control of surface water. Include cost to control surface water in unit price for work requiring controls.
 - 4. Follow Division 1 for unit price procedures.
- B. Stipulated Price (Lump Sum) Contract. If the Contract is a Stipulated Price Contract, include payment for work under this section in the total Stipulated Price.

1.3 REFERENCES

- A. ASTM D 698 - Standard Test Methods for Laboratory Compaction of Soils Using Standard Effort (12,400 ft-lbf/ft³ (600kN-m/m³))
- B. Federal Regulations, 29 CFR Part 1926, Standards-Excavation, Occupational Safety and Health Administration (OSHA)
- C. Storm Water Management Handbook for Construction Activities prepared by City of Houston, Harris County and Harris County Flood Control District.

1.4 DEFINITIONS

- A. Ground water control system: system used to dewater and depressurize water-bearing soil layers.
 - 1. Dewatering: lowering the water table and intercepting seepage that would otherwise emerge from slopes or bottoms of excavations, or into tunnels and shafts; and disposing of removed water. Intent of dewatering is to increase stability of tunnel excavations and excavated slopes, prevent dislocation of material from slopes or bottoms of excavations, reduce lateral loads on sheeting and bracing, improve excavating and hauling characteristics of excavated material, prevent failure or

- heaving of bottom of excavations, and to provide suitable conditions for placement of backfill materials and construction of structures and other installations.
2. Depressurization: includes reduction in piezometric pressure within strata not controlled by dewatering alone, necessary to prevent failure or heaving of excavation bottom or instability of tunnel excavations.
- B. Excavation drainage: includes keeping excavations free of surface and seepage water.
 - C. Surface drainage: includes use of temporary drainage ditches and dikes and installation of temporary culverts and sump pumps with discharge lines necessary to protect Work from any source of surface water.
 - D. Monitoring facilities for ground water control system: includes piezometers, monitoring wells and flow meters for observing and recording flow rates.

1.5 PERFORMANCE REQUIREMENTS

- A. Conduct subsurface investigations to identify groundwater conditions and to provide parameters for design, installation, and operation of groundwater control systems. Submit proposed method and spacing of readings for review prior to obtaining water level readings.
- B. Design ground water control system, compatible with requirements of Federal Regulations 29 CFR Part 1926 and Division 2 to produce following results:
 1. Effectively reduce hydrostatic pressure affecting:
 - a. Excavations
 - b. Tunnel excavation, face stability or seepage into tunnels
 2. Develop substantially dry and stable subgrade for subsequent construction operations
 3. Preclude damage to adjacent properties, buildings, structures, utilities, installed facilities and other work
 4. Prevent loss of fines, seepage, boils, quick condition, or softening of foundation strata
 5. Maintain stability of sides and bottom of excavations
- C. Provide ground water control systems that include single-stage or multiple-stage well point systems, eductor and ejector-type systems, deep wells, or combinations of these equipment types.
- D. Provide drainage of seepage water and surface water, as well as water from other sources entering excavation. Excavation drainage may include placement of drainage materials, crushed stone and filter fabric, together with sump pumping.
- E. Provide ditches, berms, pumps and other methods necessary to divert and drain surface water from excavation and other work areas.
- F. Locate ground water control and drainage systems so as not to interfere with utilities, construction operations, adjacent properties, or adjacent water wells.
- G. Assume sole responsibility for ground water control systems and for any loss or damage resulting from partial or complete failure of protective measures and settlement or resultant damage caused by ground water control operations. Modify ground water control systems or operations if they cause or threaten to cause damage to new construction, existing site improvements, adjacent property, adjacent water wells, or potentially contaminated areas. Repair damage caused by ground water control systems or resulting from failure of system to protect property as required.

- H. Install an adequate number of piezometers installed at proper locations and depths, necessary to provide meaningful observations of conditions affecting excavation, adjacent structures and water wells.
- I. Install environmental monitoring wells at proper locations and depths necessary to provide adequate observations of hydrostatic conditions and possible contaminant transport from contamination sources into work area or ground water control system.

1.6 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit Ground Water and Surface Water Control Plan for review by Owner's Representative prior to start of excavation work. Include the following:
 - 1. Results of subsurface investigations and description of extent and characteristics of water bearing layers subject to ground water control
 - 2. Names of equipment Suppliers and installation Subcontractors
 - 3. Description of proposed ground water control systems indicating arrangement, location, depth and capacities of system components, installation details and criteria and operation and maintenance procedures
 - 4. Description of proposed monitoring facilities indicating depths and locations of piezometers and monitoring wells, monitoring installation details and criteria, type of equipment and instrumentation with pertinent data and characteristics
 - 5. Description of proposed filters including types, sizes, capacities and manufacturer's application recommendations
 - 6. Design calculations demonstrating adequacy of proposed systems for intended applications. Define potential area of influence of ground water control operation near contaminated areas.
 - 7. Operating requirements, including piezometric control elevations for dewatering and depressurization
 - 8. Excavation drainage methods including typical drainage layers, sump pump application and other means
 - 9. Surface water control and drainage installations
 - 10. Proposed methods and locations for disposing of removed water
- C. Submit following records upon completion of initial installation:
 - 1. Installation and development reports for well points, eductors, and deep wells
 - 2. Installation reports and baseline readings for piezometers and monitoring wells
 - 3. Baseline analytical test data of water from monitoring wells
 - 4. Initial flow rates
- D. Submit the following records weekly during control of ground and surface water operations:
 - 1. Records of flow rates and piezometric elevations obtained during monitoring of dewatering and depressurization. Refer to Paragraph 3.02, Requirements for Eductor, Well Points, or Deep Wells.
 - 2. Maintenance records for ground water control installations, piezometers and monitoring wells

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Comply with requirements of agencies having jurisdiction.

- B. Comply with Texas Commission on Environmental Quality regulations and Texas Water Well Drillers Association for development, drilling, and abandonment of wells used in dewatering system.
- C. Obtain necessary permits from agencies with jurisdiction over use of groundwater and matters affecting well installation, water discharge, and use of existing storm drains and natural water sources. Since review and permitting process may be lengthy, take early action to obtain required approvals.
- D. Monitor ground water discharge for contamination while performing pumping in vicinity of potentially contaminated sites.

PART 2 PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- A. Select equipment and materials necessary to achieve desired results for dewatering. Selected equipment and materials are subject to review by Owner's Representative through submittals required in Paragraph 1.06, Submittals.
- B. Use experienced contractors, regularly engaged in ground water control system design, installation, and operation, to furnish and install and operate eductors, well points, or deep wells, when needed.
- C. Maintain equipment in good repair and operating condition.
- D. Keep sufficient standby equipment and materials available to ensure continuous operation, where required.
- E. Portable Sediment Tank System: Standard 55-gallon steel or plastic drums, free of hazardous material contamination.
 - 1. Shop or field fabricate tanks in series with main inlet pipe, inter-tank pipes and discharge pipes, using quantities sufficient to collect sediments from discharge water.

PART 3 EXECUTION

3.1 GROUND WATER CONTROL

- A. Perform necessary subsurface investigation to identify water bearing layers, piezometric pressures and soil parameters for design and installation of ground water control systems. Perform pump tests, if necessary to determine draw down characteristics. Present results in the Ground Water and Surface Water Control Plan submittal.
- B. Provide labor, material, equipment, techniques and methods to lower, control and handle ground water in manner compatible with construction methods and site conditions. Monitor effectiveness of installed system and its effect on adjacent property.
- C. Install, operate, and maintain ground water control systems in accordance with the Ground Water and Surface Water Control Plan. Notify Owner's Representative in writing of changes made to accommodate field conditions and changes to Work. Provide revised drawings and calculations with notification.

- D. Provide continuous system operation, including nights, weekends, and holidays. Arrange appropriate backup if electrical power is primary energy source for dewatering system.
- E. Monitor operations to verify systems lower ground water piezometric levels at rate required to maintain dry excavation resulting in stable subgrade for subsequent construction operations.
- F. Depressurize zones where hydrostatic pressures in confined water bearing layers exist below excavations to eliminate risk of uplift or other instability of excavation or installed works. Define allowable piezometric elevations in the Ground Water and Surface Water Control Plan.
- G. Removal of ground water control installations.
 - 1. Remove pumping system components and piping when ground water control is no longer required.
 - 2. Remove piezometers, including piezometers installed during design phase investigations and left for Contractor's use, upon completion of testing, as required in accordance with Part 3 of applicable specification.
 - 3. Remove monitoring wells when directed by Owner's Representative.
 - 4. Grout abandoned well and piezometer holes. Fill piping that is not removed with cement-bentonite grout or cement-sand grout.
- H. During backfilling, maintain water level a minimum of 5 feet below prevailing level of backfill. Do not allow the water level to cause uplift pressures in excess of 80 percent of downward pressure produced by weight of structure or backfill in place. Do not allow water levels to rise into cement-stabilized sand until at least 48 hour after placement.
- I. Provide uniform pipe diameter for each pipe drain run constructed for dewatering. Remove pipe drains when no longer required. If pipe removal is impractical, grout connections at 50-foot intervals and fill pipe with cement-bentonite grout or cement-sand grout after removal from service.
- J. The extent of ground water control for structures with permanent perforated underground drainage systems may be reduced, for units designed to withstand hydrostatic uplift pressure. Provide a means to drain affected portions of underground systems, including standby equipment. Maintain drainage systems during construction operations.
- K. Remove systems upon completion of construction or when dewatering and control of surface or ground water is no longer required.
- L. Compact backfill to not less than 95 percent of maximum dry density in accordance with ASTM D 698.
- M. Foundation Slab: Maintain saturation line at least 3 feet below lowest elevations where concrete is to be placed. Drain foundations in areas where concrete is to be placed before placing reinforcing steel. Keep free from water for 3 days after concrete is placed.

3.2 REQUIREMENTS FOR EDUCTOR, WELL POINTS, OR DEEP WELLS

- A. For aboveground piping in ground water control system, include a 12-inch minimum length of clear, transparent piping between each eductor well or well point and discharge header to allow visual monitoring of discharge from each installation.
- B. Install sufficient piezometers or monitoring wells to show that trench or shaft excavations in water bearing materials are pre-drained prior to excavation. Provide separate piezometers for monitoring of dewatering and for monitoring of depressurization. Install piezometers and monitoring wells for tunneling as appropriate for selected method of work.

- C. Install piezometers or monitoring wells at least one week in advance of the start of associated excavation.
- D. Dewatering may be omitted for portions of under drains or other excavations, where auger borings and piezometers or monitoring wells show that soil is pre-drained by existing systems and that ground water control plan criteria are satisfied.
- E. Replace installations that produce noticeable amounts of sediments after development.
- F. Provide additional ground water control installations, or change method of control if, ground water control plan does not provide satisfactory results based on performance criteria defined by plan and by specifications. Submit revised plan according to Paragraph 1.06B.

3.3 SEDIMENT TRAPS

- A. Install sediment tank as shown on approved plan.
- B. Inspect daily and clean out tank when one-third of sediment tank is filled with sediment.

3.4 SEDIMENT SUMP PIT

- A. Install sediment sump pits as shown on approved plan.
- B. Construct standpipe by perforating 12 inch to 24-inch diameter corrugated metal or PVC pipe.
- C. Extend standpipe 12 inches to 18 inches above lip of pit.
- D. Convey discharge of water pumped from standpipe to sediment trapping device.
- E. Fill sites of sump pits, compact to density of surrounding soil and stabilize surface when construction is complete.

3.5 EXCAVATION DRAINAGE

- A. Use excavation drainage methods if well-drained conditions can be achieved. Excavation drainage may consist of layers of crushed stone and filter fabric, and sump pumping, in combination with sufficient ground water control wells to maintain stable excavation and backfill conditions.

3.6 MAINTENANCE AND OBSERVATION

- A. Conduct daily maintenance and observation of piezometers or monitoring wells while ground water control installations or excavation drainage is operating at the site, or water is seeping into tunnels, and maintain systems in good operating condition.
- B. Replace damaged and destroyed piezometers or monitoring wells with new piezometers or wells as necessary to meet observation schedules.
- C. Cut off piezometers or monitoring wells in excavation areas where piping is exposed, only as necessary to perform observation as excavation proceeds. Continue to maintain and make specified observations.
- D. Remove and grout piezometers inside or outside of excavation area when ground water control operations are complete. Remove and grout monitoring wells when directed by Owner's Representative.

3.7 MONITORING AND RECORDING

- A. Monitor and record average flow rate of operation for each deep well, or for each wellpoint or eductor header used in dewatering system. Also, monitor and record water level and ground water recovery. Record observations daily until steady conditions are achieved and twice weekly thereafter.
- B. Observe and record elevation of water level daily as long as ground water control system is in operation, and weekly thereafter until Work is completed or piezometers or wells are removed, except when Owner's Representative determines more frequent monitoring and recording are required. Comply with Owner's Representative's direction for increased monitoring and recording and take measures necessary to ensure effective dewatering for intended purpose.

3.8 SURFACE WATER CONTROL

- A. Intercept surface water and divert it away from excavations through use of dikes, ditches, curb walls, pipes, sumps or other approved means. Requirement includes temporary works required to protect adjoining properties from surface drainage caused by construction operations.
- B. Divert surface water and seepage water into sumps and pump it into drainage channels or storm drains, when approved by agencies having jurisdiction. Provide settling basins when required by agencies.

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SECTION 01 71 23

FIELD ENGINEERING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Measures to ensure adequate quality control and quality assurance for all Work in accordance with Conditions of the Contract, as specified herein, and with the quality control and quality assurance requirements of each Specification Section, and authorities having jurisdiction.

1.2 RELATED SECTIONS

- A. All Sections of Work requiring layout, survey, reference points and their verification and protection, and quality control and assurance monitoring requirements.

1.3 DEFINITIONS

- A. Survey and Field Engineering: Wherever the terms “Survey”, “Field Engineering” or any derivative thereof, or similar term appears within this Section, they mean one and the same, and shall mean the survey or field engineering work performed by the Field Engineer as defined below and is separate from that of the survey work provided by the Owner.
- B. Field Engineer: Wherever the term “Field Engineer” or any derivative thereof, or similar term appears in the Contract Documents, it shall refer to the General Contractor’s employee(s) that are expert in, routinely engaged in, and have at least five (5) years experience in, the practice of construction project field engineering, building and project layout, construction measurements and monitoring, etc.
- C. “Construction Surveyor”: Wherever the term “Construction Surveyor”, or any derivative thereof, or similar term appears in the Contract Documents, the entity (person or firm) licensed as a Registered Professional Land Surveyor or Professional Engineer of the discipline required for specific service on the Project in the State in which the Project occurs, with five (5) years minimum experience, and meeting all applicable regulations of the State in which the Project occurs and Department of Labor, and other authorities having jurisdiction to perform the Work. To avoid any misunderstanding or lack of interpretation, the entity responsible for performing the Work of this Section shall be employed by the General Contractor, and the responsibility, including methods and means, is totally that of the General Contractor.
- D. Quality Control and Quality Assurance: Wherever the terms “Quality Control”, “Quality Assurance” or any derivative thereof, or similar term appears in the Contract Documents, they mean one and the same, and shall mean an aggregate of activities of the General Contractor, such as design analysis and statistical sampling with inspection for defects, designed to ensure adequate quality in materials and workmanship whether factory manufactured or jobsite produced.

1.4 QUALITY CONTROL AND QUALITY ASSURANCE

- A. Employ a Construction Surveyor complying with the definition above and acceptable to the Owner and Architect, to perform all Construction Surveying. Provide full responsibility for the Construction Surveyor and accuracy of the performance of all items of Work shown on Drawings, specified herein, or in other Specification Sections.

SUBMITTALS FOR REVIEW

- A. Submit name, address, telephone number, fax number, and registration number of the proposed Construction Surveyor prior to starting Work of this Section.
- B. Submit evidence of Construction Surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate, if different from Construction Manager's.
- C. Upon request by Architect, submit documentation verifying accuracy of all Survey Work, including a certificate sealed and signed by the Construction Surveyor, that the elevations and locations of the Work are in conformance with Contract Documents and such information has been incorporated into the Project Record Documents.
- D. Submit Project Record Documents under provisions of Section 01 77 00, Closeout Procedures.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of discrepancies discovered.

3.2 SURVEY REFERENCE POINTS

- A. Locate and protect survey control and reference points.
- B. Control datum for survey is that established by the Owner provided survey and as indicated on Drawings.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original Owner's survey control. Make no changes without prior written permission of Architect.

3.3 FIELD ENGINEERING AND CONSTRUCTION SURVEYOR REQUIREMENTS

- A. Establish a minimum of two (2) permanent benchmarks on site, referenced to established control points. Record locations, with horizontal and vertical data, on Project Record Documents.
- B. Field Engineer shall establish elevations, lines and levels. Locate, lay out, and monitor by instrumentation and similar appropriate means Work, including, but not be limited to:
 - 1. elevations, and layout of property lines and easements;
 - 2. site drainage, including storm water control and pollution prevention measures, slopes, swales, and invert elevations;
 - 3. limits of clearing and grubbing, including identification of trees and planting to be removed and methods for protection of those to remain;

4. excavations, fill and topsoil placement, and all (rough and finish) grades;
 5. trenching and trench safety;
 6. utility locations;
 7. concrete and asphaltic concrete paving, curbs, ramps, and other site improvements, as applicable;
 8. grid or axis for structures, batter board locations;
 9. elevation, grade controls, and layout of building foundation and grade beams, column locations, base plates, embedded items, depressions, formwork, and openings in concrete, including all interior finish grades;
 10. elevations of structural steel, including, steel joists/trusses, steel decks, and associated miscellaneous metals;
 11. elevations and layout of masonry, including concrete masonry units (CMU), face brick, cast stone, and other elements built-in masonry.
 12. elevations and slopes of roofing, including those for lightweight insulating concrete deck system, if applicable.
 13. elevations and layout of work as required to ensure proper operation, clearances, and tolerances, including conveying systems, plumbing and mechanical work; and
 14. monitoring of movement and protection of existing or adjacent structures, as applicable.
- C. Throughout course of Work, verify existing conditions and layouts by same means as originally used to ensure conformance with design requirements and details. Notify Architect immediately, if discrepancies are found.
- D. Provide one (1) copy each of reduced Field Engineer's notes to the Architect, Owner, Construction Surveyor, and affected Consultant within four (4) working days of completion of each portion of the Field Engineering Work.
- E. Field Engineer's notes shall be clear and complete. The Field Engineer shall be available at no expense to the Owner, Architect, or Consultants for note interpretation, if required.
- F. Field Engineer shall perform surveys to determine quantities of unit cost work, including control surveys to establish measurement reference lines. Notify Architect prior to starting work.
- G. Provide Construction Surveying services. Utilize recognized engineering survey practices.
- H. Construction Surveyor shall verify and record/document their findings, on a drawn survey at a scale matching that of the original Contract Documents, for the following:
1. All property lines and corners
 2. All building corners
 3. All paving corners
 4. Finish floor of all/each buildings
 5. Invert elevations, flow lines for all site drainage structures and improvements
- I. Payment for earthwork quantities shall be for materials in place, compacted, and determined by neat line method.
- J. Provide the Owner a reproducible hard copy and digital/electronic file copy of all the Construction Surveyor's work.

3.4 PROJECT RECORD DOCUMENTS

- A. Maintain a complete and accurate log of control and Field Engineer work as it progresses.
- B. Upon completion of Work, including, but not limited to earthwork, formwork, foundation, structural steel erection, and major site improvements, prepare Project Record Documents illustrating dimensions, locations, angles, and elevations of construction and site work.
- C. Submit Project Record Documents as specified in Paragraph 1.5.

END OF SECTION

SECTION 01 71 50

PREVENTIVE HOUSEKEEPING AND FINAL CARPET CLEANING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SCOPE OF WORK

- A. Cleaning of new and existing Tandus Powerbond carpet within the Project work area at the end of each work window upon substantial completion of work scheduled each day. Work window shall be determined by and coordinated with Owner.
- B. Clean entire area of building where construction or scope of work occurs, and all areas affected by construction activities including but not limited to dirt, debris and construction dust.
- C. Preventive Daily Housekeeping. The following are intended as a guide to facilitate the daily maintenance and cleanliness of the construction site, including but not limited to:
 - 1. Renovations involving the commons cafeteria where the stage curtain may be exposed/soiled by construction materials, dirt, dust etc. the curtain shall be removed prior to construction and stored according to curtain Manufacturer's recommended procedures and methods. Contractor reinstall after final cleaning. Contractor is responsible for curtain cleaning should it become soiled from construction activities per Curtain Manufacturer's methods.
 - 2. Contractor to segregate phased and/or areas of construction from all other areas of the building with a sealed, airtight construction barrier.
 - 3. Contractor shall provide additional AHU air filtration to protect existing Owner HVAC systems and other areas of building from becoming soiled from construction activities and dust. Should construction dirt and dust accumulate in affected construction areas, Contractor shall provide final cleaning of those spaces.
 - 4. Contractor is to prevent daily accumulation of construction dust or any other material that can cause any safety hazard.
 - 5. Contractor to eliminate, as practical as possible, tracking of dirt and debris prior to entering building each time.
 - 6. In an effort to protect existing flooring surfaces, Contractor is responsible for providing adhesive plastic sheeting and Masonite and/or plywood to prevent accumulation of all contaminants, including but not limited to: dirt, damaging foot traffic, lift equipment, machinery oil, etc. Continuously inspect and provide replacement/maintenance as needed of sheeting and Masonite/plywood as appropriate to construction intensity.
 - 7. Daily cleaning and maintenance of existing carpet to utilize procedure itemized in subsection 3.1 prior to cold water extraction.

PART 2 – PRODUCTS

2.1 CERTIFIED MAINTENANCE PARTNERS

- A. Corporate Care
Phone: 713-692-6300
Attn: Sean Barnett
- B. GCA Services Group
Phone: 972-276-5858
Attn: Dub Spencer

- C. Texan Floor Service
Phone: 713-956-9966
Attn: Jeff Hill

2.2 MATERIALS

- A. Cleaning Solutions: Cleaning solutions shall be used according to manufacturer's instructions. Review the material safety data sheets (MSDS) and/or safety data sheet (SDS), and product labels on solutions, being aware of any precautions and usage guidelines.
 - 1. Below are the minimum requirements for cleaning solutions to be used on C&A carpet. Contact your supplier to assure that these guidelines are met:
 - a. Shall be safe and non-toxic.
 - b. Shall contain no optical brighteners.
 - c. Shall have a pH between 5 and 9 diluted for normal cleaning.
 - d. Do not leave a sticky or oily residue when dried.
 - e. Will not damage carpet's fiber or color.
 - f. Will not promote rapid soiling.
 - 2. Conduct the following test to evaluate the type of residue a solution leaves behind:
 - a. Prepare the solution and pour in a pan.
 - b. Place in direct sunlight and allow to evaporate. If it leaves a sticky or oily residue, do not use. The carpet manufacturer can provide approved cleaning agents and deodorizers for the specific carpet. These cleaners have been tested for appropriate pH levels, absence of optical brighteners and zero resoil potential.

2.3 EQUIPMENT

- A. Equipment: Use the effective, well-functioning equipment:
 - 1. Vacuum Cleaner: Use a commercial vacuum cleaner that exceeds the established industry standards for soil removal. For improved indoor air quality, the vacuum shall have high efficiency filtration and shall emit minimal particles into the air. (The carpet manufacturer can provide a list of suggested vacuum cleaners.)
 - 2. Pile Lifter: Use a pile lifter to assist in the cleaning process to aggressively lift the pile fiber and loosen attached soil prior to vacuuming. Because of this aggressiveness, caution must be used when cleaning C&A's Syntex® products. (The carpet manufacturer can provide a list of suggested pile lifters.)
 - 3. Extractors: Provide hot water extraction for final deep cleaning and maintenance.
 - a. Selection should be based upon the needs of the facility. In general, the following minimum performance should be considered:
 - 1) Extractor should be C&A approved and capable of extracting a maximum volume of water injected into carpet pile fiber.
 - 2) Components should be made of a material that is non-corrosive and will not rust or deteriorate in the presence of water and/or cleaning solutions.
 - 3) Extractor should be able to generate a minimum of 50 pounds per square inch (psi) of pressure and should not exceed 400 psi.
 - 4) The carpet manufacturer can provide a list of suggested extractors.
 - 4. Portable Air Mover:
 - a. Carpet can dry within 2 to 3 hours in most environments. Drying time should never exceed 12 hours.
 - b. When extreme environmental conditions exist (relative humidity exceeds 65%), an air mover or drying fan should be used to accelerate drying time.
 - c. The carpet manufacturer can provide a list of suggested portable air movers

PART 3 – EXECUTION

3.1 PROCEDURE

- A. Cleaning Procedures:
1. Vacuuming
 - a. Make sure the vacuum cleaner is in proper working order before each use. (Clean all components regularly.)
 - b. Use slow, overlapping passes. Slowing the vacuum down allows the suction to loosen and remove the embedded dry soil that can abrade and damage fibers.
 - c. Pay careful attention to the “pull” stroke. More soil is removed in this action than in the forward stroke.
 - d. Empty vacuum bags when they become half full to improve soil removal.
 - e. Replace nylon brushes at the first sign of wear.
 - f. Use only original equipment manufacturer parts for consistent performance.
 2. Spill Removal
 - a. Spills may require cleaning solutions to remove.
 - b. The spill/liquid should be blotted into paper or cloth towels.
 - c. Place several layers of towels over the spill and apply pressure until all of the excess liquid has been removed.
 - d. Use a portable spot removal extractor with cold water solution.
 3. Spot Removal
 - a. Determine if the spot is a water-soluble or oil-based stain by applying clean water and blot with absorbent towel. Water-soluble spots will transfer to the towel; oil-based spots will not. Clean spot using one of the following methods:
 - 1) For water-based spots: Continue rinsing with water as long as there is transfer to the towel. A cleaning agent may not be necessary if water continues to remove the spot. If a cleaning agent is needed, apply a Manufacturer approved (Collins and Aikman for TanduS carpets) spot lifter to the area and allow to soak for 5 minutes. Then, flush thoroughly with water until all detergent residue has been removed. Repeat this process until the spot is removed.
 - 2) For oil-based spots: After blotting to remove excess liquid, apply a non-water based dry-cleaning solvent* to a towel and apply to the spot. (Applying a dry-cleaning solvent directly to the Carpet surface may allow the spot to spread.) Work from the outer edges of the spot to limit spreading. Continue to reapply solution in this manner until the spot is completely removed. Then flush thoroughly with water until all residue has been removed. In case of permanent stains, repairs may be necessary.*Dry-cleaning solvents denote isopropyl alcohol, denatured alcohol and other, non-water-based cleaning solutions.
 4. Extraction
 - a. In addition to vacuuming and spot removal, extraction will help maintain Carpet’s appearance.
 - b. The procedure for effective soil removal is as follows:
 - 1) Pile lift all heavy soiling areas.
 - 2) Thoroughly vacuum the entire area to remove dry soil.
 - 3) Never use detergent in the extractor rinse tank.
 - 4) Pre-spray the area with an approved pre-spray solution.
 - 5) Use agitation for improved cleaning results.
 - 6) Allow the solution to remain undisturbed for 5 to 10 minutes. This will make the soil easier to remove.
 - 7) Extract the area thoroughly to rinse and remove all the detergent and soil.
 - 8) Repeat until recovery water is relatively clean.
 - 9) Place air movers on the area to expedite the drying time.
 - 10) Limit foot traffic on the area until dry.
 - c. Extraction equipment guidelines:

- 1) Make sure extractor is in proper working order.
 - 2) Disinfect freshwater tank and recovery tank on a weekly basis.
 - 3) Replace nylon brushes at the first sign of wear.
 - 4) Use only original equipment manufacturer parts for consistent performance.
5. Tape Residue Removal
- 1) Following removal of carpet and flooring protective measures, including but not limited to plastic sheeting, adhesive plastic sheeting, Masonite, tape, etc., Contractor is responsible for complete removal of tape residue (per flooring manufacturer recommendations) from flooring surfaces prior to final cleaning.

3.2 SCHEDULE

- A. Traffic Patterns: Identify and evaluate the traffic patterns in the facility and get approval from Owner. Using a floor plan of the facility, color code the plan to identify each of the areas.
- B. Cleaning Schedule:
1. Track-Off Areas: Areas where outside soil is tracked in (entrances, lobbies, restrooms, elevators, and areas next to hard-surface flooring). These areas require specific attention.
 - a. Pre-vacuum prior to spot cleaning
 - b. Spot clean to remove entrenched stains
 - c. Vacuum again using multiple passes
 - d. Pile lift to loosen embedded soil prior to extraction
 - e. Wet extract in each direction using multiple passes to achieve desired appearance level
 - f. Spot clean as necessary
 - g. Vacuum
 2. Heavy Traffic Zones: Areas that experience more than 1,000 foot traffics per day (staging areas, traffic lanes, pivot points and funnel areas)
 - a. Vacuum using multiple passes
 - b. Pile lift to loosen embedded soil prior to extraction
 - c. Wet extract to achieve desired appearance level
 - d. Spot clean as necessary
 - e. Vacuum
 3. Moderate Traffic Zones: Areas that experience 500 to 1,000 foot traffics per day (secondary hallways, administrative areas, offices, and light-use common areas)
 - a. Vacuum using multiple passes
 - b. Pile lift to loosen embedded soil prior to extraction
 - c. Wet extract to achieve desired appearance level
 - d. Spot clean as necessary
 - e. Vacuum
 4. Light Traffic Zones: Areas that experience less than 500-foot traffics per day (conference rooms, areas outside of traffic lanes, and limited use-area)
 - a. Vacuum using multiple passes
 - b. Wet extract as necessary to achieve desired appearance level
 - c. Spot clean as necessary
 - d. Vacuum

5. Areas Prone to Spots and Stains: (break rooms, coffee areas and areas near kitchens)
 - a. Pre-vacuum prior to spot cleaning
 - b. Spot clean to remove undesirable stains
 - c. Pile lift and wet extract as required according to traffic zone identification above
 - d. Spot clean again as necessary
 - e. Vacuum

END OF SECTION

SECTION 01 77 00

GUARANTEES, CERTIFICATES AND CLOSE-OUT

CONDITIONS OF THE CONTRACT, SUPPLEMENTARY CONDITIONS AND DIVISION I APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Certain procedures have been developed and are required to fulfill all provisions of the Owner-Contractor Agreement with respect to contract Final Completion and Contract Close-Out for the work/project to be 100% complete.
- B. Refer to AIA Document A201™-2017, General Conditions of the Contract for Construction; as amended and Section CB – Supplementary Conditions of the Contract for Construction; as amended for additional information and requirements.

PART 2 - SUBSTANTIAL COMPLETION

2.1 GENERAL

- A. Projects that involve phase sequential construction of major definable areas of projects that involve separate work on multiple campuses shall have Certificates of Substantial Completion issued for each phase or campus, as applicable and agreed upon by the Owner and Contractor. All conditions for Substantial Completion, including liquidated damages, shall apply for each date of Substantial Completion for each phase or campus, as applicable.
- B. Individual Substantial Completion Dates for each phase or campus shall be determined and agreed upon by the Owner, Architect and Contractor. Where an Alternative Proposal dictating a required, guaranteed completion date (dates) is included in the Proposal Form and accepted by the Owner, the date(s) stated therein shall establish the Substantial Completion Dates to be incorporated into the Agreement.
- C. The following items are a partial list of requirements, as applicable to the Project, which must be completed prior to establishment of a Substantial Completion date. Refer to substantial completion checklist contained within the AIA Document A201™-2017, General Conditions of the Contract for Construction as amended for a complete list.
 - 1. All fire alarm system components must be completed and demonstrated to the Owner.
 - 2. All inspections by government authorities having jurisdiction over the project must have been finalized, any remedial work required by them must have been completed, and Certificates of Occupancy, local fire marshal and health department approval certificates and similar governmental approval forms must have been issued and copies delivered to the Owner and Architect.
 - 3. All exterior clean-up and landscaping must be complete, including required stand of grass mowed, edged, weeded, and fertilized.
 - 4. All interior shall have been completed and cleaned except minor items which, if complete after occupancy, will not, in the Owner's opinion, cause interference to the Owner's use of the building or any portion thereof. Contractor shall provide list of these specific items, which include punch list and completion items. 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 shall be the sole judge of what constitutes a significantly large number of items.
 - 5. All third-party HVAC air and water balancing must be complete.

6. All energy management systems must be complete, fully operational and demonstrated to the Owner, with graphics transferred to the main server.
 7. All emergency/standby generator and low voltage lighting control systems must be complete, fully operational and demonstrated to the Owner.
 8. All security systems must be complete, fully operational and demonstrated to the Owner, and must be monitorable from the District's central Police/Security Center.
 9. All school communications equipment, telephone systems and P.A. systems must be complete and demonstrated to the Owner.
 10. All final lockset cores must be installed and all final Owner directed keying completed.
 11. All room plaques and exterior signage must be complete.
 12. All Owner demonstrations must be completed including kitchen equipment, HVAC equipment, plumbing equipment, and electrical equipment and all life safety systems.
 13. A final certificate of occupancy must be signed by the Contractor and delivered to the Owner.
 14. All operation and maintenance manuals are delivered and approved by Architect and Owner ("D-slant" ring binders in duplicate).
 15. Health Department Inspections and Municipal Utility District (MUD) and Drainage District and County approvals must be provided.
 16. All other reports, testing results, certifications, studies, etc. required by Contract Documents.
- D. Final Cleaning:
1. The work area shall be thoroughly cleaned inside and outside. Cleaning includes removal of smudges, marks, stains, fingerprints, soil, dirt, spots, dust, lint, and other foreign materials from finished and exposed surfaces. Refer to Section 01 71 50 for final clean requirements of remodel areas and carpet.
 2. Remove all temporary facilities.
- E. In order for the project, a major portion thereof, a project phase or project campus 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 them 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, interior and exterior, shall have been completed and cleaned except minor items (Punch List) which, if completed after occupancy, will not, in the Owner's opinion, cause any interference to the Owner's use of the building or any portion thereof.
 3. All items stipulated in 2.1-C above.
- F. The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate. Upon such acceptance and consent of surety, if any, the Owner, at his sole discretion, may make (partial) payment of retainage applying to such work or designated portion thereof which is 100% complete and accepted by the Owner. Such payment, if made at all, shall be adjusted in the Owner's favor for work that is incomplete or not in accordance with the requirements of the Contract Documents.
- G. The date of Substantial Completion shall represent day one (1) of the thirty (30) day period to complete all work and correct all deficiencies contained in the Punch List and the ninety (90) day period allowed for complete Contract Close-Out as described below.

2.2 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. It is anticipated that the detailed list of items of work to be completed or corrected at the Date of Substantial Completion.
- 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.

2.3 OPERATIONS AND MAINTENANCE MANUALS

- A. Operation and Maintenance (O&M) Manuals shall be delivered prior to, and are a condition of, Substantial Completion to allow the Owner the benefit of having the manuals for on-site training and start-up procedures provided by the Contractor.
- B. Operation and Maintenance (O&M) Manuals shall provide concise descriptions, technical information, principles of operation; operating instructions, maintenance instructions and schedules, MSDS sheets, and other information that will enable the proper on-going operation and maintenance of the material and/or assembly.
- C. Separate O&M Manuals shall be provided for the following as applicable to the project scope of work:

1. Architectural materials, equipment and/or assemblies
 2. Food services materials, equipment and/or assemblies
 3. Mechanical materials, equipment and/or assemblies
 4. Plumbing materials, equipment and/or assemblies
 5. Electrical materials, equipment and/or assemblies
 6. Low-voltage systems materials, equipment and/or assemblies
 7. Theater lighting/sound systems materials, equipment and/or assemblies
- D. Provide O&M Manuals/information for all materials, equipment and/or assemblies where required in individual sections of specifications.
- E. Each O&M Manual shall contain a cover and spine label depicting contents as delineated in paragraph C above; and within each Manual shall be organized in numerical order corresponding to specification sections.
- F. O&M Manuals shall be provided in 3-ring binders similar to close-out manuals described above.
1. O&M manuals shall contain a table of contents listing the specification number with corresponding general description of the material, equipment, and/or assembly included in the manual.
 2. The indexed sections shall be divided and identified by tabbing each section as listed in the index.
- G. Deliverables:
1. Provide electronic copy of all O&M manuals for review. Deliver A/E Consultant O&M Manuals directly to the relative A/E Consultant with a copy of the transmittal to the Architect.
 2. Resubmit as necessary to obtain final acceptance of Manuals.
 3. Once all corrections have been made and the O&M Manuals found to be acceptable, provide one (1) hard copy of each binder and one (1) PDF format electronic copy of each binder to the Architect for transfer to the Owner.

2.4 SUBSTANTIAL COMPLETION SCHEDULE

- A. After the date of Substantial Completion of the project as evidenced by the Certificate of Substantial Completion, AIA document G704-2000, the Contractor will be allowed a period of thirty (30) days, unless extended by mutual agreement or provision of the Contract, within which to complete all work and correct all deficiencies contained in the Punch List attached to the Certificate of Substantial Completion. It is incumbent upon the Contractor to request Substantial Completion **only** when there is assurance that all work included on the Punch List shall be completed within the thirty (30) day time frame.
1. In the event the Owner must take occupancy of the project prior to Contractor's completion of the punch list, the Contractor shall make all adjustments necessary to schedule the work to allow full and normal operation of the project by the Owner.
 2. Where this requires work outside of normal business hours, the work shall be provided at no additional cost to the Owner.
- B. Upon Contractor's and sub-contractor's verification that all punch list items have been 100% completed, the Contractor shall notify the Architect and the Architect and consultant(s) shall conduct an on-site observation to verify that all items are 100% complete.
1. On-site verifications for partial completions, if any, shall be conducted by the Architect at the Architect's discretion.
 2. If any items shown to be complete by the Contractor are found not to be complete by the Architect, the observation shall be stopped, with such notification to the Contractor.
 3. Contractor's requested punch list observations by the Architect shall be limited to a maximum of two (2) per punch list.

- C. If the Contractor fails to complete all work on the punch list within thirty (30) days after the Substantial Completion date, Contractor shall be required to attend weekly meetings at the project site or Owner's office until such time as 100% of the punch list items are completed and accepted by the Owner. During this time the Contractor will be charged from the Owner's, Architect's and any A/E Consultant's time associated with achieving completion of the punch list.
1. Billable time shall include, without limitation, travel time, meeting time, document preparation, document review, and re-inspection of on-site conditions.
 2. The weekly meetings shall include a minimum of two (2) hours charge per participant.
- D. Owner billable time shall be deducted from the Contractor's Final Payment or separately invoiced to the Contractor at Owner's option. Owner billable hourly rates shall be as follows:
1. Assistant Superintendent: \$200.00 per hour
 2. Director: \$175.00 per hour
 3. Project Manager: \$150.00 per hour
 4. Project Coordinator: \$120.00 per hour
 5. Administration/Secretarial: \$50.00 per hour
- E. Architect and A/E Consultant billable time shall be invoiced to the Contractor by the Architect. A/E billable rates shall be as follows:
1. A/E Principal: \$175.00 per hour
 2. A/E Project Manager: \$150.00 per hour
 3. Staff Architect/Consultant: \$120.00 per hour
 4. A/E Field Representative: \$100.00 per hour
 5. Administration/Secretarial: \$50.00 per hour

PART 3- PRODUCTS

- 3.1 Not used.

PART 4 - CONTRACT CLOSE-OUT

4.1 GENERAL

- A. Upon issuance of the (final) Certificate of Substantial Completion, and per the Owner- Contractor Agreement, the Contractor will be allowed a period of ninety (90) days within which to complete all Contract Close-Out requirements, unless extended by mutual agreement or provision of the Contract.
- B. In addition to all work and requirements described for Substantial Completion, in order to achieve Contract Close-Out, the Contractor shall submit all Close-Out documents per Form AO.

Record Document

- C. Final/ 100% release of retainage will not be authorized by the Architect until the Contractor completes all of the requirements for Contract Close-out; and until all expenses incurred and to be paid by the Contractor have been paid in full.
- D. It is the Contractor's sole responsibility prior to submission to verify that Close-Out documents being submitted for review and acceptance are 100% complete and accurate. The Owner/Architect reserves the right to reject any incomplete close-out documents.
1. Upon discovery by the Architect that Close-Out documents are incomplete and/or inaccurate, the Architect's review shall cease, and the Contractor shall be so notified.

2. The A/E Consultants' will provide a comprehensive list of possible missing and/or incorrect items needed.
- E. It is desirable and beneficial to submit all Close-Out documents as a single submission; however, Close-Out documents may be submitted separately in four (4) deliverables as follows:
1. Close-Out Documents Manual
 2. Operations and Maintenance Manuals (required prior to Substantial Completion)
 3. Record Drawings
 4. Owner's Record Copy of Submittals (one (1) flash drive in PDF format)
- F. Close Out Tracking
1. Contractor shall track the progress of project closeout utilizing excel spreadsheets which will be provided by the Architect (see examples attached at the end of this Spec Section).
 2. Contractor shall update closeout tracking spreadsheets weekly and submit electronic copy to Architect twenty-four hours prior to the weekly closeout review meetings.
 3. Master Closeout Checklist represents all items required to be provided by the Contractor to the Owner at the conclusion of the project. It is more general in nature and only includes a status of the closeout item in question. It does not drill down into the details of when the item was submitted, why it was rejected, when it was approved, etc. This checklist will be used throughout the project to track all closeout deliverables.
 4. Detailed Checklists are more comprehensive lists developed for each section of the closeout requirements. These lists are used by the Contractor to identify and track every deliverable required from each subcontractor. This list will contain a separate entry for each item that is required from each and every subcontractor. It should include the specification section that lists the requirement, a description of the item, responsible subcontractor, and the dates that the items were requested, received, and transmitted to the Owner. The information included in these detailed checklists is used to update the Master Closeout Checklist.
 5. A sample of the Master and Detailed Checklists are attached at the end of this Spec Section. An excel file with the checklists will be provided by Architect.

4.2 CLOSE-OUT MANUALS FORMAT

- A. All close-out documents shall be submitted in CFISD provided digital format with detailed table of contents, intext tabs corresponding to the table of contents.
1. The close-out documents must be neatly organized and easily useable, as determined by the Architect and Owner.
 2. At completion and final review, submit one (1) electronic PDF file and one (1) flash drive containing close-outs.

Table of Contents

Part 1: Close-Out Log

- a. Project Checklist – Form A0
- b. Close Out Log

Part 2: Project Directory

- a. Project Team (architect, engineer, contractor, consultants)
- b. List of Final Subcontractors/Suppliers/Local Representatives (by Specification Section)

Part 3: Close-out Documents and Affidavits

- 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
- d. Subcontractor's Release of Lien

Part 4: Project Documents and Certificates

- a. AIA G704 - Certificate of Substantial Completion
- b. Punch List / Architect's Letter Confirming Completed Punch List
- c. Copy of All Permits
- d. Copy of Final Utility Bill or Letter of Transfer
- e. Certificate of Occupancy
- f. Certification of Project Compliance
- g. Hazardous Material Certificate
- h. Asbestos Manifest / TDLR Inspection / EAB Letter / Structural Letter / Material Testing Letter(s) / Commissioning / other Consultants
- i. Form AQ - Certificate of Final Completion

Part 5: Warranties (Compiled Sequentially by Specification)

- a. General Contractor's Warranty
- b. Subcontractor's Warranty
- c. Extended Warranties & Maintenance / Service Agreements

Part 6: Insurance (General Contractor / Subcontractor)

- a. Continued Coverage
- b. Worker's Compensation Certificate

Part 7: Receipts

- a. Extra Stock by Division
- b. Keys
- c. Paint Mix Cards

Part 8: Record Documents

- a. Demonstration and Training Sign-in Sheets by Division with Digital Video
- b. Operations & Maintenance Manuals and Record Drawing Transmittal(s)

4.3 WARRANTIES

- A. All guarantees and warranties required by the Contract Documents shall establish the date of Substantial Completion as day one (1) of the required warranty period; regardless of how long the product, assembly or work has been installed or in operation prior to Substantial Completion.

1. Coordinate with subcontractors and material suppliers to account for provision in their original proposal/bid amount, if necessary.
- B. Contractor's One-Year Warranty: The Contract requires the General Contractor to warrant ALL materials and work provided/furnished for a period of one (1) year following the date of Substantial Completion.
 1. The one-year general warranty shall include all labor, material and delivery costs required to correct defective material or installation during the Warranty period.
- C. Sub-Contractor's One-Year Warranty: each sub-contractor that performed work on the project shall be required to submit a one-year warranty similar to the above Contractor's One-Year Warranty for their specific work provided.
- D. Extended Warranties: In addition to the General Contractors and subcontractors' one-year warranty, other required guarantees shall be included in the Close-Out Binder in original issue form. All extended warranties shall begin on the Substantial Completion date; and shall include all labor, material and delivery costs required to correct defective material or installation for the entire required extended warranty period, as specified in the respective specification section.

4.4 RECORD DRAWINGS:

- A. Upon Substantial Completion, the Contractor shall be furnished, at no charge, a complete set of electronic files in AutoCAD release 2018 or later, and Revit if applicable, of all drawings included in the Contract Documents. The title blocks shall be stripped of all logos, disclaimers and licensed seals of the Architect and Consultants.
 1. Throughout the construction phase, Architect's and Consultant's supplemental drawings/sketches provided to the Contractor in AutoCAD and Revit format shall be provided to the Contractor electronically and shall be incorporated in the electronic files by the Contractor.
- B. Upon request, the Architect and/or Consultants shall assist the Contractor with understanding the structure and composition of the electronic files to facilitate the generation of the Record Drawings.
- C. The Contractor shall modify the title block on each/every sheet to include only the project name, project address, Owner name, consultants' name and address, date, and clearly identify the set as "Record Drawings".
- D. All record drawings shall be provided in AutoCAD, Revit, and PDF formats. AutoCAD files shall be provided in "E-Transmit" format with all associated external references, image files, plot styles, and blocks included. CAD files shall be provided and labeled by sheet number. External references shall be setup up with relative file paths and not full (absolute) file paths. PDF files that are provided shall be one complete pdf file with the complete set of drawing files. The PDF shall be bookmarked by sheet number. Specifications shall be submitted in the same manner where they are complete pdf files by volume and bookmarked by specification section. In addition to the complete drawing set PDF, a separate file folder shall be provided with each sheet in the set saved as a separate file with the file named by sheet number. Create sub folders by discipline for all the individual sheet files.
- E. All modifications, additions, deletions, and revisions made to the project during the construction phase shall be reflected on the Record Drawings; and shall include, but not necessarily limited to:
 1. All as-built dimensions (different than original dimensions)
 2. All as-built locations and conditions relative to underground plumbing, sanitary and storm piping installations, natural gas piping and electrical conduits; shown accurately to within twelve (12) inches. Notes shall indicate approximate depth of all underground piping and utilities.
 3. All as-built conditions relative to ductwork installations; shown accurately to within six (6) inches.

4. All as-built conditions relative to HVAC water piping installations; shown accurately to within six (6) inches.
 5. All as-built conditions relative to underground electrical conduit installations. shown accurately to within six (6) inches.
 6. Record drawings shall include a copy of fire sprinkler layout of piping and equipment.
 7. All approved CPR's resulting in a physical change in the work.
 8. All RFI's resulting in a physical change in the work.
 9. All AEA's resulting in a physical change in the work.
 10. All Minor Changes resulting in a physical change in the work.
 11. All Construction Change Directives resulting in a physical change in the work.
 12. Update the list of drawings as necessary to reflect added and deleted sheets.
- F. All modifications shall be represented by actually deleting the original work and accurately depicting the revised as-built modifications/configurations. "X-ing out" deleted work shall not be accepted.
- G. Upon completion of all revisions to the Record Drawings, including the Architect's acceptance, the Record Drawings shall be copied to a thumb drive or solid-state media drive maintaining the exact folder/file structure originally furnished to the Contractor. Submit to the Architect for review before proceeding with deliverables.
- H. Deliverables: Upon Deliverables: review and acceptance of the documentation, including format, the Architect shall direct the Contractor to proceed with delivery of the following:
1. Three (3) thumb drives or solid-state media drives, containing the entire set of Record Drawings in PDF and TIFF format. Each sheet shall be a separate PDF and TIFF file. The thumb drives shall be organized to duplicate the order of drawings as they were issued for bidding and construction, with record drawing modifications.

4.5 RECORD SUBMITTALS

- A. The Contractor shall maintain and submit a separate set of final submittals to be delivered to the Owner as a condition of Contract Close-Out.
- B. Include only the final version of each submittal, including all submittal review comment sheets from the Architect and Consultant. Versions of submittals that were rejected or required to be revised and resubmitted are not required.
- C. Deliverables:
1. Deliver one (1) hard copy set of Record Submittals in file boxes, organized in order by specification division, with tabs included for each section of specifications and submittal log of contents of each file box.
 2. Deliver three (3) copies of all Record Submittals in PDF electronic format on three (3) thumb drives or solid-state media drives.

4.6 RECORD SPECIFICATIONS/PROJECT MANUAL

- A. The Contractor shall submit a record copy of specifications in PDF format on thumb drive or solid-state media drive. The PDF shall be formatted as stated in section 4.4, subsection D of this specification document. Record specifications shall be edited to contain only actual manufacturers, products, colors and model numbers actually used in the project.

4.7 CONTRACT CLOSE-OUT SCHEDULE

- A. If the Contractor fails to complete requirements of Contract Close-Out within sixty (60) days after the actual Substantial Completion date, Contractor shall be required to attend weekly meetings at the project site or Owner's office until such time as 100% of the Close-Out documents are

completed and accepted by the Owner. During this time the Contractor will be charged for the Owner's, Architect's and any A/E Consultant's time associated with achieving Final Completion.

1. Billable time shall include, without limitation, travel time, meeting time, document preparation, document review, and re-inspection of on-site conditions.
 2. The weekly meetings shall include a minimum of two (2) hours charge per participant.
 3. Refer to A201 – for Owner and Architect/A&E/Consultants billable times.
- B. In scheduling submission(s) and final approvals of Close-Out documents, the Contractor shall allow for the following review period for each submission:
1. Architect: Ten (10) calendar days
 2. Architect's Consultant: Twelve (12) calendar days.
- C. Additionally, failure by the Contractor to complete Contract Close-Out within the stipulated time will be reported to the Contractor's surety. In the report of deficiency, the Contractor and surety will be informed that, should correction work remain incomplete for fifteen (15) additional days, the Owner at his discretion may initiate action to complete corrective work out of the remaining contract funds in accordance with the Owner-Contractor Agreement, General and Supplementary Conditions to the Agreement as they apply.
1. Additional costs of the Owner, Architect, and other consultants incurred because of the Contractor's failure to complete Contract Close-Out within sixty (60) days after the date of Substantial Completion, unless extended by mutual agreement or provision of the contract, will be deducted from the funds remaining to be paid to the Contractor.

4.8 WARRANTY INSPECTION

Refer to: This summary is in accordance with AIA Document A201 § 3.5 - Warranty.

- A. Warranty periods start from Substantial Completion. If repairs are done post-Substantial Completion, warranty periods extend accordingly. The Contractor must track all warranty work and ensure its completion.
- B. Scheduled Inspections:
1. Approximately six months after Substantial Completion, and one month before the expiration of the one-year warranty, the Contractor shall notify the Architect and Owner to schedule a warranty inspection. A minimum of 10 days' notice must be provided to both the Architect and Owner prior to the inspection.
 2. At the scheduled inspections (6 and 11 months after Substantial Completion), the Contractor will inspect the project with the Owner and Architect and correct any deficiencies.
- C. Corrective Action:
1. For any defective work identified, the Contractor must immediately provide the necessary materials and labor to remedy the issues and continue working until the corrections are completed to the satisfaction of the Architect and Owner, even if the corrective work extends beyond the expiration of the warranty period.
 2. The Contractor is not responsible for correcting work that has been damaged by Owner neglect or abuse, or for replacing parts due to normal wear and tear.
- D. Warranty work must be completed within 10 working days unless specified otherwise. For urgent issues (e.g., life safety, HVAC, security), response times range from 4 to 6 hours.

- E. For urgent warranty requests, the Contractor must maintain an answering service available 24/7, 365 days a year.
- F. If the Contractor fails to complete warranty work within the specified timeframe, the Owner can complete the work and backcharge the Contractor for all related costs.

END OF SECTION

SECTION 01 91 00

GENERAL COMMISSIONING REQUIREMENTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Specifications throughout all Divisions of the Project Manual, which pertain to operable and non-operable equipment and/or building systems, are directly applicable to this Section, and this Section is directly applicable to them.

1.2 SUMMARY

- A. This Section establishes general and administrative requirements pertaining to commissioning of equipment, devices, and building systems on the project. Technical requirements for commissioning of particular systems and components are established in the respective technical sections of this Project Manual.
- B. It is of primary concern that all operable systems installed in the Project perform in accordance with the Contract Documents, the Owner's Project Requirements (OPR) and the Basis of Design (BOD). During Commissioning, the Contractor systematically demonstrates to the Owner or Owner's representative that the operable systems have been installed and performing in strict accordance with the Contract Documents.
- C. Commissioning requires cooperation and involvement of all parties throughout the construction process. The Contractor shall deliver a successful Commissioning process. Successful Commissioning requires that installation of all building systems complies with Contract Document requirements and that full operational check-out and necessary adjustments are performed prior to Substantial Completion with the exception of Deferred tests approved in advance by the Owner.
- D. Commissioning will encompass and coordinate traditionally separate functions of system documentation, installation checkout, System Verification Checklists and start-up, control system calibration and point-to-point checkout, testing, adjusting, and balancing, Functional Performance Tests, Integrated System Tests, Contractor demonstration to the Owner, and training of Owner's personnel. This requires assembling all related documentation into one cohesive collection. Commissioning is intended to achieve the following specific objectives of the Contract Documents:
- E. Verify and document proper installation and intended performance of equipment, systems, and integrated systems.
- F. Ensure that operating and maintenance and Commissioning documentation requirements are complete.
- G. Provide the Owner with functional buildings and systems that meet the Contract Document requirements and the Owner's Project Requirements (OPR) at Substantial Completion.

1.3 DEFINITIONS

- A. Basis of Design (BOD): A document that records the concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements and to satisfy applicable regulatory requirements, standards and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- B. Commissioning (Cx): A systematic process confirming that building systems have been installed, properly started, and consistently operated in strict accordance with the Project Documents, that all systems are complete and functioning in accordance with the Contract Documents at Substantial Completion, and the Contractor has provided the Owner adequate system documentation and training.

- C. Commissioning Authority (CxA): Party having a contractual agreement with the Owner to provide third party commissioning services as defined herein under Commissioning Authority's Role and Responsibilities. Commissioning Authority may represent the Owner and is authorized to act on behalf of the Owner. The Commissioning Authority does not have authority to alter design or installation procedures without the written approval of the Owner or the design team.
- D. Contract Documents: The General Conditions, Drawings, Specifications, Addenda, and other documents developed by the A/E Team and approved by the Owner that constitute the contractual obligations of the project scope.
- E. Control Point and Sensor Calibration Verification: Process of verifying the point integrity and/or sensor calibration from the physical point of monitoring (sensor, contact, actuator, etc.) to the digital point location at the Operator's interface within the respective control system (Building Automation, Lighting Controls, Power Status and Monitoring, etc.).
- F. Deferred Testing: Functional Performance or Integrated System Tests performed after Substantial Completion due to partial occupancy, partial equipment acceptance, seasonal requirements, design, or other site conditions that prohibit the test from being performed prior to Substantial Completion.
- G. Deficiency: Condition of a component, piece of equipment, or system that is not in compliance with the Project Documents.
- H. Functional Performance Test (FPT): Test of dynamic function and operation of equipment and systems executed by the Contractor and witnessed by the CxA. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, life safety conditions, power failure, etc. Systems are operated through all specified sequences of operation. Components are verified to be responding in accordance with requirements in the Project Documents.
- I. Functional Performance Testing Procedures: Commissioning protocols, detailed test procedures and instructions in tabular and script-type format that fully describe system configuration and steps required to determine if the system is performing and functioning properly.
- J. Integrated Systems Test (IST): Test of dynamic function and operation of multiple systems. Integrated Systems Tests are tested under various modes, such as fire alarm and emergency situations, life safety conditions, power failure, etc. Systems are integrally operated through all specified sequences of operation. Systems and interconnections are verified to be responding in accordance with the requirements in the Project Documents.
- K. Integrated Systems Testing Procedures: Commissioning protocols and detailed test procedures and instructions in tabular and script-type format that fully describe system configurations and steps required to determine if the interacting systems are performing and functioning properly.
- L. Operational Testing: Activities and testing occurring after initial energizing and/or start-up of equipment that determine whether equipment is operating within the manufacturer's recommendations and the design requirements. These activities are intended to ensure that equipment and systems meet all warranty requirements and are ready for Functional Performance Testing. Common examples are Testing, Adjusting and Balancing of HVAC systems and initial load testing of electrical equipment.
- M. Owner's Project Requirements (OPR): A written document that details the functional requirements of a project and the expectations of how the facility will be used and operated. These include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria and supporting information.
- N. Project Documents: Consists of the Contract Documents, Approved Submittals, Requests for Information (RFI), Vendor documentation, Operations and Maintenance (O&M) information and other

documentation that determines the requirements for acceptable installation and operation of the specific equipment and systems on the project.

- O. System Verification Checklist (SVC): A list of static inspections and material or component tests that verify proper installation of equipment (e.g., belt tension, oil levels, labels affixed, gages in place, sensors calibrated, etc.), start-up activities and documentation, as well as operational testing results. The checklists are meant to document all activities for an individual piece of equipment from procurement on the project through operational testing are performed in accordance with the requirements in the project documents.
- P. Start-up: The activities where equipment is initially energized, tested and operated. Start-up is completed prior to Operational Testing and Functional Performance Testing and is an integral item documented in the System Verification Checklist (SVC).
- Q. Training Plan: A detailed plan prepared by the Contractor and reviewed by the Owner and Commissioning Authority that outlines the training activities, instructors, time durations, and system requirements in accordance with the Contract Documents and Commissioning Plan.
- R. Trending: Data collection of monitored points using the Building Automation System, Lighting Controls System, Power Status and Monitoring System or independent data acquisition instrumentation.

1.4 COMMISSIONING TEAM

- A. Owner shall appoint the following Members:
 - 1) Owner's Project Manager and any other designated representatives of the Owner's staff.
 - 2) Commissioning Authority (CxA)
 - 3) Architect/Engineer (A/E)
 - 4) Test, Adjust and Balance Firm (TAB) – may be sub-contracted to the CxA
- B. Contractor shall appoint the following Members:
 - 1) Individuals, each having authority to act on behalf of the entity they represent, explicitly organized to implement the Commissioning process through coordinated actions. At a minimum, the Contractor shall designate a Commissioning Coordinator and each major sub-contractor (Mechanical, Electrical, Plumbing, Building Automation) shall have a dedicated representative.
 - 2) Vendor representatives (as needed) required for start-up, operational testing, Functional Performance Testing, Integrated Systems Testing, and Owner Training activities.
 - 3) Representatives of independent testing agencies (Test, Adjust and Balance, Electrical Testing Agency, etc.)

1.5 ROLES AND RESPONSIBILITIES

- A. Roles and responsibilities of Commissioning Team members related to the Commissioning Process are provided in this Section. The respective entities defined below shall fulfill the listed roles and responsibilities as contained herein. Specific technical roles and responsibilities are defined in other sections of the Project Specifications.
- B. Owner's Roles and Responsibilities:

- 1) Provide guidance in development of the Owner's Project Requirements (OPR).
 - 2) Review Technical Specifications containing Commissioning requirements.
 - 3) Approve the Commissioning Scope of Work and schedule of Commissioning activities.
 - 4) Assign Owner's representatives and schedule them to participate in Commissioning activities, including the following:
 - a. Commissioning Team meetings.
 - b. Review and approval of the Commissioning Plan, Training Plan, System Verification Checklist templates, Functional Performance Test Procedures, Integrated Systems Test Procedures, Deferred Testing Plans, Final Commissioning Process Report, Systems Manual, Measurement and Verification Plan and other Commissioning documents.
 - c. Attend Owner Training sessions in operation and maintenance of systems and equipment.
 - d. Observation of Contractor's demonstration of systems and equipment operation.
- C. Commissioning Authority's (CxA) Roles and Responsibilities:
- 1) Prepare the Commissioning Plan with the Owner's and Contractor's review and input.
 - 2) Periodically attend and/or review the proceedings of the regular Construction Meetings hosted by the Contractor to understand the progress of construction activities on the project.
 - 3) Conduct and document Commissioning Team meetings including the Commissioning Kickoff Meeting.
 - 4) Perform site visits as necessary to observe component and system installations prior to energizing or start-up of equipment and systems.
 - 5) Review and comment on product data and shop drawing submittals and coordination drawings applicable to systems being commissioned.
 - 6) Following submittal review and approvals by the A/E team, review the sequences of operation and coordinate with the Contractor and A/E Team in order to prepare the Functional Performance Test Procedures and Integrated Systems Test procedures. Submit to the Owner and Contractor for review and comment prior to facilitating FPTs and ISTs on the project.
 - 7) Upon written notice that equipment or systems are ready for initial energizing or start-up, review the progress of the System Verification Checklist(s) for the respective systems and components and ensure that all requirements have been completed by the Contractor to permit energizing or start-up in accordance with the project documents; CxA shall issue written notice to the Owner and Contractor that equipment is ready to energize or start-up. CxA will witness and ensure proper documentation is provided by the Contractor for major equipment energizing and start-ups as executed by the Contractor with appropriate notice as indicated herein.
 - 8) Witness, verify, and document results of Functional Performance Tests and Integrated Systems Tests.
 - 9) Coordinate resolution of deficiencies identified during site observations, equipment energizing or start-up, Functional Performance Testing, Integrated Systems Testing, Deferred Testing, and during the warranty period.

- 10) Review the Operating and Maintenance (O&M) documents to ensure that as-built information and correct data is included prior to the Owner Training sessions; review final O&M submittal to ensure compliance with the requirements in the project documents and provide written comments to the Owner.
- 11) Review the Contractor's Training Plan and individual training agendas for compliance with the requirements in the project documents. Recommend acceptance to the Owner prior to the Contractor scheduling training sessions with the Owner. Review the attendance and content of the training sessions to ensure the requirements of the project documents are completed. Conduct a survey of the Owner's personnel to evaluate the effectiveness of the Owner Training.
- 12) Compile the Final Commissioning Process Report and submit to the Owner for review and approval.

D. Architect/Engineer's (A/E) Roles and Responsibilities:

- 1) Specify control sequences of operation within the Contract Documents that comply with the OPR and BOD.
- 2) Incorporate Commissioning requirements into the Contract Documents if requested by the Owner.
- 3) Attend Commissioning Team meetings.
- 4) Review the Commissioning Plan, System Verification Checklist templates, Functional Performance Test Procedures, Integrated Systems Test Procedures, Deferred Testing Plans, and other Commissioning documents as required by the Owner or the Contract Documents.
- 5) Review Contractor's Training Plan and provide comments to the Owner.
- 6) Approve technical requirements for correction of Deficiencies identified during Commissioning, Deferred Tests, and during the warranty period.
- 7) Review Operating and Maintenance Manuals and provide comments to the Owner.

E. Contractor's Roles and Responsibilities:

- 1) Contractor shall review and provide comments on documents produced by the Commissioning Authority, and shall accept the Commissioning Plan, System Verification Checklists, Functional Performance Test Procedures, and Integrated System Test Procedures as approved by the Owner.
- 2) Provide an individual, subject to the Owner's approval, experienced in construction and Commissioning of building systems to organize, schedule, conduct, and document the Contractor's responsibilities in the Commissioning process. The Contractor shall assign this individual to act as the Contractor's Commissioning Coordinator. The Contractor's Commissioning Coordinator may have additional duties such as MEP Coordinator, but not as Project Manager or Superintendent. Submit qualifications demonstrating the Commissioning Coordinator's technical expertise and experience to the Owner for approval. In the event that Contractor chooses to subcontract its Commissioning obligations, then Contractor must submit the subcontractor's qualifications and personnel to Owner for Owner's approval.
- 3) Furnish and install systems that meet all requirements of the Contract Documents.
- 4) Ensure that Commissioning Process activities are incorporated into the Master Project Schedule. The Contractor shall coordinate with the CxA and the Owner to determine the required activities, durations and predecessors.
- 5) Submit inspection requests, start-up requests and all supporting documentation in accordance with

the Contract Documents, General Conditions, and Commissioning Plan.

- 6) Cooperate with Owner's representative(s), provide access to work and provide adequate labor, resources, and time for Commissioning.
- 7) Furnish copies of all shop drawings and submittals, manufacturers' literature, maintenance information, and any other information required for the Commissioning process. Contractor must submit to the Owner installation and checkout materials actually shipped inside equipment and actual field checkout sheet forms used by the factory or field technicians. This requirement does not supersede any additional requirements contained in the Contract Documents.
- 8) Schedule and conduct pre-installation meetings and pre-commissioning meetings with subcontractors and equipment suppliers related to Commissioning. Contractor must invite Architect/Engineer, Owner and CxA to attend the pre-installation meetings and pre-commissioning meetings.
- 9) Provide qualified personnel, including subcontractors as required, to fully perform the testing and operational demonstrations required by the Contract Documents and the Commissioning Plan, including any Deferred Testing or re-testing related to warranty work.
- 10) Correct deficiencies identified during any stage of the Commissioning process.
- 11) Coordinate with the CxA to develop the Training Plan and submit to the Owner for approval. Provide training to the Owner's personnel in accordance with the Contract Documents and the approved Training Plan. Coordinate with the Owner to schedule training sessions and coordinate subcontractor/vendor participation in all training sessions.
- 12) Perform Deferred Testing and make necessary amendments to Operating and Maintenance Manuals and as-built drawings for applicable issues identified during the Deferred Testing.
- 13) Perform system maintenance during construction as specified and recommended by the Owner and send the maintenance records to the Owner for Record.
- 14) Document the equipment as it arrives onsite to ensure that the submitted and received equipment is correct as it arrives onsite, including the completion of the system verification sections pertaining to the procurement process.

1.6. SYSTEMS TO BE COMMISSIONED

1.6.1. The following systems shall be commissioned according to the process defined in this Section:

1.6.1.1. Major HVAC Systems (100% including but not limited to the list below)

- 1.6.1.1.1 Air Handling Units
- 1.6.1.1.2 Fan Coil Units
- 1.6.1.1.3 Exhaust Fans
- 1.6.1.1.4 Supply Fans
- 1.6.1.1.5 Pumps
- 1.6.1.1.6 Chillers
- 1.6.1.1.7 Boilers

1.6.1.2. Terminal Units (10% Sampling)

1.6.1.3. Building Automation System

1.6.1.4. Lighting Controls - Occupancy Sensors (25% greater than 25 sensors installed, 100% less than 25 sensors installed)

- 1.6.1.5. Lighting - Daylight Controls (100%)
- 1.6.1.6. Lighting - Time Switch Controls (100%)
- 1.6.1.7. Normal and Emergency Power Systems

PART 2 - PRODUCTS

2.1. COMMISSIONING PLAN

- 2.1.1. Document developed by the CxA that provides the structure, schedule, and coordination plan for the Commissioning Process from the Pre-construction phase through the Occupancy Phase. The Commissioning Plan shall describe the project and systems to be commissioned, Commissioning Process activities and deliverables, procedures to follow throughout the process, specific roles and responsibilities for each participant, and general description of testing and verification methods.
- 2.1.2. The Commissioning Plan shall comply with the Owner's Project Requirements (OPR).
- 2.1.3. The Commissioning Team shall review the Commissioning Plan prior to the Pre-Commissioning Meeting and submit written comments or questions to the CxA to be addressed in the meeting.
- 2.1.4. Following the Pre-Commissioning meeting, the CxA shall incorporate all changes discussed and agreed upon in the Pre-Commissioning meeting and submit the Final Commissioning Plan to the Commissioning Team for approval and acceptance.
- 2.1.5. If changes to the Commissioning Plan are needed during the Commissioning Process, the CxA shall edit the plan and distribute to the Commissioning Team for approval and acceptance.
- 2.1.6. The Contractor's acceptance shall constitute acceptance of all parties sub-contracted to the Contractor. The Contractor shall ensure that all sub-contractors and vendors agree and accept the Commissioning Plan.

2.2. SYSTEM VERIFICATION CHECKLISTS

- 2.2.1. System Verification Checklists (SVCs) are important to ensure that the equipment and systems are connected and operational and that Functional Performance Testing proceeds without unnecessary delays. These checklists document the inspections and procedures necessary to take a piece of equipment from a static state into an operating state. These checklists augment the manufacturer's start-up checklists to provide a complete document from procurement to the start of Functional Performance Testing when combined.
- 2.2.2. The CxA shall develop the System Verification Checklist templates for review by the Cx Team. The Contractor, appropriate Subcontractors and Vendors shall support the CxA in development of SVCs for each system and components by providing any necessary supporting documentation as requested by the CxA and reviewing and commenting on the checklist templates in accordance with the Project Specifications and the Commissioning Plan.
- 2.2.3. Once the checklist templates are reviewed and accepted, the CxA will produce checklists for all equipment and components to be commissioned on the project utilizing an electronic commissioning database that is accessible via web portal or local field tool (i.e., iPad, tablet, laptop, etc.).
- 2.2.4. The CxA shall provide login access and training to the Contractor and other members of the Cx Team in the use of the electronic commissioning database.
- 2.2.5. The Contractor shall be responsible for completing the required sections of the System Verification

Checklists utilizing the electronic commissioning database and providing all supporting documentation via electronic transmittal to the CxA. Additional requirements for completion of the SVCs are included in this section and other technical sections of the Specifications.

- 2.2.6. Once equipment arrives on the project site, the Contractor or sub-contractors shall begin completing the individual checklists and continue throughout the installation process. The checklists are meant to be progressive and a tool for tracking progress.
- 2.2.7. Once the SVCs are electronically completed, the CxA will review and approve the checklists and supporting documentation and compile the information to include in the Final Commissioning Process Report.

2.3. FUNCTIONAL PERFORMANCE TESTING PROCEDURES:

- 2.3.1. The purpose of the Functional Performance Testing Procedures is to verify and document that the equipment and systems on the project individually perform in accordance with the requirements in the Contract Documents and meet the Owner's Project Requirements.
- 2.3.2. The CxA shall develop specific script-type test procedures to verify and document proper operation of each piece of equipment and system. The Contractor shall provide any supporting information to the CxA that may be needed including but not limited to product submittals, O&M information, and sequences of operation. Once developed, the CxA will issue to the Cx Team for review and comment.
- 2.3.3. The Commissioning Team shall review the Functional Performance Test procedures and submit written comments or questions to the CxA. The Contractor shall ensure that the sub-contractors and any vendors that would be involved with Functional Performance Testing review the procedures and provide comments.
- 2.3.4. The CxA will coordinate with the Cx Team to address any comments and produce the final FPT procedures for acceptance by the Cx Team. The Contractor's acceptance shall constitute acceptance of all parties sub-contracted to the Contractor.
- 2.3.5. The Contractor shall utilize the FPT procedures for any pre-testing activities prior to Functional Performance Testing.

2.4. INTEGRATED SYSTEMS TESTING PROCEDURES:

- 2.4.1. The purpose of the Integrated Systems Testing Procedures is to verify and document that all the integrated equipment and systems on the project perform together in accordance with the requirements in the Contract Documents and meet the Owner's Project Requirements.
- 2.4.2. The CxA shall develop specific script-type test procedures to verify and document proper operation of the integrated systems throughout the facility. The Contractor shall provide any supporting information to the CxA that may be needed including but not limited to product submittals, O&M information, and sequences of operation. Once developed, the CxA will issue to the Cx Team for review and comment.
- 2.4.3. The Commissioning Team shall review the Integrated Systems Testing procedures and submit written comments or questions to the CxA. The Contractor shall ensure that the sub-contractors and any vendors that would be involved with Integrated Systems Testing review the procedures and provide comments.
- 2.4.4. The CxA shall coordinate with the Cx Team to address any comments and produce the final IST procedures for acceptance by the Cx Team. The Contractor's acceptance shall constitute acceptance of all parties sub-contracted to the Contractor.

- 2.4.5. The CxA shall also develop the IST personnel matrix that will be utilized to track the individual testing teams involved with the IST. The CxA will distribute the matrix to the Cx Team so that the Contractor and Owner can assign the appropriate personnel to the appropriate teams.
 - 2.4.6. The CxA shall also host a coordination meeting prior to the IST to review the IST procedures, complete any final coordination, review safety procedures, and answer any questions.
 - 2.4.7. The CxA estimates there will be two Integrated Systems Tests on the project. The first will test the Data Center systems separately and the second will test the entire facility. Requirements of the testing are included in the respective technical sections of the Project Specifications.
 - 2.4.8. The IST procedures shall be utilized by the Contractor for any pre-testing activities prior to official Integrated Systems Testing.
- 2.5. TRAINING PLAN
- 2.5.1. Contractor, in coordination with Owner and CxA, shall develop the Training Plan with project specific requirements for Owner Training, after reviewing the different systems to be installed and commissioned. The purpose of the Training Plan is to specifically communicate the required content and training durations required by the Owner based upon the type of equipment and the Owner's past experience.
 - 2.5.2. The Contractor shall review all of the individual technical sections of this specification for specific training requirements.
 - 2.5.3. The Contractor shall coordinate with the Owner to ensure that the proposed training requirements meet the Owner's needs and expectations.
 - 2.5.4. The Contractor shall coordinate with the sub-contractors and vendors to ensure the Owner Training requirements can be achieved and gather any additional information or recommendations.
 - 2.5.5. Any changes to the training requirements in this specification must follow contractual protocols.
 - 2.5.6. The Training Plan shall include a list of systems and equipment for which training will be provided according to the three-tiered training approach outlined in the project specifications.
 - 2.5.7. All training sessions shall have a syllabus indicating the following as a minimum in addition to any other specification requirements:
 - 2.5.7.1. Session Objectives
 - 2.5.7.2. Proposed Instructor(s)
 - 2.5.7.3. Instructor Qualifications
 - 2.5.7.4. Training Materials that will be provided
 - 2.5.7.5. Location and durations of the various parts of the training session (i.e., Classroom, On-site, etc.)
 - 2.5.7.6. Applicable specification sections and O&M Manual sections
 - 2.5.7.7. Detailed outline of training session content
 - 2.5.8. The Contractor shall coordinate with the CxA to organize the systemic training sessions comparable

to the organization of the Systems Manual.

- 2.5.9. Owner training must be completed prior to the contractor obtaining substantial completion by the Owner.

2.6. FINAL COMMISSIONING PROCESS REPORT

- 2.6.1. The CxA shall prepare the Final Commissioning Process Report that will include the following:

- 2.6.1.1. Executive Summary

- 2.6.1.2. Participants and Roles

- 2.6.1.3. Brief building description

- 2.6.1.4. Overview of commissioning and testing scope

- 2.6.1.5. General description of testing and verification methods

- 2.6.1.6. Appendices with supporting information, issues log, and communications

- 2.6.2. The Contractor shall coordinate with the CxA to provide any additional information that may be needed to complete the Final Commissioning Process Report.

- 2.6.3. The Contractor shall resolve any outstanding commissioning items prior to the CxA preparing the final commissioning report.

- 2.6.4. The CxA shall issue the Final Commissioning Process Report to the Cx Team for review. The Owner shall approve the Final Commissioning Process report after any comments or discrepancies are resolved by the CxA.

PART 3- EXECUTION

3.1. PROJECT SCHEDULE

- 3.1.1. The Contractor shall integrate all Commissioning activities into the detailed Project Schedule. All parties will address scheduling problems and make necessary notifications in a timely manner to expedite the Commissioning Process.

3.2. COMMISSIONING TEAM MEETINGS

- 3.2.1. Upon obtaining Owner's approval of the Commissioning Plan, the CxA shall coordinate with the Cx Team to schedule, plan, and conduct a Pre-Commissioning Meeting with all parties involved in the Commissioning process. This meeting should include the major subcontractors, specialty manufacturers/suppliers, Architect/Engineer, Test, Adjust, and Balance (TAB) Firm, Electrical Testing Agency, and Owner's representatives as participants.

- 3.2.2. Contractor shall prepare for the Pre-Commissioning Meeting by supplying the following documents created by the CxA to all applicable sub-contractors and vendors: Commissioning Plan, Example System Verification Checklists, Example Functional Performance Test Procedures and Example Integrated Systems Test Procedures.

- 3.2.3. The CxA shall conduct the Pre-Commissioning Meeting and review all aspects of the Commissioning Plan and applicable specifications.

- 3.2.4. The Commissioning Plan shall be reviewed with all attendees and the scope of work discussed. Contractor should be prepared to distribute copies of the pertinent sections to the various subcontractors involved in the Commissioning process.
 - 3.2.5. The final outcome of the meeting shall be an understanding of the commissioning process, roles and responsibilities, and consensus acceptance of the Commissioning Plan by the Cx Team.
 - 3.2.6. The Contractor may request additional meetings with the CxA and individual sub-contractors to clarify roles, responsibilities and procedures as needed.
- 3.3. TEST EQUIPMENT
- 3.3.1. Contractor shall provide all specialized tools, test equipment and instruments required to execute start-up, checkout, and testing of equipment.
 - 3.3.2. All specialized tools, test equipment and instruments required to execute start-up, checkout, and testing of equipment shall be of sufficient quality and accuracy to test and/or measure system performance within specified tolerances. A testing laboratory must have calibrated test equipment within the previous twelve (12) months. Calibration shall be NIST traceable. Contractor must calibrate test equipment and instruments according to manufacturer's recommended intervals and whenever the test equipment is dropped or damaged. Calibration tags must be affixed to the test equipment or certificates readily available.
- 3.4. REPORTING
- 3.4.1. Beginning at the procurement stage for the equipment included in the Cx scope, the Contractor shall communicate at least monthly with all members of the Commissioning Team, keeping them apprised of construction progress and scheduling changes.
 - 3.4.2. Contractor shall submit Deficiency reports to the Owner within five (5) days of the deficiency occurrence. This includes responses to items noted by the Commissioning Authority.
- 3.5. DEFICIENCY RESOLUTION
- 3.5.1. The CxA shall document any issues noted during observation or testing activities in the Commissioning Issues Log (CxIL). The CxIL shall be distributed electronically to the Cx Team at regular intervals.
 - 3.5.2. The Contractor shall respond in writing to the CxA within 10 days to all new CxIL items regardless of the disposition. This response does not constitute a request for re-verification, only an acknowledgement of the outstanding item. The Contractor should utilize CxIL responses to update the Cx Team on the progress of deficiency resolution.
 - 3.5.3. The Contractor shall respond to the CxA and the Owner indicating CxIL items that are completed and ready for the CxA to verify completion.
 - 3.5.4. If any item indicated complete by the Contractor is found to be incomplete by the CxA upon re-verification the Contractor is responsible for all costs and additional compensation resulting from incomplete Cx Issues Log items.
- 3.6. REQUEST FOR ENERGIZING / START-UP OF EQUIPMENT
- 3.6.1. The Owner and/or Owner's representative may install lockout devices on equipment in addition to the Contractor's lockout / tagout devices once permanent power is connected to the facility. This lock would be removed once the proper start-up notification is received by the Owner and/or CxA, and the CxA has reviewed the appropriate SVCs and supporting documentation to verify the

equipment is ready for energizing and/or start-up.

- 3.6.2. These requirements do not supersede any additional requirements noted elsewhere in the Contract Documents or as required by applicable code authorities.
 - 3.6.3. Contractor shall notify Owner and CxA in writing to request initial energizing and/or start-up of equipment and systems at least 72 hours (not including weekends or holidays) prior to the scheduled start-up.
 - 3.6.4. Contractor shall complete the applicable sections of the System Verification Checklist(s) evidencing the Contractor's thorough inspection of the system and readiness for start-up activities as required by the Project Documents and the Commissioning Plan. Contractor shall submit required supporting documentation to the Owner and/or CxA, including but not limited to, factory testing reports, alignment reports, electrical testing reports and any other documentation required by the Project Documents prior to energizing and/or start-up.
 - 3.6.5. The CxA shall review the SVCs and supporting documentation within the 72-hour notice period and confirm in writing that the systems and equipment are approved to proceed with energizing and start-up.
 - 3.6.6. The CxA and/or owner may witness equipment energizing and/or start-up at the scheduled time, but witness is not required, unless noted elsewhere in the Specifications, as long as written approval is received as noted herein.
 - 3.6.7. Contractor shall perform Start-up under supervision of the responsible manufacturer's representative in accordance with manufacturer's instructions and Project Document requirements.
 - 3.6.8. Contractor shall complete all required factory start-up documentation and applicable items in the System Verification Checklists, prior to startup, to ensure compliance with the requirements in the Project Documents.
- 3.7. OPERATIONAL TESTING
- 3.7.1. Once the appropriate start-up activities are completed, the Contractor shall complete all necessary operational testing requirements included in the Project Documents prior to Functional Performance Testing. Specific requirements for systems and equipment are included in other technical sections of the Specifications.
 - 3.7.2. Contractor shall complete all operational testing items in the System Verification Checklist and submit all supporting documentation to the Owner and/or CxA for review.
 - 3.7.3. Contractor and manufacturer's representatives shall supervise and coordinate adjustments and balancing of all devices and systems for proper operation prior to requesting a Functional Performance Test(s).
 - 3.7.4. Contractor shall clearly list outstanding items or System Verification Checklist items not completed successfully. Contractor shall obtain from Subcontractor or vendor completed forms documenting any outstanding deficiencies within five (5) days of completion of energizing and/or start-up activities.
 - 3.7.5. Contractor shall review completed deficiencies to determine if outstanding items prevent execution of the Functional Performance Tests and shall issue any necessary responses to the Owner and/or Commissioning Authority.
 - 3.7.6. Contractor shall notify Owner and CxA in writing to request Functional Performance Testing of equipment and systems at least 72 hours (not including weekends or holidays) prior to the scheduled

activities. Owner may require Contractor to reschedule Functional Performance Testing to ensure availability of Owner's representative(s) as needed.

- 3.7.7. The CxA shall review the SVCs and supporting documentation within the 72-hour notice period and confirm in writing that the systems and equipment are approved to proceed with Functional Performance Testing.
- 3.7.8. If any item indicated complete by the Contractor is found to be incomplete by the CxA upon re-verification the Contractor is responsible for all costs and additional compensation resulting from incomplete System Verification Checklist items.

3.8. CONTROL POINT AND SENSOR CALIBRATION VERIFICATION

- 3.8.1. Automation systems installed on the project must be fully verified for point integrity and sensor calibration prior to Functional Performance Testing. Additional requirements for this verification are listed in other technical sections of the Specifications.
- 3.8.2. The Contractor shall verify these points according to the requirements in the project documents as part of start-up and operational testing of systems.
- 3.8.3. The TAB contractor shall independently verify each sensor and point and document the results to be included in the Final TAB Report.
- 3.8.4. The CxA will witness, at their discretion, this verification and/or independently verify and document the results to be included in the Final Commissioning Process Report.
- 3.8.5. These activities must be completed prior to the Contractor requesting Functional Performance Testing as indicated herein.

3.9. FUNCTIONAL PERFORMANCE TESTING

- 3.9.1. The objective of Functional Performance Testing is to demonstrate that each system operates according to the requirements in the Project Documents and meets the OPR and BOD.
- 3.9.2. Contractor shall operate, or cause to be operated, each system, device, or equipment item, both intermittently and continuously, for a duration period as indicated in the Specification Section(s) for each item and/or in accordance with the Project Documents, the Commissioning Plan and applicable Functional Performance Testing procedures.
- 3.9.3. Contractor shall operate each component device and each building system to the full extent of its capability, from minimum to maximum, and under automatic control and manual control.
- 3.9.4. The CxA and members of the Cx Team, including the Owner's personnel, may observe Functional Performance Testing of equipment components and systems. The CxA shall facilitate the Functional Performance Testing activities according to the accepted FPT procedures and record the results of all testing activities.
- 3.9.5. The CxA shall record any deficiencies noted during the testing in the CxIL. If significant deficiencies exist, the owner and/or CxA may request that the testing activities be terminated and re-scheduled after proper verification by the Contractor. The Contractor is responsible for all costs and additional compensation resulting from deficiencies and incomplete systems noted during scheduled Functional Performance Testing.
- 3.9.6. All Functional Performance Testing of Integrated Systems must be completed in accordance with the Project Documents and the Commissioning Plan prior to the Contractor scheduling the Integrated Systems Testing activities.

3.10. INTEGRATED SYSTEMS TESTING

- 3.10.1. The objective of Integrated Systems Testing is to demonstrate that each integrated system operates jointly and/or independently of other systems according to the requirements in the Contract Documents.
- 3.10.2. Contractor shall operate each system, jointly and independently of other systems, through selected modes of operation (fire alarm integration with HVAC, emergency power modes, equipment failures among related systems, etc.) according to the accepted Integrated Systems Testing procedures developed by the CxA. The CxA shall facilitate and document the testing, organizing the appropriate testing teams and providing sufficient instruction to all participants to conduct efficient and effective testing activities.
- 3.10.3. Integrated Systems Testing typically involves multiple teams with representation from the CxA, Owner, and Contractor. The Contractor shall provide any needed communication equipment (i.e., radios) or make available any centralized intercom or paging system for communication with all testing groups.
- 3.10.4. The Contractor shall provide no less than 7 days (not including weekends or holidays) notice when requesting to conduct the Integrated Systems Testing. All personnel must be assigned to the Personnel Matrix by the CxA and a coordination meeting held within the 7 day period as prescribed elsewhere in this section.
- 3.10.5. Contractor conducts Integrated Systems Testing after all applicable Functional Performance Testing is satisfactorily completed and approved by the Owner and/or CxA.
- 3.10.6. The CxA shall record any deficiencies noted during the testing in the CxIL. If significant deficiencies exist, the owner and/or CxA may request that the testing activities be terminated and re-scheduled after proper verification by the Contractor. The Contractor is responsible for all costs and additional compensation resulting from deficiencies and incomplete systems noted during scheduled Integrated Systems Testing.

3.11. DEMONSTRATION AND OWNER TRAINING

- 3.11.1. The Contractor, in coordination with Owner and CxA, shall develop the Training Plan with project specific requirements for Owner Training as required throughout various sections of the Project Specifications.
- 3.11.2. The specific requirements for scheduling and conducting the Owner Training are included in other sections of this Specification.
- 3.11.3. Owner Training activities shall not occur until the Training Plan is approved by the Owner and the Contractor has submitted all O&M information for review and use during the training sessions.
- 3.11.4. The Contractor shall notify the CxA of all training sessions. The Contractor shall record attendance of the training sessions and the Owner shall ensure the appropriate personnel are in attendance.
- 3.11.5. The CxA shall ensure the content of the Owner Training sessions meets the requirements in the Project Documents.
- 3.11.6. The CxA may conduct surveys of the Owner's personnel to gauge the effectiveness of the Owner training sessions. If unfavorable surveys are received by the Owner's personnel indicating unsatisfactory training, the Owner reserves the right to require the Contractor to re-train in those specific areas of non-conformance until the requirements in the Project Documents are satisfactorily completed.

- 3.11.7. Owner training must be completed prior to the contractor obtaining substantial completion by the Owner.
- 3.12. DEFERRED / SEASONAL TESTING
- 3.12.1. All Construction phase requirements of the Commissioning Process must be completed prior to Substantial Completion or as indicated elsewhere in this Specification.
- 3.12.2. If any testing or other requirements cannot be completed prior to Substantial Completion due to the building structure, required occupancy condition, or other condition, performance of such test may be delayed to later in the warranty period, upon approval of the Owner. Contractor shall reschedule testing according to the protocols described in this section and any other operational protocols prescribed by the Owner.
- 3.12.3. Contractor shall complete all outstanding commissioning requirements as part of this Contract during the warranty period. Contractor shall schedule all activities with Owner and/or CxA.
- 3.12.4. The CxA shall document any deferred testing activities and ensure the appropriate commissioning documents are updated. The Contractor shall provide any additional documentation needed by the CxA to complete these requirements.

END OF SECTION

SECTION 02 30 00

SUBSURFACE INVESTIGATION

CONDITIONS OF THE CONTRACT AND DIVISION 1, AS APPLICABLE, APPLY TO THIS SECTION.

PART 1 - GENERAL

2.01 THE FOUNDATION INVESTIGATION REPORT

- A. There are two Geotechnical Investigations, "Geotechnical Engineering Reports as follows:
 - 1. Entitled: Geotechnical Engineering Report, CFISD
Prepared for: *Cy-Fair Independent School District c/o Natex Architects*
Prepared by: *Terracon Consultants, Inc.*
Dated: September 27, 2024, Report No 92245368 and Report No 92245368.Supplement 1 dated November 12, 2024
- B. The boring plans, results of laboratory tests, and description of stratum for each test hole are enclosed in this Section. A complete copy of the Geotechnical reports are included herein.
- C. The Contractor is advised to review the Geotechnical Reports and visit the site to ascertain the conditions affecting the Work. In the event of discrepancies between the Drawings, Specifications, Geotechnical Reports, the Geotechnical reports shall take precedence. In the absence of a Geotechnical Report, discrepancies between the Drawings and Specifications shall be brought to the attention of the Architect for resolution. Failure to review the Geotechnical Reports and report all discrepancies, between the Geotechnical Reports and Drawings and Specifications, to the Architect will not relieve the Contractor from the responsibility to perform the work required by such documents, at no additional expense to the Owner.

2.02 SOIL CONDITIONS

- A. The conditions indicated in the reports were known to exist at the location shown on the date the tests were performed; however, these boring logs are for the Construction Manager's/Contractor's consideration only, and he shall visit the site and fully acquaint himself with the existing conditions and be prepared to complete all work required by the documents.

PART 2 - PRODUCTS

3.01 NOT USED

PART 3 - EXECUTION

4.01 NOT USED

END OF SECTION 02 30 00

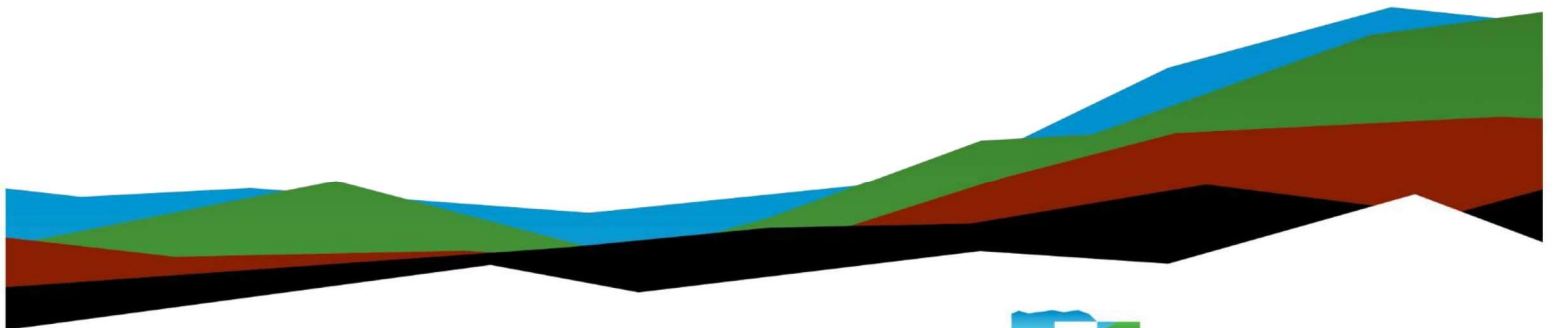
CFISD Cypress Lakes High School Building Additions

Geotechnical Engineering Report

September 27, 2024 | Terracon Project No. 92245368

Prepared for:

Natex Architects
10375 Richmond Avenue, Suite 225
Houston, Texas 77042



Nationwide
[Terracon.com](https://www.terracon.com)

- Facilities
- Environmental
- Geotechnical
- Materials



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September 27, 2024

Natex Architects
10375 Richmond Avenue, Suite 225
Houston, Texas 77042

Attn: Ms. Carolina Weitzman, AIA, LEED, President and CEO
P: (713) 975 - 9525
E: carolina@natexarchitects.com

Re: Geotechnical Engineering Report
CFISD Cypress Lakes High School Building Additions
5750 Greenhouse Road
Katy, Texas
Terracon Project No. 92245368

Dear Ms. Weitzman:

Terracon Consultants, Inc. (Terracon) is pleased to submit our geotechnical engineering report for the project referenced above in Katy, 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

(Texas Firm Registration No.: F-3272)

Ammar Ali, Ph.D.
Senior Staff Engineer

Rana Ravula

Ranadeep Ravula, P.E.
Group Manager

Bobbie Hood, P.E.
Senior Engineer



Table of Contents

- Introduction..... 1**
- Site Conditions 1**
- Project Description..... 2**
- Geotechnical Characterization 3**
 - Geology 3
 - Subsurface Profile..... 4
 - Laboratory Data 4
 - Groundwater Conditions..... 5
- Geotechnical Overview 5**
- Earthwork 7**
 - Site Preparation..... 7
 - Fill Material Types 8
 - Fill Compaction Requirements 9
 - Utility Trench Backfill..... 9
 - Grading and Drainage..... 9
 - Wet Weather/Soft Subgrade Considerations 10
- Foundation Systems 10**
 - Design Recommendations – Drilled-and-Underreamed Footings..... 11
 - Construction Considerations – Drilled-and-Underreamed Footings..... 12
 - Grade Beams – Drilled-and-Underreamed Footings..... 13
 - Design Recommendations – Post-Tensioned (PTI) Slab-on-Grade 13
 - Construction Considerations – Post-Tensioned Slab-on-Grade 15
 - Design Recommendations – Drilled Straight Shaft Foundations 15
 - Construction Considerations – Drilled Straight shafts..... 16
 - Foundation Construction Monitoring 18
 - Connection of Building Addition to Existing Building 18
- Floor Slabs 19**
- Detention Pond 20**
 - Excavation and Slopes 20
 - Erosion 21
 - Potential Use of Excavated Soils 21
- Pavements 21**
- General Comments 26**

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

Terracon Consultants, Inc. (Terracon) is pleased to submit our geotechnical engineering report for the proposed construction of a proposed improvements on a site located at 5750 Greenhouse Road in Katy, Texas. This project was authorized by Ms. Carolina Weitzman, AIA, LEED, President and CEO, of Natex Architects through signature of our “agreement for services” on August 12, 2024. This project was performed in general accordance with Terracon Document No. P92245368, dated August 1, 2024.

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
- Detention pond construction considerations
- Pavement design guidelines

The geotechnical engineering Scope of Services for this project included the advancement of eight 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 site is located within the existing Cypress Falls High School campus located at 5750 Greenhouse Road in Katy Texas. See Site Location .
Existing Improvements	The site was occupied by an existing school building, tennis courts, sports fields, and associated pavements at the time of our field program.

Item	Description
Current Ground Cover	Grass, weeds, concrete pavements, and scattered trees.
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 Improvements¹	<ul style="list-style-type: none"> ■ A two-story building addition with an approximate footprint of 875 square feet (sf) planned at the southeast end of the existing school building. ■ A single-story building addition with an approximate footprint of 19,250 sf planned at the southwest end of the existing school building. ■ A single-story greenhouse building with an approximate footprint area of 2,750 sf. ■ A new athletics field storage building with an approximate footprint of 1,600 sf. ■ Tennis courts and associated light poles. ■ A detention pond with a maximum depth of 8 feet and sideslope declinations of 4(horizontal): 1(vertical) or flatter is planned to be located south of the current school building. ■ Associated pavements.
Building Construction	Either steel-frame or concrete masonry unit (CMU) construction.
Finished floor Elevation	<ul style="list-style-type: none"> ■ Greenhouse and Athletics Buildings: Approximately one to two feet above existing grade. ■ Building Additions: Within approximately one foot above existing grade and to match the finished floor elevation to the existing building.
Maximum Loads (Assumed)	<ul style="list-style-type: none"> ■ Columns: 75 to 125 kips ■ Floor slab pressure: 125 pounds per square foot (psf)

Item	Description
Planned Foundation Systems	<ul style="list-style-type: none"> ■ Tennis Courts: Post-tensioned (PTI) slab-on-grade ■ Buildings: Drilled-and-underreamed footings ■ Light Poles: Drilled straight shafts
Pavements	<p>We understand portions of the existing pavements are planned to be replaced with a new rigid (concrete) pavement section. 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 and buses from time-to-time in driveway areas.</p>

1. Based on the information provided by the client.

Geotechnical Characterization

Geology

Based on the geologic maps published by the Bureau of Economic Geology, the site for the proposed project is located on the upper Lissie formation, sometimes denoted the Montgomery formation. The upper Lissie formation is heterogeneous, containing interbedded layers of clay, sand and silt. This formation was deposited in mid-Pleistocene time in shallow coastal river channels and flood plains.

The clay present in the formation has been preconsolidated by a process of desiccation. Numerous wetting and drying cycles have produced a network of randomly oriented and closely-spaced joints, which are sometimes slickensided, that is, have a shiny appearance when exposed. The joint pattern strongly influences the engineering behavior of the soil.

The sand layers vary in compactness from loose to very dense, and in thickness from a fraction of an inch to many feet due to an irregular depositional environment. Sands are generally subrounded to subangular and vary from coarse to very fine, are poorly graded, and often contain significant amounts of silt-sized particles in the sand matrix.

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 and B-2 and was measured to be approximately 5 inches thick.

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	tan and dark gray, with ferrous stains and calcareous nodules
2	Lean Clay and Sandy Lean Clay	light gray and reddish brown, medium stiff to hard, with sand seams, ferrous stains and calcareous nodules
3	Fat Clay	light gray and reddish brown, very stiff, with sand pockets, ferrous stains, calcareous nodules, and slickensides
4	Silty Sand	light gray and reddish brown, medium dense, with clay pockets

Laboratory Data

Hydrometer tests were performed on two soil samples from borings B-6 and B-7 drilled in the area of the proposed tennis courts. Results of the hydrometer tests are presented in the table below.

Hydrometer Analyses				
Boring No.	Sample Depth (feet)	Description	Percentage Fines (%) ¹	Percent Finer Than 2 Microns (%) ²
B-6	4 to 6	Sandy Lean Clay (CL)	68	26

Hydrometer Analyses				
Boring No.	Sample Depth (feet)	Description	Percentage Fines (%) ¹	Percent Finer Than 2 Microns (%) ²
B-7	2 to 4	Sandy Lean Clay (CL)	68	20

1. Percent passing the No. 200 sieve.
2. Computed clay content of the soils has been used for the computation of the edge and center lift movements for the design of post-tensioned slabs-on-grade.

Groundwater Conditions

Borings B-1 through B-8 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. Groundwater was not observed at borings B-1 through B-8 during or upon completion of drilling.

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 structure may be present within the depths explored. 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 beneath the existing pavement at borings B-1 and B-2 and extended to a depth of about 2 feet. Fill soils were observed at the surface at borings B-3 and B-4 and extended to depths that ranged from about 2 to 4 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 structure areas to expose the underlying native subsurface soils. Select fill soils should be used to raise grade up in the proposed structure areas.
- Expansive soils were observed at this site. This report provides recommendations to help reduce the effects of soil shrinkage and expansion. However, even if these procedures are followed, some movement and distress in the structures should be anticipated. The severity of distress will increase if any modification of the site results in excessive wetting or drying of the expansive soils. Eliminating the risk of movement associated with expansive soils may not be feasible. However, this risk can be significantly reduced if the structures are designed as a structural slab over a void space with the structural loads supported by a foundation system terminated below the active zone. Terracon can provide recommendations for this option, if requested.
- A foundation system consisting of drilled-and-underreamed footings may be utilized to support the proposed building additions and buildings planned at this site.
- A post-tensioned (PTI) slab-on-grade foundation system may be utilized to support the proposed tennis courts planned at this site.
- A foundation system consisting of drilled straight-shafts may be utilized to support the proposed light poles planned at this site.
- A minimum 24-inch thick select fill pad should be placed under the proposed building additions and buildings to provide uniform support to the floor slab and reduce the estimated Potential Vertical Rise (PVR) of the subgrade to approximately one-inch or less.
- The PTI design parameters provided in this report are based on existing soil conditions and/or soils with similar characteristics as the on-site soils. Import fill, if planned to raise grade at the site for a post-tensioned slab-on-grade, should have similar classification, moisture content, and density as the adjacent in-situ soils and may be used provided it is free of organics and debris.
- Based on the soil conditions observed at boring B-8, which were drilled in the proposed detention pond area, these soils should support sideslopes for the anticipated maximum excavation depth of 8 feet with sideslope declinations of 4(horizontal):1(vertical) or flatter.
- Based on the soil and groundwater information obtained during our field activities, we anticipate that excavations for the detention pond that extend into the near surface clay soils may occur without advance dewatering. Groundwater seepage from

the clay soils is expected to be minor and can likely be managed by pumping water collected with sumps positioned in the bottom of the excavation.

- 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, detention pond, and pavements.

Site Preparation

Construction areas should be stripped of vegetation, topsoil, trees, existing pavements, and other debris/unsuitable surface material. Roots of trees to be removed within the construction areas should be grubbed to full depths. Care should be taken to replace or recompact all soil removed or loosened by the removal of tree roots and stumps as recommended in subsequent paragraphs. 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.

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

Once final subgrade elevations have been achieved, the exposed subgrade should be 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.

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 floor slabs and for all grade adjustments within the structure areas.
On-site Soils	Varies	<ul style="list-style-type: none"> ■ 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. ■ PTI structure area should be accomplished with on-site soils or exhibiting similar classification, moisture content, and density as the adjacent in-site soils 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.
Compaction Requirements	<ul style="list-style-type: none"> ■ 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. ■ The select fill soils should be moisture adjusted to within 2 percent of the optimum moisture content. ■ The on-site clay soils should be moisture conditioned to between optimum and +4 percent of the optimum moisture content.

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. 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 structures during and after construction. Water permitted to pond next to the structures can result in distress in the building. 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 structures for at least 10 feet beyond the perimeter of the structures. After building construction and landscaping, we recommend verifying final grades to document that effective drainage has been achieved. Grades around the structures should also be periodically inspected and adjusted as necessary, as part of the structures maintenance program.

Planters located within 10 feet of the proposed structures 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 structures lines. Low-volume, drip-style landscaped irrigation should not be used near the building. Collect roof runoff in drains or gutters. Discharge roof drains and downspouts onto pavements and/or flatworks which slope away from the proposed building or extend down spouts a minimum of 10 feet away from structures.

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 drilled-and-underreamed footings may be utilized to support the proposed building additions and buildings planned at this site, provided the subgrade is properly prepared as described in this report. A foundation system consisting of a PTI slab-on-grade may be utilized to support the proposed tennis court. A foundation system consisting of drilled straight shafts may be utilized to support the proposed light poles planned at this site. Recommendations for these types of foundation

systems are provided in the following sections, along with other geotechnical considerations for this project.

Design Recommendations – Drilled-and-Underreamed Footings

Item	Description
Minimum Embedment Depth ¹	10 feet below existing grade (grade at the time of our field program)
Allowable Bearing Pressures ²	Net dead plus sustained live load – 4,000 psf Net total load – 6,000 psf
Maximum Underream-to-Shaft Diameter Ratio	3:1
Minimum Underream-to-Shaft Diameter Ratio ³	2:1
Estimated Uplift Pressure Due to Post-Construction Heave of the Clay Soils ⁴	1,000 psf
Minimum Percentage of Steel ⁵	0.5 percent
Approximate Post-Construction Settlement ⁶	One inch or less
Estimated Differential Settlement ⁷	Approximately ½ of post-construction settlement
Allowable Passive Pressure ⁸	1,000 psf
Uplift Resistance ⁹	Foundation Weight (150 pcf) & Soil Weight (120 pcf)

1. The footings should extend through the fill soils and bear within the native undisturbed clay soils. If possible, the footings should bear at the same depth as the existing footings.
2. Whichever condition yields a larger bearing area.
3. This minimum underream-to-shaft diameter ratio should result in a large enough diameter of the underream to overcome uplift forces on the footing without casing local soil failure to the overlying soils.
4. The magnitude of uplift is difficult to predict and will vary with in-situ moisture contents. This uplift pressure can be approximated over the entire perimeter of the shaft above the top of the underream.
5. The footings should contain sufficient vertical reinforcing steel throughout the entire shaft length to resist uplift (tensile) forces due to post-construction heave of the clay soils. The amount of reinforcing steel required can be computed by assuming that the dead load of the structure surcharges the footing, that the above estimated tensile force acts vertically on the shaft, and that the underream acts as a rigid anchor.
6. This estimated post-construction settlement of the drilled-and-underreamed footings is without considering the effect of stress distribution from adjacent foundations and assuming proper construction practices are being followed. A clear distance between the footings of one underream diameter of the larger footing (new and existing) should be provided between the underreams to develop the recommended bearing pressures and to control settlements. If a

Item	Description
	clearance of one diameter cannot be maintained in every case, the above bearing capacities should be reduced by 20 percent for a clearance between one half and one underream diameters. Underreams closer than a clearance of one half of an underream diameter are not recommended.
7.	The differential settlement will result from variances in subsurface conditions, loading conditions and construction procedures, such a cleanliness of the bearing area or flowing water in the shaft.
8.	For footings placed against an undisturbed vertical face of the in-situ soils. Lateral resistance of the drilled-and-underreamed footings is primarily developed by passive resistance of the soils against the side of the footing. Due to surface effects and the presence of fill and expansive soils, the lateral resistance of the upper 4 feet of the soils at the surface for exterior footings should be neglected unless area paving is provided up to the edge of the structures.
9.	Structural uplift loads on the drilled-and-underreamed footings will be resisted by the dead weight of the footings and supported structure plus the weight of a soil wedge above the footing. The soil wedge can be assumed to extend upward from the bottom of the underream at a slope of 4 vertical to 1 horizontal.

Construction Considerations – Drilled-and-Underreamed Footings

Drilled excavations to a depth of 10 feet below existing grade will be necessary for installation of drilled-and-underreamed footings for the proposed structures planned at this site. The excavations should be performed with equipment capable of providing a relatively clean bearing area. The presence of secondary structures such as sand pockets and seams, ferrous stains, slickensides, and calcareous nodules, etc., can cause sloughing during footing excavation. Thus, the drilling contractor should have casing available in the event that sloughing causes improperly formed shafts.

Based on our groundwater observations (refer to **Groundwater Conditions**), groundwater is not expected to be a major concern during construction at the recommended bearing depth. However, depending on climatic conditions, groundwater levels may vary from the levels observed during our field program. Water must not be allowed to accumulate in the bottom of the footing excavations. The contractor should be prepared to remove water from the drilled footings, if necessary. To reduce the potential for water seepage into the footing excavation and to minimize disturbance to the bearing area, we recommend that concrete and steel be placed as soon as possible after footing excavations are completed. Preferably, footing excavations should be backfilled with concrete within about 2 to 4 hours of completion of the drilling and in no case should an excavation be left open overnight. The concrete placed in the excavations should have a 6-inch slump with a plus or minus one inch tolerance. The bottom of each footing excavation should be free of all loose materials and/or water, and the bearing surface should be evaluated immediately prior to placing concrete.

Based on the available field and laboratory data, the underreams constructed as described in this report should remain stable for a short period of time. However, if

underreams are marginally stable due to water seepage and/or the presence of sloughing soils, successful construction of underreamed footings may be possible by performing the sequence of construction without interruption, that is, each footing drilled, underreamed, and backfilled with concrete in one continuous operation. The contractor must coordinate the operation very closely to have concrete on site at the time each footing is drilled and underreamed so that no shaft or underream is drilled without concrete standing by, ready to be placed. Additional measures to reduce the potential for caving of the underream would be to limit the underream-to-shaft diameter ratio to 2.5:1 or 2:1 or to install straight shaft footings in isolated problem areas. If straight-shaft footings are planned at the site, Terracon should be contacted for additional recommendations.

Grade Beams – Drilled-and-Underreamed Footings

Grade beams associated with the drilled-and-underreamed footings and a grade-supported floor slab should be designed to span between the footings without subgrade support. We understand the grade beams are planned to be constructed without a void space. However, due to the underlying clay soils, nominal upward movement of the grade beams may occur during moisture variations of the subgrade.

Backfill against the outside face of the grade beams should consist of select fill used to prepare the building pad. The select fill should be uniformly compacted to at least 95 percent of the Standard Effort (ASTM D 698) maximum dry density at a moisture content within 2 percent of optimum moisture content.

Design Recommendations – Post-Tensioned (PTI) Slab-on-Grade

Based on our analysis of the field and laboratory data, design parameters were computed using Addenda No. 1¹ and No. 2² to the 2004 Post-Tensioning Institute (PTI) method for slab-on-grade design. The moisture beneath a shallow foundation will change in response to wetting and drying conditions around the foundation perimeter. The maximum moisture variation distance is termed the edge moisture variation distance, e_m , and is an important factor governing the design of a post-tensioned floor slab. The e_m is related to percent fine clay and climatic conditions as well as other parameters, such as soil fabric factor and unsaturated diffusion coefficient.

¹. Post-Tensioning Institute, "Addendum No. 1 to the 3rd Edition of the Design of Post-Tensioned Slabs-on-Ground", Post-Tensioning Institute, Phoenix, AZ, May 2007.

². Post-Tensioning Institute, "Addendum No. 2 to the 3rd Edition of the Design of Post-Tensioned Slabs-on-Ground", Post-Tensioning Institute, Phoenix, AZ, May 2008.

The plasticity index of the soil, type and amount of clay mineral in the soil, and the moisture conditions from the time of construction through the life of the structure are parameters that should be considered in design of a slab-on-grade. The plasticity index and the clay mineral are values of the soil that can be estimated by laboratory tests and, although variable from location to location, remain relatively constant with time. The moisture condition has a significant effect on slab behavior and is highly variable with time, changing seasonally, with annual climate conditions, drainage patterns, ground cover, and vegetation (trees and shrubs).

Based on our laboratory test data and on our experience with similar soils, the post-tensioned slabs at this site should be designed using criteria outlined by the Post-Tensioning Institute using the following parameters:

Item	Description
Depth of Seasonal Moisture Change	Approximately 9 feet
Effective Plasticity Index	22
Percent Finer than 2 Microns ¹	20 to 25
Soil Fabric Factor	1.0
Approximate Thornthwaite Moisture Index ²	+15
Estimated Constant Soil Suction, pF	3.5 pF
Range of Soil Suction, pF ²	3.0 to 4.5 pF
Estimated Edge Moisture Variation Distance, e_m ³	For center lift: 9.0 feet For edge lift: 4.7 feet
Estimated Differential Soil Movement, y_m ³	For center lift: 0.7 inch For edge lift: 0.4 inches
Allowable Bearing Capacity ⁴	Dead load plus sustained live load: 1,000 psf Total net load: 1,500 psf

1. For varying soil properties to 9 feet.
2. The differential movements were calculated by modeling the soil profile using the commercial software program VOLFLO as recommended by the PTI manual. Based on a Thornthwaite Index of +15 for this site, we considered the Post-Equilibrium Case to determine the Stress Change Factor (SCF). As recommended by the PTI manual, a suction change of 1.5 pF was used for the analysis for the Post- Equilibrium Case.
3. The estimated movements do not consider the effects of non-climatic factors which might arise from conditions beyond the control of Terracon. The conditions include, but are not limited to, location of planters and trees around the building, poor drainage, and operations of the owner/contractor on the site subsequent to our explorations.
4. Provided the subgrade is prepared as recommended in the **Earthwork** section of this report.

Post construction settlements for the slab foundation described in this subsection should be one inch or less, provided the site is prepared as described in this report. Settlement response of the foundation system is expected to be influenced more by the quality of construction and fill placement than by soil-structure interaction.

Construction Considerations – Post-Tensioned Slab-on-Grade

The excavations for slab should be performed with equipment capable of providing a relatively clean bearing area. The bottom 6 inches of the planned foundation excavations should be performed using a smooth-mouthed excavation bucket or hand labor. The excavations should be neatly excavated and properly formed. Debris in the bottom of the excavations should be removed prior to steel placement. Water should not be allowed to infiltrate foundation excavations.

To reduce the potential for groundwater seepage into the excavations and to minimize disturbance to the bearing area, we recommend that steel and concrete be placed as soon as possible after the excavations are completed and properly cleaned. Excavations should not remain open overnight. The bearing surface of the foundation should be evaluated upon completion of the excavation and immediately prior to placing concrete.

Design Recommendations – Drilled Straight Shaft Foundations

The drilled straight shafts planned for the proposed light poles should be designed to resist both horizontal and vertical forces. Horizontal forces can be resisted by the passive pressure of soil acting on the vertical face of the drilled straight shafts. Vertical downward forces can be resisted by the allowable end bearing pressure of the soils at the bottom of the drilled straight shafts. Vertical uplift forces can be resisted by the dead weight of the poles and its foundation. When foundation concrete is cast in direct contact with excavation sides, an allowable side friction value can also be used to resist vertical loads.

The allowable design criteria for utilization of drilled straight shafts as the foundation system for the proposed light poles are presented in the following table. The table includes the effective soil unit weights, shear strength parameters, allowable end bearing pressure, lateral passive pressure and side friction values. Furthermore, the lateral subgrade modulus values are provided for the cyclic and static loading conditions. Care should be exercised to utilize the appropriate loading condition in the analysis.

The design parameters presented in the table below are applicable for the natural undisturbed soils. The capacities within the upper 4 feet of the on-site soils should be disregarded for end bearing and side friction to account for surface effects and anticipated disturbance during foundation installation. Drilled straight shaft foundations should extend at least 2 feet or one-half the shaft diameter, whichever is greater, into the desired bearing strata in order to use the

recommended allowable end bearing pressures. We assumed no groundwater for the design parameters provided below.

Long-term settlement of the drilled straight shaft foundation, designed and constructed in accordance with the recommendations presented in this report, should be about one inch or less.

Design Parameters for Drilled Straight Shaft Footings								
Below Existing Grade (feet) ¹	Effective Unit Weight (pcf)	Allowable Unit Skin Friction Resistance (psf) ³	Allowable End Bearing Pressure (psf) ²	Lateral Subgrade Modulus (pci) ⁴		Strain ϵ_{50} (in/in)	Undrained Shear Strength (psf)	Angle of Internal Friction (degree)
				Static	Cyclic			
0 to 4	120			Disregard				
4 to 10	120	275	3,000	500	175	0.007	1,000	---
10 to 23	120	500	6,000	700	275	0.007	2,000	---
23 to 30	120	600	6,000	90	90	---	---	30

1. Grade at the time of our field program.
2. The net allowable end bearing pressure refers to the pressure at the foundation bearing level in excess of the surrounding overburden pressure. A minimum penetration of 4 feet or one-half a shaft diameter, whichever is greater, into the desired bearing strata should be achieved with a minimum of 4 feet of the selected bearing stratum beneath the shaft tip to use the recommended allowable end bearing pressure.
3. The allowable side friction is based on a rectangular pressure distribution.
4. The lateral subgrade modulus values are provided for static and cyclic loading conditions. An appropriate loading condition should be selected for analysis.

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 systems for the proposed structures 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 foundations 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 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 additions, and the performance of the foundation system of the existing structure. Therefore, any members or connections of the building

additions 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 structures were not available at the time of this report. We anticipate that the finished floor elevation of the proposed building additions is planned to be within about one foot above existing grade and to match the finished floor elevation of the existing building. We anticipate that the finished floor elevation of the proposed buildings and tennis court to be within one to two feet above the existing grade. 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 at this site generally exhibited a low to medium expansion potential. These soils can subject the interior floor slab of the building to significant movements (due to shrinking and swelling) with fluctuations in their moisture content. This movement potential is influenced primarily by the properties of the subgrade soils, as well as the moisture content of the subgrade at the time of construction, overburden pressures, and the stability of the moisture contents throughout the life of the building. 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 1¾ inches. Therefore, we highly recommend that the near-surface soils be prepared as stated below to reduce the potential for slab movement associated with volumetric changes of the near-surface clay soils due to moisture variations to a more acceptable level. The actual movements could be greater if poor drainage, ponded water, and/or other sources of moisture are allowed to infiltrate beneath the structure after construction.

The most common method of subgrade preparation to reduce potential expansion of the subgrade would be to provide a pad of properly placed and compacted select fill beneath the grade-supported floor slabs. The corresponding decrease in the potential soil movements is primarily a function of the fill pad thickness and the moisture levels of the underlying clay subgrade. While the indicated preparations do not eliminate the potential for soil movement, the magnitude of such movements should be reduced to more acceptable levels. To provide uniform support to the floor slab and to reduce the estimated PVR to approximately one inch or less, we recommend that a minimum 24 inches of properly placed and compacted select fill material be constructed immediately beneath the floor slabs. The select fill pad should extend a minimum of 5 feet beyond the edge of the structure area. This overbuild requirement may be omitted where the building addition is located immediately adjacent to the existing building. The final

exterior grade adjacent to the structure should be sloped to promote effective drainage away from the structure.

Select fill should be utilized for all grade adjustments within the proposed structure 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.

The subgrade soils for flatwork outside of the structure which will be sensitive to movement should be prepared as discussed previously. This preparation will be important on surrounding sidewalks and paving immediately adjacent to the structure. If these adjacent flatwork areas are not prepared as stated above for the structure areas, the estimated PVR for these areas could approach those indicated previously for in-situ conditions. If the soils swell in these areas, this movement could result in significant distress to the adjacent sidewalks and paving and possibly result in reversed drainage (flow of runoff toward the structure) around the perimeter of the structure.

Detention Pond

Based on the information provided to us, we understand that a detention pond is planned to be constructed in the eastern portion of the site. As stated previously, we understand that the proposed detention pond is planned to have a maximum depth of 8 feet with sideslopes no steeper than 4(horizontal):1(vertical). The following paragraphs present our recommendations regarding excavation of the detention pond sideslopes, erosion concerns, and potential use of excavated soils as fill.

Excavation and Slopes

Based on the soil conditions observed at boring B-8, which was drilled in the proposed detention pond area, these soils are generally consisted of very stiff to hard clays soils. These soils should support sideslopes for the anticipated maximum excavation depth of 8 feet with sideslope declinations of 4(horizontal):1(vertical) or flatter. If the initial proposed depth of 8 feet is planned to be exceeded or if the sideslopes are planned to be steeper than 4(horizontal):1(vertical), Terracon should be notified for additional services.

Groundwater was not observed at boring B-8 during or upon completion of drilling. Therefore, groundwater is not expected to be a major concern during construction. However, depending on climatic conditions, groundwater levels may vary from the levels observed during our field program and minor seepage from the inclusions in the near-surface clay soils could be observed within the pond's excavation depth, but we anticipate that the minor seepage can be handled with sumps and pumps positioned in the bottom of the excavations.

The suggested method given above serves as a guideline for groundwater control; other appropriate means may be required for groundwater control during the construction. Control of groundwater should be accomplished in a manner that will preserve the strength of the soils; will not cause instability of the excavation; and will not result in damage to existing structures, if any.

As stated previously, the groundwater levels will fluctuate with seasonal and climatic changes and should be evaluated just prior to construction. To evaluate the groundwater conditions in the area of the proposed ponds, piezometers may be installed or trenches or pits may be excavated to the planned excavation depth. Based on those results, the contractor should determine effective methods of groundwater management prior to starting excavation operations.

Erosion

If water flow is permitted along the sideslopes of the pond, the surficial soils will likely erode, causing gradual steepening and subsequent sloughing of the sideslopes. Therefore, the sideslopes should be protected against sheet flow down the banks or concentrated high velocity water flow. Measures to protect the sideslopes may include slope paving, rip-rap, geofabrics, or even vegetation with an aggressive root system. Routine maintenance of the sideslopes should be performed to reconstruct areas where sloughing and/or erosion have occurred.

Potential Use of Excavated Soils

The subsurface soils observed at boring B-8 (within the area of the proposed detention pond) generally consisted of medium plasticity clay soils (with plasticity indices that ranged from 13 to 27 percent) to the anticipated excavation depth (8 feet) of the proposed detention pond. These soils may be used for grade adjustments in the pavement areas provided they are free of organics and debris.

Pavements

Once the subgrade is properly prepared, a rigid pavement system 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 should be chemically treated with lime. 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.

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 rigid 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.

Lime Treated Subgrade – The on-site soils 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.

The pavement design methods described above are intended to provide structural sections with adequate thickness over a particular subgrade such that wheel loads are reduced to a level the subgrade can support. The support characteristics of the subgrade for pavement design do not account for shrink/swell movements of an expansive clay subgrade such as the soils encountered at this site. Thus, the pavement may be adequate from a structural standpoint, yet still experience cracking and deformation due to shrink/swell related movement of the subgrade. Post-construction subgrade movements and some cracking of pavements are not uncommon for clay subgrade conditions such as those observed at this site. Reducing moisture changes in the subgrade is important to reduce shrink/swell movements. 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

Geotechnical Engineering Report

CFISD Cypress Lakes High School Building Additions | Katy, Texas

September 27, 2024 | Terracon Project No. 92245368



excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing.

Geotechnical Engineering Report

CFISD Cypress Lakes High School Building Additions | Katy, Texas

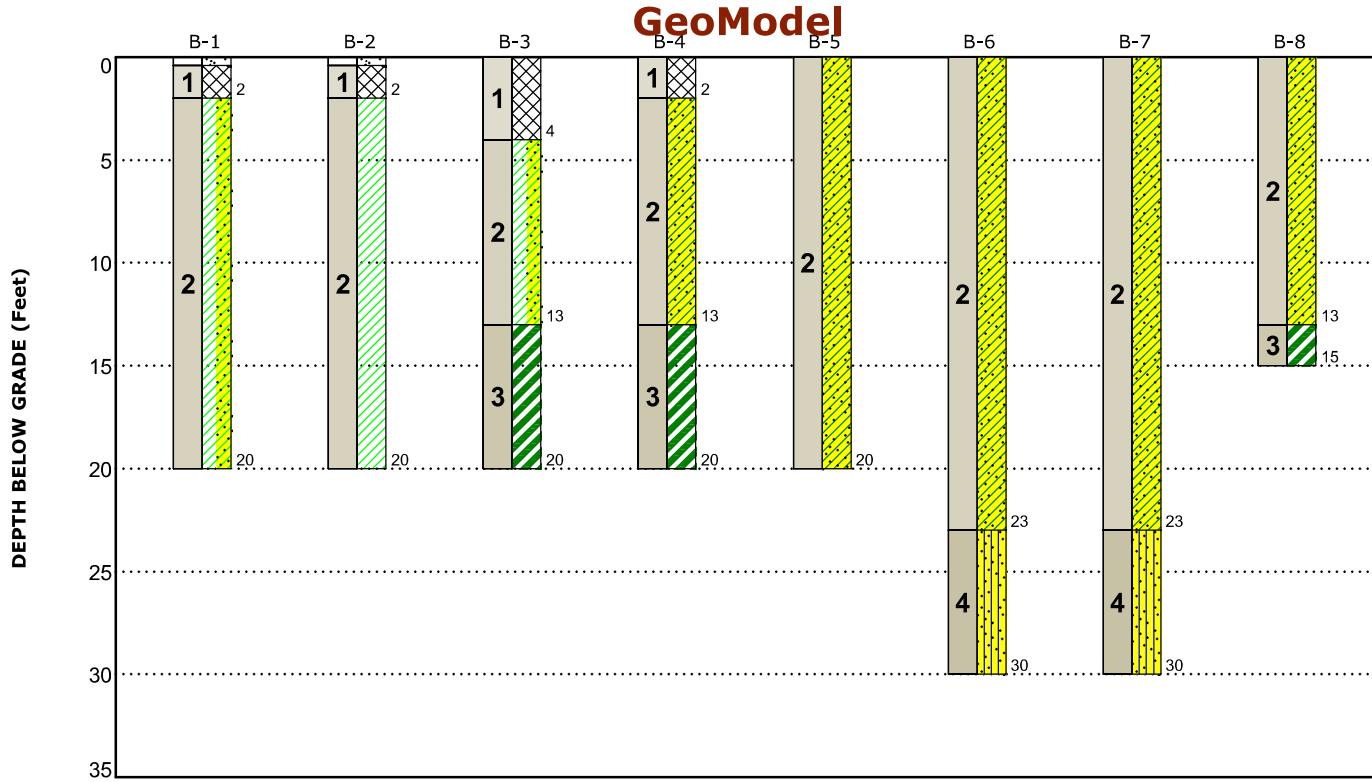
September 27, 2024 | Terracon Project No. 92245368



Figures

Contents:

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	Legend	
1	Fill: Sandy Lean Clay	tan and dark gray, with ferrous stains and calcareous nodules	Pavement	Fill
2	Lean Clay and Sandy Lean Clay	light gray and reddish brown, medium stiff to hard, with sand seams, ferrous stains, and calcareous nodules	Lean Clay with Sand	Lean Clay
3	Fat Clay	light gray and reddish brown, very stiff, with sand pockets, ferrous stains, calcareous nodules, and slickensides	Fat Clay	Sandy Lean Clay
4	Silty Sand	light gray and reddish brown, medium dense, with clay pockets	Silty Sand	

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

CFISD Cypress Lakes High School Building Additions | Katy, Texas

September 27, 2024 | Terracon Project No. 92245368



Attachments

Exploration and Testing Procedures

Field Exploration

Number of Borings	Approximate Boring Depth (feet)	Location
3 (B-1 through B-3)	20	Proposed building addition areas
1 (B-4)	20	Proposed greenhouse building area
1 (B-5)	20	Proposed athletics storage building area
2 (B-6 and B-7)	30	Proposed tennis court and light pole areas
1 (B-8)	15	Detention pond area
8	175	Total

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 upon completion. Excess auger cuttings were dispersed in the general vicinity of the borings. 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, or grout the borings 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

CFISD Cypress Lakes High School Building Additions | Katy, Texas
September 27, 2024 | Terracon Project No. 92245368

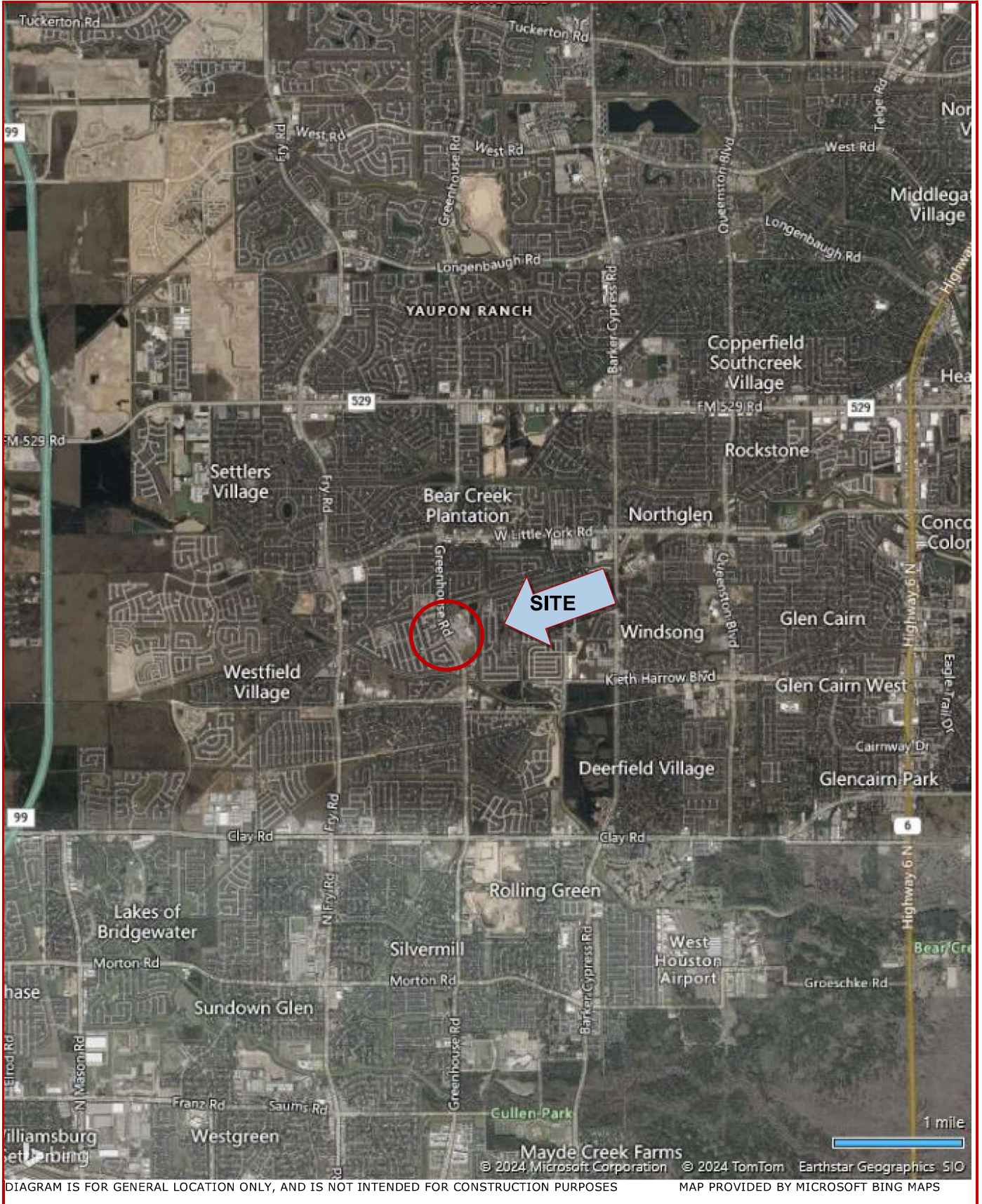


Site Location and Exploration Plans

Contents:

Site Location Plan
Exploration Plan

Site Location



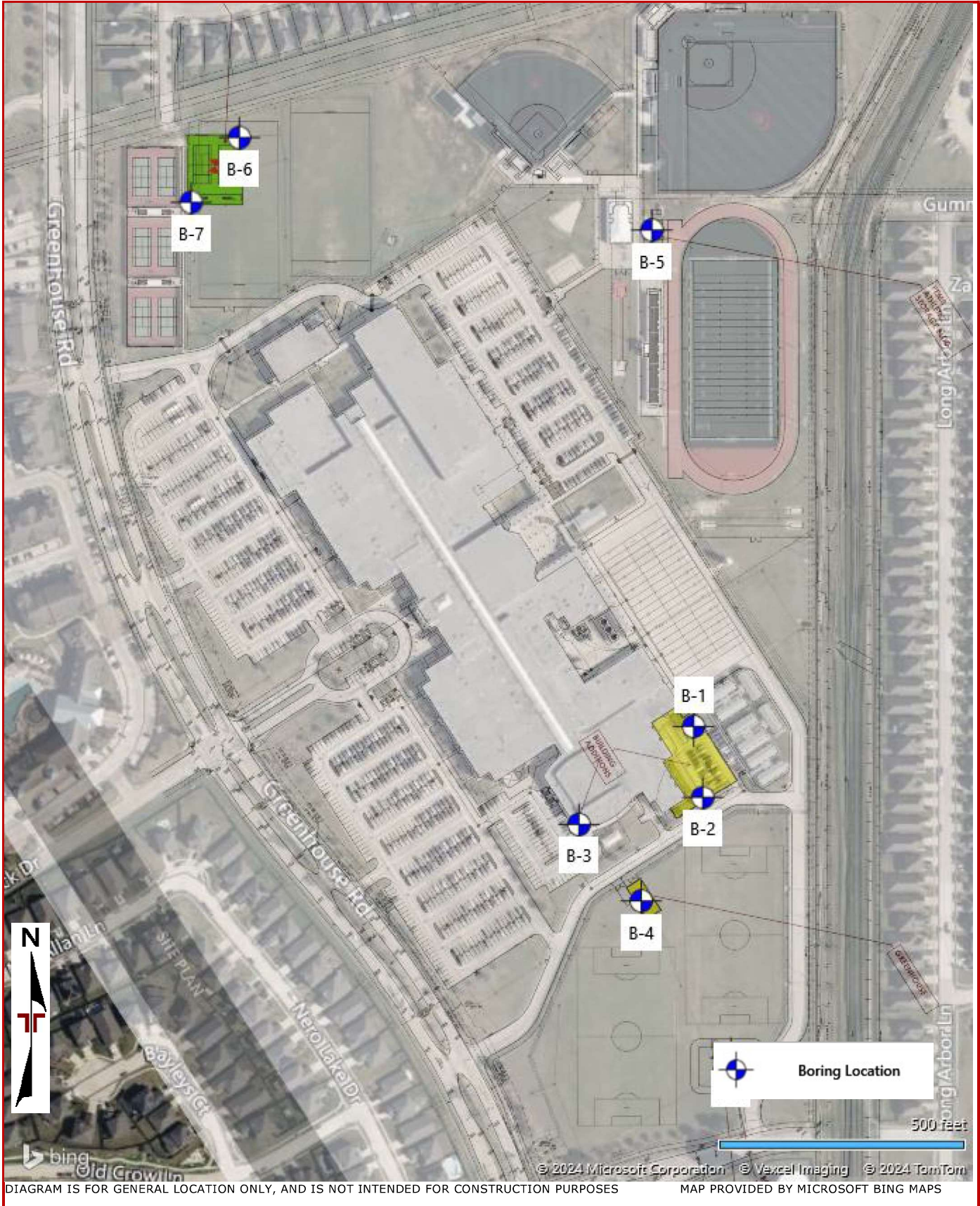
Geotechnical Engineering Report

CFISD Cypress Lakes High School Building Additions | Katy, Texas

September 27, 2024 | Terracon Project No. 92245368



Exploration Plan



Exploration and Laboratory Results

Contents:

Boring Logs (B-1 through B-8)

Boring Log No. B-1

Graphic Log	Location: See Exploration Plan Latitude: 29.8533° Longitude: -95.7020°	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 (%)				
0.4	PAVEMENT , approximately 5 inches of concrete											
2.0	FILL - SANDY LEAN CLAY (CL) , tan and dark gray, with ferrous stains				3.0 (HP)			21.8		39-23-16		
	LEAN CLAY WITH SAND (CL) , light gray and reddish brown, medium stiff to very stiff - with ferrous stains 2 to 13 feet	5			3.0 (HP)							
		5			1.0 (HP)			12.5		22-14-8		
		10			2.0 (HP)							
		10			4.5 (HP)	UC	2.75	4.7	13.6	116		75
		15			4.5 (HP)							
		15			4.5 (HP)							
		20			4.5 (HP)							
	Boring Terminated at 20 Feet	20										

<p>See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).</p> <p>See Supporting Information for explanation of symbols and abbreviations.</p>	<p>Water Level Observations No free water observed</p>	<p>Drill Rig Truck</p>
<p>Notes</p>	<p>Advancement Method Dry augered to 20 feet.</p> <p>Abandonment Method Boring backfilled with soil cuttings and patched at the surface with concrete upon completion.</p>	<p>Driller East Texas Drilling</p> <p>Logged by C. Keeth</p> <p>Boring Started 08-31-2024</p> <p>Boring Completed 08-31-2024</p>

Boring Log No. B-2

Graphic Log	Location: See Exploration Plan Latitude: 29.8530° Longitude: -95.7019° 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 (%)				
0.4	PAVEMENT , approximately 5 inches of concrete											
2.0	FILL - SANDY LEAN CLAY (CL) , tan				1.0 (HP)							
	LEAN CLAY (CL) , gray and reddish brown, stiff to very stiff				2.0 (HP)			16.1			33-15-18	
	- with ferrous stains below 4 feet	5			4.0 (HP)							
	- light gray below 6 feet				3.5 (HP)			13.9			45-15-30	
	- with calcareous nodules below 10 feet	10			4.5 (HP)							
					4.0 (HP)	UC	3.35	14.3	16.4	118		91
		15			3.5 (HP)							
					3.5 (HP)							
		20										
	Boring Terminated at 20 Feet											

<p>See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).</p> <p>See Supporting Information for explanation of symbols and abbreviations.</p>	<p>Water Level Observations No free water observed</p>	<p>Drill Rig Truck</p>
<p>Notes</p>	<p>Advancement Method Dry augered to 20 feet.</p> <p>Abandonment Method Boring backfilled with soil cuttings and patched at the surface with concrete upon completion.</p>	<p>Driller East Texas Drilling</p> <p>Logged by C. Keeth</p> <p>Boring Started 08-31-2024</p> <p>Boring Completed 08-31-2024</p>

Boring Log No. B-3

Graphic Log	Location: See Exploration Plan Latitude: 29.8529° Longitude: -95.7027° 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 (%)					
	FILL - SANDY LEAN CLAY (CL) , reddish brown, with calcareous nodules	4.0			4.5 (HP)				8.2		29-14-15		
		4.5 (HP)											
	LEAN CLAY WITH SAND (CL) , light gray and reddish brown, medium stiff to very stiff, with ferrous stains	5			3.5 (HP)				13.4		43-16-27		
		1.0 (HP)											
		10				3.0 (HP)	UC	3.44	9	14.1	121		
		3.0 (HP)											
	FAT CLAY (CH) , light gray and reddish brown, very stiff, with ferrous stains - with sand pockets below 18 feet	13.0			3.0 (HP)								
		15											
	Boring Terminated at 20 Feet	20											

<p>See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (if any).</p> <p>See Supporting Information for explanation of symbols and abbreviations.</p>	<p>Water Level Observations No free water observed</p>	<p>Drill Rig Truck</p>
<p>Notes</p>	<p>Advancement Method Dry augered to 20 feet.</p> <p>Abandonment Method Boring backfilled with auger cuttings upon completion.</p>	<p>Driller East Texas Drilling</p> <p>Logged by C. Keeth</p> <p>Boring Started 08-31-2024</p> <p>Boring Completed 08-31-2024</p>

Boring Log No. B-4

Graphic Log	Location: See Exploration Plan Latitude: 29.8524° Longitude: -95.7023°	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 (%)				
2.0	FILL - SANDY LEAN CLAY (CL) , tan				4.5 (HP)							
5	SANDY LEAN CLAY (CL) , light gray and reddish brown, very stiff to hard - with ferrous stains 4 to 13 feet				4.5 (HP)			9.5		41-17-24		
10	- with calcareous nodules 8 to 13 feet				4.5 (HP)			8.9		46-15-31		
15	FAT CLAY (CH) , light gray and reddish brown, very stiff, with calcareous nodules and ferrous stains				4.5 (HP)	UC	7.14	3.2	9.0	125		67
20	- with slickensides below 18 feet				4.5 (HP)							
20.0	Boring Terminated at 20 Feet											

<p>See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).</p> <p>See Supporting Information for explanation of symbols and abbreviations.</p>	<p>Water Level Observations No free water observed</p>	<p>Drill Rig Truck</p>
<p>Notes</p>	<p>Advancement Method Dry augered to 20 feet.</p> <p>Abandonment Method Boring backfilled with auger cuttings upon completion.</p>	<p>Driller East Texas Drilling</p> <p>Logged by C. Keeth</p> <p>Boring Started 08-31-2024</p> <p>Boring Completed 08-31-2024</p>

Boring Log No. B-5

Graphic Log	Location: See Exploration Plan Latitude: 29.8562° Longitude: -95.7022°	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 (%)					
	SANDY LEAN CLAY (CL) , light gray and reddish brown, stiff to hard, with ferrous stains - with sand seams 2 to 4 feet				4.5 (HP)				8.3		39-14-25		
					1.5 (HP)								
		5			4.5 (HP)				12.1			39-15-24	
					4.5 (HP)								
		10			4.5 (HP)	UC	4.48	5	13.6	118			
					4.5 (HP)								
		15			4.5 (HP)								
					4.5 (HP)								
20.0	Boring Terminated at 20 Feet												

<p>See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).</p> <p>See Supporting Information for explanation of symbols and abbreviations.</p>	<p>Water Level Observations No free water observed</p>	<p>Drill Rig Truck</p>
<p>Notes</p>	<p>Advancement Method Dry augered to 20 feet.</p> <p>Abandonment Method Boring backfilled with auger cuttings upon completion.</p>	<p>Driller East Texas Drilling</p> <p>Logged by C. Keeth</p> <p>Boring Started 08-31-2024</p> <p>Boring Completed 08-31-2024</p>

Boring Log No. B-6

Graphic Log	Location: See Exploration Plan Latitude: 29.8567° Longitude: -95.7049°	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 (%)				
<p>SANDY LEAN CLAY (CL), light gray and reddish brown, very stiff, with ferrous stains</p>					4.5 (HP)							
					3.5 (HP)			10.8		34-13-21		
		5			4.5 (HP)			12.1			68	
					4.5 (HP)			9.8		38-15-23		
		10			4.5 (HP)							
					4.5 (HP)	UC	2.95	9	13.8	118		
		15			4.0 (HP)							
		20			4.5 (HP)							
23.0												
<p>SILTY SAND (SM), reddish brown, medium dense - with clay pockets 23 to 28 feet</p>					7-9-9 N=18							
30.0					9-10-12 N=22							
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.

Water Level Observations
No free water observed

Drill Rig
Truck
Hammer Type
Rope and Cathead
Driller
East Texas Drilling

Notes
Percent finer than 2 microns at 4 to 6 feet is 26%.

Advancement Method
Dry augered to 30 feet.

Logged by
C. Keeth
Boring Started
08-31-2024
Boring Completed
08-31-2024

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Boring Log No. B-7

Graphic Log	Location: See Exploration Plan Latitude: 29.8563° Longitude: -95.7052° Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test			Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits		
						Test Type	Compressive Strength (tsf)	Strain (%)			LL-PL-PI	Percent Fines	
<p>SANDY LEAN CLAY (CL), gray, very stiff</p> <p>- light gray and reddish brown 2 to 23 feet</p> <p>- with ferrous stains 6 to 23 feet</p>					4.5 (HP)				6.0		25-15-10		
					4.5 (HP)				6.5			68	
		5			N/A				7.5		26-14-12		
					4.5 (HP)								
					4.5 (HP)								
		10			4.5 (HP)								
					4.5 (HP)								
					4.0 (HP)								
					4.5 (HP)	UC	2.55	10.1	19.2	110			57
		20											
	23.0												
<p>SILTY SAND (SM), reddish brown, medium dense</p> <p>- with clay pockets 23 to 28 feet</p> <p>- light gray below 28 feet</p>					6-9-10 N=19								
						10-10-12 N=22							
	30.0												
	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.

Water Level Observations
No free water observed

Drill Rig
Truck
Hammer Type
Rope and Cathead
Driller
East Texas Drilling

Notes
Percent finer than 2 microns at 2 to 4 feet is 20%.

Advancement Method
Dry augered to 30 feet.

Logged by
C. Keeth

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Boring Started
08-31-2024
Boring Completed
08-31-2024

Boring Log No. B-8

Graphic Log	Location: See Exploration Plan Latitude: 29.8516° Longitude: -95.7017°	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 (%)				
SANDY LEAN CLAY (CL)	tan and reddish brown, very stiff to hard - with calcareous nodules 0 to 2 feet - gray 2 to 4 feet - light gray 4 to 13 feet - with ferrous stains 8 to 13 feet				4.5 (HP)							
					4.5 (HP)			8.5		28-15-13		
		5			4.5 (HP)	UC	4.78	3.4	12.2	119		
					4.5 (HP)				10.9		42-15-27	
		10			4.5 (HP)							
					4.5 (HP)							
	13.0											
	15.0				4.5 (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).</p> <p>See Supporting Information for explanation of symbols and abbreviations.</p>	<p>Water Level Observations No free water observed</p>	<p>Drill Rig Truck</p>
<p>Notes</p>	<p>Advancement Method Dry augered to 15 feet.</p> <p>Abandonment Method Boring backfilled with auger cuttings upon completion.</p>	<p>Driller East Texas Drilling</p> <p>Logged by C. Keeth</p> <p>Boring Started 08-31-2024</p> <p>Boring Completed 08-31-2024</p>








Supporting Information

Contents:

General Notes

Unified Soil Classification System

General Notes

Sampling	Water Level	Field Tests
 Rock Core  Shelby Tube  Standard Penetration Test	 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

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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 <small>(More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance</small>		Consistency of Fine-Grained Soils <small>(50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance</small>		
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 $[Cc < 1 \text{ or } Cc > 3.0]$ ^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 $[Cc < 1 \text{ or } Cc > 3.0]$ ^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.

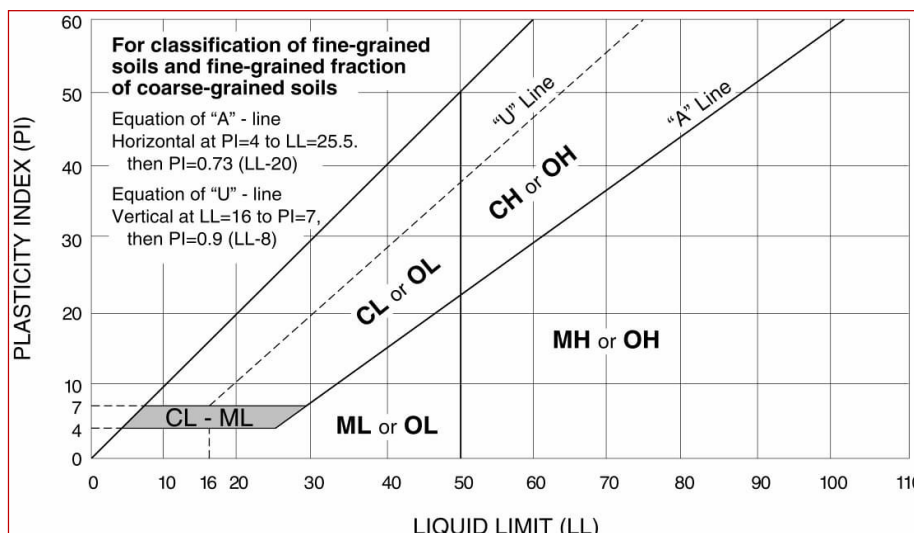
^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

^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.





November 12, 2024

Natex Architects
10375 Richmond Avenue, Suite 225
Houston, Texas 77536

Attn: Ms. Carolina Weitzman, AIA, LEED, President and CEO
P: (713) 975 - 9525
E: carolina@natexarchitects.com

Re: Additional Geotechnical Engineering Services
CFISD Cypress Lakes High School Building Additions
5750 Greenhouse Road
Katy, Texas
Terracon Project No. 92245368.Supplement1

Dear Ms. Weitzman:

Terracon Consultants, Inc. (Terracon) is pleased to submit our additional geotechnical engineering recommendations for the project referenced above in Katy, Texas. These additional services were authorized by Ms. Carolina Weitzman, AIA, LEED, President and CEO, of Natex Architects through an electronic correspondence on October 9, 2024. This letter should be considered a supplement to our original Geotechnical Engineering Report (Terracon Project No. 92215368, dated September 30, 2024).

Based on information provided by client, we understand that the storage building location has moved since our field exploration in August. The storage building with a footprint area of approximately 1,000 square feet (sf) is planned to be located on the south side of the competition field within the existing Cypress Falls High School campus. We understand a foundation system consisting of drilled-and-underreamed footings is being considered and that the finished grade elevation will be within one to two feet above existing grade.

In order to provide additional recommendations, we drilled an additional boring (B-9) to a depth of about 20 feet below existing grade within the proposed building area and performed additional laboratory testing in the recovered soil samples to evaluate their classification.

The boring was located using hand measuring equipment. The boring was advanced using a standard truck-mounted drill rig using solid stem continuous flight augers. Samples were obtained at a 2-foot interval in the upper 12 feet of each boring and at intervals of 5 feet thereafter. Soil sampling was typically performed using open-tube and split-barrel sampling procedures. Hand penetrometer tests were performed on samples of cohesive soils in the field to serve as a general measure of consistency. An automatic Standard Penetration Test (SPT) hammer was used in advancing the split-spoon sampler at the boring.

Terracon Consultants, Inc. 11555 Clay Road, Suite 100 Houston, Texas 77043
P (713) 690 8989 F (713) 690 8787 terracon.com

Environmental

Facilities

Geotechnical

Materials

11-17-2024 Issue for Bios

Additional Geotechnical Engineering Services

CFISD Cypress Lakes High School Building Additions ■ Katy, Texas
November 12, 2024 ■ Terracon Project No. 92245368.Supplement1



Samples were placed in appropriate containers, taken to our soil laboratory for testing, and classified by a geotechnical engineer. In addition, groundwater was not observed at the boring.

The following paragraphs provide additional recommendations. These recommendations should be used in conjunction with our original report, provided the assumptions listed in our original report are still accurate.

Based on the soil conditions observed at boring B-9 the recommendations provided in our original report are appropriate for the new location of the building provided the assumptions listed in our original report are still accurate.

We trust that this letter report is responsive to your project needs at this time. Any items not specifically discussed herein should be addressed as indicated in our original report. If you have any questions concerning this report or if we may be of further services, please contact us.

Sincerely,

Terracon Consultants, Inc.

(Texas Firm Registration No.: F-3272)

A handwritten signature in black ink, appearing to read 'Ammar Ali'.

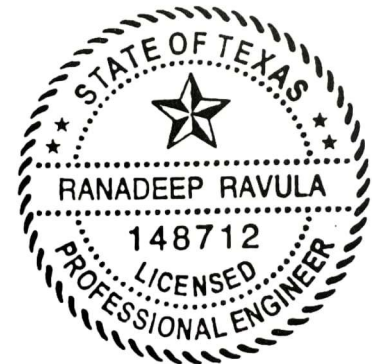
Ammar Ali, Ph.D.
Senior Staff Engineer

A handwritten signature in black ink, appearing to read 'Ranadeep Ravula'.

Ranadeep Ravula, P.E.
Group Manager

A handwritten signature in black ink, appearing to read 'Bobbie Hood'.

Bobbie Hood, P.E.
Senior Engineer



Attachments:

- *Site Location*
- *Exploration Plan*
- *Boring Log (B-9)*
- *General Notes*
- *Unified Soil Classification System*

SITE LOCATION
 CFISD Cypress Lakes High School Building Additions ■ Katy, Texas
 November 12, 2024 ■ Terracon Project No. 92245368.Supp1ment1

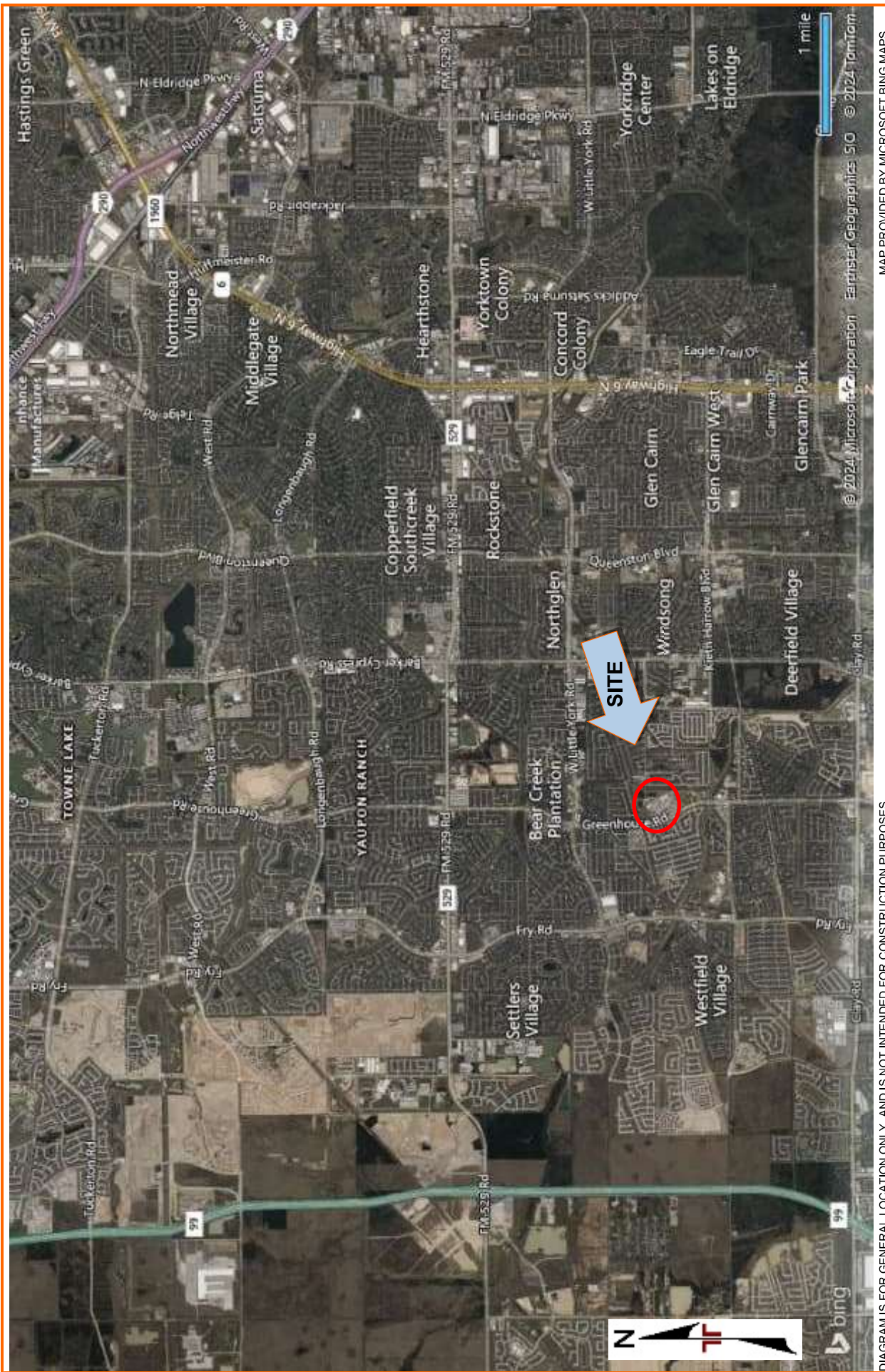


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

CFISD Cypress Lakes High School Building Additions ■ Katy, Texas
November 12, 2024 ■ Terracon Project No. 92245368.Supp1ment1

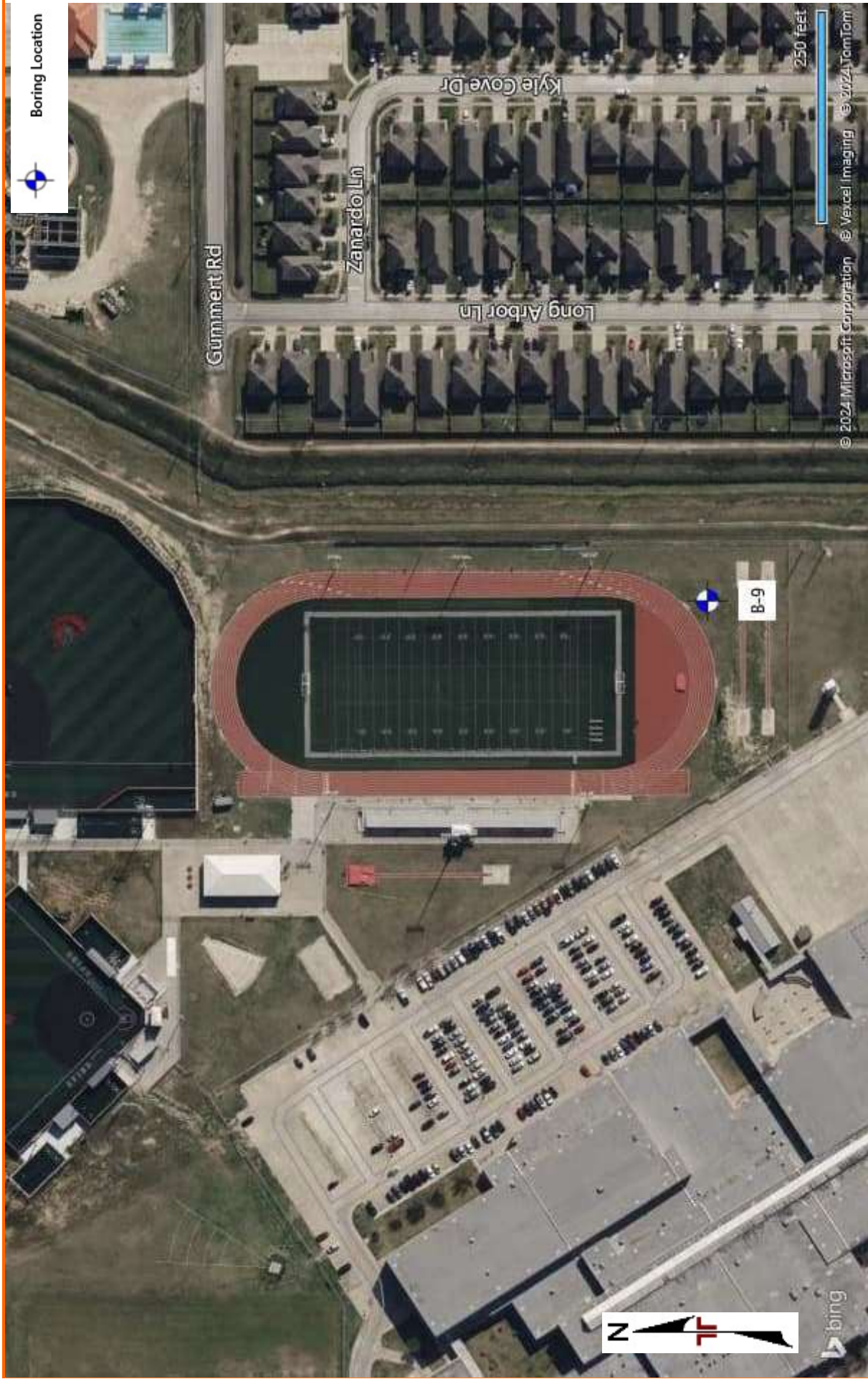


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MAP PROVIDED BY MICROSOFT BING MAPS

Boring Log No. B-9

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 29.8547° Longitude: -95.7014° 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 (%)				
2	[Hatched Yellow]	SANDY LEAN CLAY (CL) , tan, very stiff	4.0			4.5 (HP)							
			4.0			4.5 (HP)			5.6		29-13-16		
3	[Hatched Green]	FAT CLAY (CH) , light gray and reddish brown, very stiff to hard, with sand pockets, calcareous nodules and ferrous stains	5			4.5 (HP)			11.0		53-16-37		
						4.5 (HP)			9.4		50-14-36		
			10			4.5 (HP)							
						4.5 (HP)	UC	6.54	9.8	11.6	124		96
			15			4.5 (HP)							
4	[Dotted Yellow]	SILTY SAND (SM) , tan, medium dense	18.0										
			20.0			9-10-12 N=22							
		Boring Terminated at 20 Feet	20										

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>Water Level Observations No free water observed</p>	<p>Drill Rig Truck</p> <p>Hammer Type Automatic</p> <p>Driller Herman Drilling</p>
<p>Notes</p>	<p>Advancement Method Dry augered to 20 feet.</p> <p>Abandonment Method Boring backfilled with auger cuttings upon completion.</p>
	<p>Logged by K. Chavez</p> <p>Boring Started 10-23-2024</p> <p>Boring Completed 10-23-2024</p>

General Notes

Sampling	Water Level	Field Tests
Rock Core Shelby Tube Standard Penetration Test	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

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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

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	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.

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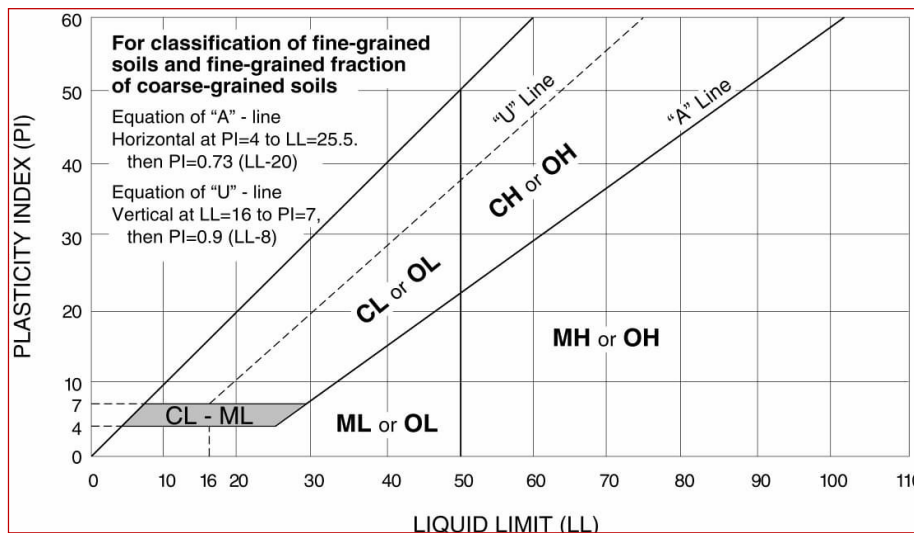
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^O PI < 4 or plots below "A" line.

^P PI plots on or above "A" line.

^Q PI plots below "A" line.



SECTION 02 41 01
DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Demolition of items scheduled excluding removal of hazardous materials and toxic substances.
- B. Selective demolition of built site elements.
- C. Selective demolition of building elements for alteration and addition purposes.
- D. Abandonment and removal of existing utilities and utility structures as indicated.

1.02 RELATED REQUIREMENTS

- A. Section 01 10 00 – Summary of Work.
- B. Section 01 31 13 – Project Coordination.
- E. Section 01 50 00 - Temporary Facilities.
- F. Section 01 77 00 – Guarantees, Certificates and Closeout

1.03 REFERENCE STANDARDS

- A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2013.

1.04 SUBMITTALS

- A. See Section 01 33 00 – Submittals.
- B. Site Plan: Showing:
 - 1. Areas for temporary construction and field offices.
- C. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.05 QUALITY ASSURANCE

- A. Project Conditions
 - 1. Visit the site as required to become familiar with existing conditions.
 - 2. Note all conditions as to character and extent of work involved for demolition.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 SCOPE

- A. Remove portions of existing buildings in the following sequence:
- B. Remove paving and curbs as required to accomplish new work.
- C. Remove all other paving and curbs within site boundaries.
- D. Remove other items indicated, for salvage, relocation, and recycling.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with other requirements specified in Section 01 70 00.

- B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain and pay for all required permits.
 - 2. Comply with applicable requirements of NFPA 241.
 - 3. Use of explosives is not permitted.
 - 4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 - 5. Provide, erect, and maintain temporary barriers and security devices.
 - 6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
 - 7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 - 8. Do not close or obstruct roadways or sidewalks without permit.
 - 9. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
 - 10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
 - 11. Coordinate with all utility providers as required for demolition of electrical, water, sanitary, storm and any other utilities present on the site and building.
- C. Do not begin removal until receipt of notification to proceed from Owner.
- D. Protect existing structures and other elements that are not to be removed.
 - 1. Provide bracing and shoring.
 - 2. Prevent movement or settlement of adjacent structures.
 - 3. Stop work immediately if adjacent structures appear to be in danger.
- E. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- F. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
- G. Perform demolition in a manner that maximizes salvage and recycling of materials.
 - 1. Comply with requirements of Section 01 74 19 - Waste Management.
 - 2. Dismantle existing construction and separate materials.
 - 3. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.
- H. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

3.03 EXISTING UTILITIES

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
- H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

3.04 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as shown.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Separate areas in which demolition is being conducted from other areas that are still occupied.
 - 1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 50 00 in locations indicated on drawings.
 - 2. Provide sound retardant partitions of construction indicated on drawings in locations indicated on drawings or as required to minimize noise into occupied areas.
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
- D. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove items indicated on drawings.
- E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, Telecommunications, and Security): Remove existing systems and equipment as indicated.
 - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
 - 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - 3. See Section 01 10 00 for other limitations on outages and required notifications.
 - 4. Verify that abandoned services serve only abandoned facilities before removal.
 - 5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- F. Protect existing work to remain.
 - 1. Prevent movement of structure; provide shoring and bracing if necessary.
 - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
 - 4. Patch as specified for patching new work.

3.05 BUILDING DEMOLITION

- A. Coordinate all work with the city having jurisdiction, and all applicable utility companies, and governing authorities.
- B. Before commencing the work of this Section, verify with Architect all items to be removed. Schedule the work in a careful manner with all necessary consideration for the

public and the Owner. Owner shall have the right of salvage to all items of existing equipment and materials such as door hardware, scrap copper, light fixtures, plumbing fixtures, accessories or any other item of value to the Owner. The equipment and material shall remain the property of the Owner and shall be delivered to a site designated by the Owner.

- C. Completely remove all building structure, building slabs, and all plumbing lines that occur within 60 inches beneath grade or as indicated in the drawings whichever is greater. Cap all plumbing and utility lines abandoned or as indicated in the drawings. Building foundations, including grade beams shall be removed completely. Drilled piers shall be removed to a minimum dept of 60" below grade unless they conflict with new work and then they shall be removed completely.
- D. Remove walks and drives as shown on the drawings. Protect existing street curbs shown to remain.
- E. All material removed under this contract, which is not to be salvaged or sold at the "memorabilia sale", 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 site.
- F. Conduct operations so as not to interfere with adjacent roads, streets, drives, walks, services lines, and the like.
- G. Disconnect any electric, telephone, gas, water, steam or other injection lines servicing the structure per rules and regulations of authorities having jurisdiction, as specified, or as directed by the Architect, but always maintain existing building to remain operational at all times.
- H. Backfill any trenches caused by demolition work, in accordance with Section 31 23 33 - Trenching and Backfilling.
- I. Remove all debris from the building premises and leave construction site "broom clean" each day. All debris shall be dumped in an approved disposal facility. All fees for this shall be paid by the Contractor.
- J. All work shall be subject to phasing of construction.
- K. Keep all pedestrian areas clear for passage at all times.
- L. Upon completion of demolition of all existing structures, drives, fences, and utility lines, grade site with imported select fill and regrade so no evidence exists that structures were ever present on the site. Slope fill to natural drainage patterns so that ponding doesn't occur. Bring fill elevations up to surrounding existing grade elevations.

3.06 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Remove from site all materials not to be reused on site; comply with requirements of Section 01 74 19 - Waste Management.
- C. Leave site in clean condition, ready for subsequent work.
- D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 02 41 13.10

REMOVING EXISTING PAVEMENT AND STRUCTURES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Removing concrete paving, asphaltic concrete pavement, and base courses.
- B. Removing concrete curbs, concrete curbs and gutters, sidewalks, and driveways.
- C. Removing pipe culverts and sewers.
- D. Removing existing inlets and manholes.
- E. Removing miscellaneous structures of concrete or masonry.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for removing and disposing of asphaltic surfacing and unreinforced concrete base under asphaltic surfacing, regardless of the thickness encountered, is on a square yard basis measured between lips of gutters.
 - 2. Payment for removing and disposing of concrete base under surfacing with curbs, regardless of the thickness encountered, is on a square yard basis measured from back-to-back of curbs. Payment includes removal of all concrete base, asphaltic surfacing, concrete pavement, esplanade curbs, curb and gutters, and paving headers.
 - 3. Payment for removing and disposing of reinforced concrete pavement, regardless of its thickness, is on a square yard basis measured from back-to-back of curbs. Payment includes concrete pavement, esplanade curbs, curbs and gutters, and paving headers.
 - 4. Payment for removing and disposing of monolithic curbs and gutters, and concrete curbs, is on a linear foot basis measured along the face of the curb.
 - 5. Payment for removing and disposing of cement stabilized shell base course, with or without asphaltic surfacing, is on a square yard basis.
 - 6. Payment for removing and disposing of concrete sidewalks is on a square yard basis.
 - 7. Payment for removing and disposing of concrete driveways is on a square yard basis.
 - 8. Payment for removing and disposing of miscellaneous concrete and masonry is on a cubic yard basis of the structure in place.
 - 9. Payment for removing and disposing of pipe culverts and sewers is on a linear foot basis for each diameter and each material type of pipe removed.
 - 10. Payment for removing and disposing of existing inlets is on a unit price basis for each inlet removed.
 - 11. Payment for removing and disposing of existing manholes is on a unit price basis for each manhole removed.
 - 12. Payment for saw cutting of existing pavement is on a linear foot basis.
 - 13. No payment will be made for work removed without the Engineer's approval or for pavements or structures removed for the Contractor's convenience.
- B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.3 REGULATORY REQUIREMENTS

02 41 13.10 - 1

REMOVING EXISTING PAVEMENT
AND STRUCTURES

- A. Conform to applicable codes for disposal of debris.
- B. Coordinate removal work with utility companies.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION

3.1 PREPARATION

- A. Obtain advance approval from Engineer for dimensions and limits of removal work.
- B. Identify known utilities below grade. Stake and flag locations.

3.2 PROTECTION

- A. Protect the following from damage or displacement:
 - 1. Adjacent public and private property.
 - 2. Trees, plants, and other landscape features designated to remain.
 - 3. Utilities designated to remain.
 - 4. Pavement and utility structures designated to remain.
 - 5. Bench marks, monuments, and existing structures designated to remain.

3.3 REMOVALS

- A. Remove pavements and structures by methods that will not damage underground utilities. Do not use a drop hammer near existing underground utilities.
- B. Minimize amount of earth loaded during removal operations.
- C. Where existing pavement is to remain, make straight saw cuts in existing pavement to provide clean breaks prior to removal. Do not break concrete pavement or base with drop hammer unless concrete or base has been saw cut to a minimum depth of two (2) inches.
- D. Where street and driveway saw cut locations coincide or fall within three (3) feet of existing construction or expansion joints, break out to existing joint.
- E. Remove sidewalks and curbs to nearest existing dummy, expansion, or construction joint.
- F. Where existing end of pipe culvert or end of sewer is to remain, install an 8-inch thick masonry plug in pipe end prior to backfill.

3.4 BACKFILL

- A. Backfill of removal areas shall be in accordance with requirements of Division 31.

3.5 DISPOSAL

- A. Inlet frames, grates, plates, and manhole frames and covers may remain property of the Owner. Disposal shall be in accordance with requirements of Section 02 41 13.11 – Construction Waste Management and Disposal.
- B. Remove from the site debris resulting from work under this section in accordance with requirements of Section 02 41 13.11 - Construction Waste Management and Disposal.

END OF SECTION

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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 56 39 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
 - 3. Section 31 10 00 "Site Clearing" for site clearing and removal of above- and below-grade improvements.

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.

1.5 PREINSTALLATION MEETINGS

- A. Predemolition 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.
- C. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
- D. Predemolition Photographs or Video: Show existing conditions of adjoining construction and site improvements. 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:

- a. List to be determined during bid phase.
- 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.

1.10 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.

PART 2 - PRODUCTS (Not Used)

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. Survey existing conditions 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 02 50 00

SITE RESTORATION

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Restoration of site affected by the Work in public or private property, including pavement, esplanades, sidewalks, driveways, fences, lawns and landscaping.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices.
 - 1. Payment for restoration of Project site disturbed by utility construction operations is on a linear foot basis. Measurement will be as provided for corresponding utility in each Specification section. No separate payment made for branch pipe, valves and, other associated work for utilities. Measurement for restoration with multiple utilities within the same right-of-way will be on a linear foot basis for only one utility.
 - 2. No separate payment made for facility or roadway projects. Include cost in the surface improvements associated with the facility or roadway construction.
 - 3. Payment includes required site restoration within the right-of-way or easement regardless of size or type of pipe, method of construction, paved or unpaved areas or thickness and width of pavement.
 - 4. No separate payment made for site restoration for service connections under this Section. Include cost in appropriate utility section.
 - 5. Refer to Division 1 for Unit Price procedures.
- B. Stipulated Price (Lump Sum) Contracts. If Contract is Stipulated Price Contract, include payment for work under this section in total Stipulated Price.

1.3 DEFINITIONS

- A. Phase: Locations identified on the plans and listed in Division 1.
- B. Site Restoration: Replacement or reconstruction of Site Improvements located in rights-of-way, easements, public property, and private property affected or altered by the Work.
- C. Site Improvement: Includes pavement, curbs and gutters, esplanades, sidewalks, driveways, fences, lawns, irrigation systems, landscaping, and other improvements in existence at the Project site before commencement of construction operations.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Schedule of testing, service connections, abandonment, backfill, and site restoration.
- C. Sample of notices to residents outlining their responsibility for maintenance of site improvements adjacent to the Project that are not disturbed by construction operations.

1.5 SCHEDULING

- A. Schedule testing, service connections, abandonment, backfill and site restoration immediately following completion of pipe laying work or paving within each block or line segment.

- B. Phased Construction:
 - 1. Commencement of subsequent Phase will follow scheduling of site restoration of prior Phase. Limit work to a maximum of two Phases of the project.
- C. Construction of Projects with no Phases listed in Division 1:
 - 1. Complete site restoration prior to disturbing over 50% of total project linear feet or 2,000 linear feet, whichever is greater, of right-of-way or easement.
 - 2. Limit work to a maximum of 50% of total project linear feet or 2,000 linear feet, whichever is greater, of right-of-way and easement. Commence work in additional right-of-way or easement after completion of site restoration.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Pavement, Sidewalks and Driveways: Materials specified in Division 2.
- B. Seeding and Sodding: Sod specified in Division 2.
- C. Trees, Shrubs and Plantings: Conform to requirements of Division 1.

PART 3 EXECUTION

3.1 PREPATORY WORK

- A. Provide cleanup and restoration crews to work closely behind pipe laying and roadway construction crews, and where necessary, during testing, service restoration, abandonment, backfill and surface restoration.
- B. Water Lines: Unless otherwise approved by Owner's Representative, comply with the following:
 - 1. Once Owner's Representative approves work within a Phase, immediately begin preparatory work for disinfection effort.
 - 2. No later than three days after completing disinfection preparatory work, initiate disinfection work.
 - 3. Immediately after transfer of services, begin abandonment of old water lines and site restoration.
- C. Wastewater Lines:
 - 1. Once Owner's Representative approves work within a Line Segment, immediately begin preparatory work for testing effort.
 - 2. No later than three days after completing preparatory work for testing, initiate testing work.
 - 3. Immediately after transfer of service connections, begin abandonment of old wastewater lines, and site restoration.
- D. Street Construction and Paving Projects
 - 1. Once Owner's Representative approves work within a Line Segment or block, immediately begin preparatory work for testing effort.

2. No later than three days after completing preparatory work for testing, initiate testing work.
3. Immediately after testing begin site restoration.

E. Street Construction and Paving Projects

1. Once Owner's Representative approves work within a block, immediately begin preparatory work for sidewalk construction, sodding and hydromulching and tree planting.
2. No later than seven days after completing preparatory work, initiate construction.

3.2 CLEANING

- A. Remove debris and trash to maintain a clean and orderly site in accordance with requirements of General Conditions and Division 1.

3.3 LANDSCAPING AND FENCES

A. Seeding and Sodding.

1. Remove construction debris and level area with bank sand so that new grass surface matches level of existing grass and maintains pre-construction drainage patterns. Level and fill minor ruts or depressions caused by construction operations with bank sand, where grass is still viable.
2. Restore previously existing turfed areas with sod and fertilize in accordance with Division 2. Sod to match existing turf.
3. Restore unpaved areas not requiring sodding with hydromulch seeding conforming to Division 2.

B. Trees, Shrubbery and Plants.

1. Remove and replant trees, shrubs, and plants in accordance with requirements of Division 1.

C. Fence Replacement.

1. Replace removed or damaged fencing to equal or better condition than existed prior to construction, including concrete footings and mow strips. Provide new wood posts, top and bottom railing and panels. Metal fencing material, not damaged by the Work as determined by owner representative, may be reused.
2. Remove and dispose of damaged or substandard material.

3.4 MAINTENANCE

- A. Maintain shrubs, plantings, sodded areas and seeded areas.
- B. Replace shrubs, plantings and seeded or sodded areas that fail to become established.
- C. Refer to Division 1 and Division 2 for maintenance requirements.
- D. Notify Owner's Representative 10 days before end of maintenance period for inspection and acceptance.

END OF SECTION

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SECTION 03 05 80 - UNDER-SLAB VAPOR BARRIER/RETARDER

PART 1 - GENERAL

1.1 SUMMARY

- A. Products Supplied Under This Section
 - 1. Vapor Barrier, 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

1.2 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 Vapor Barrier Component (plastic membrane) is not less than 10 mils thick.

1.3 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.

1.4 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 Barrier (Performance based specification). When the specifications of different sections conflict, the contractor shall perform to the most restrictive provision. Vapor Barrier 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 barrier 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 Barrier/Retarder:
 1. Installation shall be in accordance with manufacturer's written instructions and ASTM E 1643-09.
 - a. Unroll Vapor Barrier/Retarder with the longest dimension parallel with the direction of the pour.

- b. Lap Vapor Barrier/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 Barrier/Retarder is allowed except for reinforcing steel and permanent utilities.
- f. Repair damaged areas by cutting patches of Vapor Barrier/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. Concrete toppings.
- B. Related Sections:
 - 1. Section 01 45 23 “Testing and Inspection Services”.
 - 2. Section 03 30 00 “Cast In Place Concrete”.
 - 3. Section 03 20 00 “Concrete Reinforcing”.

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.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
- C. 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.
- D. 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.
- 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 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 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. Design, engineering and construction, and removal of formwork are the responsibility of the contractor.
- E. 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."
- F. 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. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- H. 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.
1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

- I. 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.
 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
 3. 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 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.

3.5 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.

3.6 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.

3.7 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 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 or to receive trowel finish or to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

3.8 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 2000 - 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. Concrete toppings.
- 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 04 22 00 "Concrete Unit Masonry".
 - 5. Section 31 20 00 "Earth Moving".
 - 6. 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. 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.
- B. 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.
- C. 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. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
- C. 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.
- D. 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 according to 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 for #6 and smaller bars, Grade 75 for #7 and larger bars, 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. Stainless-Steel Reinforcing Bars: ASTM A 955, Grade 60, [Type 304] [Type 316L], deformed.

- E. Steel Bar Mats: ASTM A 184, fabricated from ASTM A 615, Grade 60 or ASTM A 706, deformed bars, assembled with clips.
- F. Plain-Steel Wire: ASTM A 82, as drawn .
- G. Deformed-Steel Wire: ASTM A 496.
- H. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.
- I. 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 supports 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 re-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. 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. 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 $\frac{1}{4}$ inch.
 2. Minimum spacing between bars: Minus $\frac{1}{4}$ inch.
 3. Top bars in slabs and beams:
 - a. Members 8 inches deep or less: Plus or minus $\frac{1}{4}$ inch.
 - b. Members between 8 and 24 inches deep: Plus or minus $\frac{1}{2}$ 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. Concrete toppings.
- 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 15 13 "Waterstops".
 5. Section 03 05 80 "Under-slab Vapor Barrier – Retarder".
 6. 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. LEED Submittals:
1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 2. Product Data for Credit IEQ 4.3: For liquid floor treatments and curing and sealing compounds, documentation including printed statement of VOC content.
 3. Design Mixtures for Credit ID 1.1: For each concrete mixture containing fly ash as a replacement for Portland cement or other Portland cement replacements, and for equivalent concrete mixtures that do not contain Portland cement replacements.
- C. 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.
- D. Steel Reinforcement Shop Drawings: Refer Section 03 20 00.
- E. Formwork Shop Drawings: Refer Section 03 10 00.
- F. 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.
 - 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.
- 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. BASF Construction Chemicals - Building Systems; FricTex NS.
 - c. L&M Construction Chemicals, Inc.; Grip It AO.

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. BASF Construction Chemicals - Building Systems; Confilm.
 - c. ChemMasters; SprayFilm.
 - d. Conspec by Dayton Superior; Aquafilm.
 - e. Dayton Superior Corporation; Sure Film (J-74).
 - f. Edoco by Dayton Superior; BurkeFilm.
 - g. Euclid Chemical Company (The), an RPM company; Eucobar.
 - h. Kaufman Products, Inc.; Vapor-Aid.
 - i. Lambert Corporation; LAMBCO Skin.
 - j. L&M Construction Chemicals, Inc.; E-CON.
 - 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. BASF Construction Chemicals - Building Systems; Kure 200.
 - c. ChemMasters; Safe-Cure Clear.
 - d. Conspec by Dayton Superior; W.B. Resin Cure.
 - e. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
 - f. Edoco by Dayton Superior; Res X Cure WB.

- g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
 - h. Kaufman Products, Inc.; Thinfilm 420.
 - i. Lambert Corporation; AQUA KURE - CLEAR.
 - j. L&M Construction Chemicals, Inc.; L&M Cure R.
 - k. Meadows, W. R., Inc.; 1100-CLEAR.
 - l. Nox-Crete Products Group; Resin Cure E.
 - m. Right Pointe; Clear Water Resin.
 - n. SpecChem, LLC; Spec Rez Clear.
 - o. Symons by Dayton Superior; Resi-Chem Clear.
 - p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
 - q. 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. BASF Construction Chemicals - Building Systems; Kure 1315.
 - b. ChemMasters; Polyseal WB.
 - c. Conspec by Dayton Superior; Sealcure 1315 WB.
 - d. Edoco by Dayton Superior; Cureseal 1315 WB.
 - e. Euclid Chemical Company (The), an RPM company; Super Diamond Clear VOX; LusterSeal WB 300.
 - f. Kaufman Products, Inc.; Sure Cure 25 Emulsion.
 - g. Lambert Corporation; UV Safe Seal.
 - h. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
 - 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. Screed 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, 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 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 restraighening 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, Fl=25; with minimum local values of flatness, Ff=24; and levelness, Fl=17.
 2. Carpeted floors, floors under concrete toppings, thickset tile and terrazzo: Specified overall values of flatness, Ff=25; and levelness, Fl=20; with minimum local values of flatness, Ff=17; and levelness, Fl=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 manufacturers 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 35 11
CONCRETE FLOOR FINISHES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface treatments for concrete floors and slabs.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Finishing of concrete surface to tolerance; floating, troweling, and similar operations; curing.
- B. Section 09 67 00 - Fluid-Applied Flooring.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with concrete floor placement and concrete floor curing.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.
- C. Maintenance Data: Provide data on maintenance and renewal of applied finishes.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's sealed packaging, including application instructions.

1.06 FIELD CONDITIONS

- A. Maintain light level equivalent to a minimum 200 W light source at 8 feet (2.5 m) above the floor surface over each 20 foot (6 m) square area of floor being finished.
- B. Do not finish floors until interior heating system is operational.
- C. Maintain ambient temperature of 50 degrees F (10 degrees C) minimum.

PART 2 PRODUCTS

2.01 COATINGS

- A. High Gloss Clear Sealer: Transparent, non-yellowing, water- or solvent-based coating.
 - 1. Nonvolatile Content: 40 percent, minimum, when measured by volume.
 - 2. Products:
 - a. BRICKFORM; BRICKFORM Poly-Seal 100 VOC: www.brickform.com.
 - b. W.R. Meadows, Inc; Decra-Seal W/B: www.wrmeadows.com.
- B. Plastic Aggregate: Finely ground polymer for addition to coatings for slip resistance.
 - 1. Products:
 - a. SpecChem, LLC; Surface Grip: www.specchemllc.com.
 - b. W.R. Meadows, Inc; Sure-Step: www.wrmeadows.com.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that floor surfaces are acceptable to receive the work of this section.
- B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

3.02 GENERAL

- A. Apply materials in accordance with manufacturer's instructions.

3.03 COATING APPLICATION

- A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.
- B. Verify that water vapor emission from concrete and relative humidity in concrete are within limits established by coating manufacturer.
- C. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.
- D. Apply coatings in accordance with manufacturer's instructions, matching approved mock-ups for color, special effects, sealing and workmanship.

END OF SECTION

SECTION 03 52 00 LIGHTWEIGHT CONCRETE ROOF INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES:

- A. Lightweight Insulating Concrete Application to Prepared Substrate

1.02 RELATED SECTIONS

- A. Section 01 45 29- Testing Laboratory Services
- B. Section 06 10 55 - Rough Carpentry
- C. Section 05 31 23 - Roof Deck
- D. Section 07 52 00 & 07 52 01 - Roofing
- E. Section 07 62 00- Sheet Metal Flashing and Trim
- F. Section 07 81 00 - Sprayed Fire Protection

1.03 REFERENCE STANDARDS

References in these specifications to standards, test methods and codes, are implied to mean the latest edition of each such standard adopted. The following is an abbreviated list of associations, institutions, and societies which may be used as references throughout this specification section.

ASTM	American Society for Testing and Materials Philadelphia, PA
FM	Factory Mutual Engineering and Research Norwood, MA
UL	Underwriters Laboratories Northbrook, IL

1.04 SUBMITTALS

All submittals which do not conform to the following requirements will be rejected.

- A. Submittal of Equals:** Submit lightweight insulating concrete systems to be considered as equals to the specified roof system no less than 10 days prior to bid date. Primary lightweight insulating concrete systems which have been reviewed and accepted as equals to the specified system will be listed in an addendum prior to bid date; only then will equals be accepted at bidding. Submittals shall include the following:

1. Submit manufacturer's instructions for proper placement of the proposed lightweight insulating concrete roof insulation system.
2. Submit documentation confirming compliance with FM **1-90 & 1-150**, Windstorm Resistance Classification utilizing the specific roof membrane system proposed for use on this project.
 - a) Submit documentation confirming that the specific expanded polystyrene proposed for use on this project is approved by Factory Mutual for use in conjunction with the proposed lightweight insulating concrete system.
3. Submit a letter from the supplier of the proposed lightweight insulating concrete system confirming that the expanded polystyrene used as a component in the lightweight insulating concrete system is to be furnished by the supplier of the proposed lightweight insulating concrete system.
4. Submit shop drawings including a roof plan, roof slopes, and thickness of insulation.
5. Submit a sample copy of the warranty covering the proposed lightweight insulating concrete system.
6. Submit a sample copy of the roof system guarantee covering the proposed lightweight insulating concrete system and roof membrane system.
7. Submit a letter from the roof membrane manufacturer confirming the intention to issue the roof system guarantee covering the proposed lightweight insulating concrete system and roof membrane system at project completion.
8. 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.

1.05 QUALITY ASSURANCE

- A. **Acceptable Contractor:** The contractor must be certified in writing prior to bid by the supplier to install the proposed lightweight insulating concrete system.
- B. **Agency Approvals:** The proposed lightweight insulating concrete system shall conform to the following requirements. No other testing agency approvals will be accepted.
 1. **Underwriters Laboratories:** Tested by Underwriters Laboratories in accordance with the procedures of ASTM E 119 and listed in the most recent Underwriters Laboratories Fire Resistance Directory. Lightweight insulating concrete roof insulation components are defined by Underwriters Laboratories under sections CCVW for foamed plastic and CCOX for floor or roof-topping mixture in the latest edition of the Underwriters Laboratories Fire Resistance Directory.
 2. **Factory Mutual:** Tested by Factory Mutual Research and listed in FM Global RoofNav as non-combustible or Class 1, and for **1-90** windstorm classification utilizing the specific roof membrane system proposed for use on this project. Tested by Factory Mutual Research and listed in FM Global RoofNav as non-combustible or Class 1, and for **1-150** windstorm classification utilizing the specific roof membrane system proposed for use on this project.
- C. **PRE-Installation Meeting:** Architect, General Contractor, installing contractor, CFISD, material testing, lab and roof consultant shall be present.
- D. Lightweight pours to be monitored full time by the District's roof consultant, a third-party service, and

therefore they shall not be the designers. During the 100% document review the architect shall bring separately a set of roofing drawings and specs sections for the District's PM to transmit the documents for roof consultant's review and comments.

1. The District's material testing lab will be used to perform cylinder tests and a lightweight pull test to determine the fastening pattern in the presence of the architect and roof consultant. The minimum requirement is forty pounds or more per fastener.
2. Water tests shall be performed and witnessed by the roof consultant to eliminate ponding of water. Anything that covers a nickel after 24 hours shall be addressed.
3. Prior to lightweight pour all items under slotted deck shall be covered and any items on the slab shall be elevated.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. **Delivery:** Deliver materials in the supplier's original unopened packages, fully identified as to manufacturer, brand or other identifying data and bearing the proper Underwriters Laboratories label.
- B. **Storage:** Store Insulcel concentrate at temperatures between 52°F and 80°F (11° - 27° C). Expanded polystyrene board should not be stored in areas of standing water prior to application but can be exposed to rainwater before application. Boards must be clean and free from foreign substances.

1.07 PROJECT/SITE CONDITIONS

A. Requirements Prior to Job Start

1. **Notification:** Give a minimum of 5 days notice to the Owner and manufacturer prior to commencing any work and notify both parties on a daily basis of any change in work schedule.
2. **Permits:** Obtain all permits required by local agencies and pay all fees which may be required for the performance of the work.
3. **Safety:** Familiarize every member of the application crew with all fire and safety regulations recommended by OSHA, NRCA and other industry or local governmental groups.

B. Environmental Requirements

1. **Precipitation:** Do not apply materials during precipitation or in the event there is a probability of precipitation during application. Take adequate precautions to ensure that materials and building interiors are protected from possible moisture damage or contamination.
2. **Temperature Restrictions:** When air temperatures of 40°F (4.4°C) or above are predicted to occur within the first 24 hours after placement, normal mixing and application procedures may be used. When air temperatures of 32°F to 40°F (0°C - 4.4°C) are predicted to occur within the first 24 hours after placement, the Contractor may opt to increase the Portland cement quantity 15% by weight. Do not install the lightweight insulating concrete system when air temperatures are below 32°F (0°C).

1.08 WARRANTY/GUARANTEE

A. Insulation System Warranty: Upon successful completion of the project, and after all post installation procedures have been completed, furnish the Owner with the insulation system manufacturer's 20 year labor and materials warranty. The insulation system warranty shall include the composite roof deck system consisting of pregenerated foam and polystyrene insulation panels. All repair or replacement costs covered under the guarantee shall be borne by the insulation system manufacturer. The guarantee shall be a term type, without deductibles or limitations on coverage amount, and be issued at no additional cost to the Owner. Specific items covered during the term of the insulation system warranty include:

1. The actual resistance to heat flow through the roof insulation will be at least 80% of the design thermal resistance, provided that the roofing membrane is free of leaks.
2. The roof insulation will remain in a reroofable condition should the roof membrane require replacement (excluding damage caused by fastener pullout during removal of the old membrane.)
3. The Insulating Concrete Warranty will not limit, by geographic location, the owners rights for claims, actions, and/or proceedings.
4. The roof insulation material will not cause structural damage to the building as a result of expansion from thermal or chemical action.

B. Roof System Guarantee: Upon successful completion of the project, and after all post installation procedures have been completed, furnish the Owner with the roof system manufacturer's 20 year labor and materials roof system guarantee. The roof system guarantee shall include both the roofing and flashing membranes, and the specified new lightweight insulating concrete system consisting of pre-generated foam, patented-pre-formed polystyrene panels, and base sheet fasteners. All repair or replacement costs covered under the guarantee shall be borne by the roofing membrane manufacturer. The guarantee shall be a term type, without deductibles or limitations on coverage amount, and be issued at no additional cost to the Owner. Specific items covered under the roof system guarantee include:

1. The actual resistance to heat flow through the roof insulation will be at least 80% of the design thermal resistance, provided that the roofing membrane is free of leaks;
 2. Should a roof leak occur, the insulating performance of the roof insulation will be at least 80% of the design thermal resistance within a 2 year period following repair of the leak.
 3. The roof insulation will remain in a reroofable condition should the roof membrane require replacement (excluding damage caused by fastener pullout during removal of the old membrane.)
 4. The roof insulation material will not cause structural damage to the building as a result of expansion from thermal or chemical action.
- > Siplast 20-year Roof System Guarantee

PART 2: PRODUCTS

2.01 MATERIALS

A. Acceptable Manufacturer: Provide a lightweight insulating concrete roof insulation system incorporating pregenerated foam and expanded polystyrene board supplied by a single manufacturer.

- > Insulcel Roof Insulation System by Siplast, Inc., Irving, TX

2.02 SYSTEM DESCRIPTION

A. Lightweight Concrete System Description: Provide materials used in the lightweight concrete roof insulation system conforming to the following.

1. **Galvanized Metal Deck:** Corrugated steel decking incorporating a pre-applied galvanized coating conforming to a minimum Class G-60 as specified in ASTM A 525 and having slots in the flutes equal to a minimum of 0.5% of the deck area. Refer to general notes on the structural drawings and Specification Section 05300 for metal deck specifications and attachment requirements.

* NOTE Modification of metal deck welding patterns may be required to meet specific design criteria.

2. **Portland Cement:** Portland cement conforming to Type I, II, or III as defined by ASTM C 150.
3. **Foam Concentrate:** Protein based foam concentrate conforming to ASTM C 869 and ASTM C 796.
 - > Insulcel PB Foam Concentrate by Siplast, Inc., Irving, TX
4. **Expanded Polystyrene Insulation Board:** Expanded polystyrene (EPS) insulation board having a nominal density of 1 pcf (16 kg/m³) defined as Type I by ASTM C 578 and containing approximately 3% open area. Each bundle of board shall be delivered to the job site with clear identification as to manufacturer and shall carry the Factory Mutual approval label and the Underwriter's Laboratories Classified label on each bundle.
 - > Insulperm Insulation Board by Siplast, Inc., Irving, TX
5. **Water:** Potable water that is clean and free of deleterious amounts of acid, alkali and organic materials.
6. The minimum average R-value of the insulated concrete deck system shall be R-25

2.03 MIX DESIGN

A. Density: Mix Portland cement and pregenerated foam with water to achieve a wet density ranging from 38 to 48 pcf (609 to 769 kg/m³), resulting in a minimum dry density of 30 pcf (481 kg/m³) and minimum compressive strength of 300 psi (1380 kPa).

PART 3: EXECUTION

3.01 EXAMINATION

A. General: Ensure that all surfaces to receive lightweight insulating concrete are free of oil, grease, paints/primers, loose mill scale, dirt, or other foreign substances. Where necessary, cleaning or other corrections of surfaces to receive lightweight insulating concrete is the responsibility of the party causing the unacceptable condition of the substrate.

- B. Substrate Acceptance:** With the general contractor present, examine surfaces to receive the roof insulation system and determine that the surfaces are acceptable prior to placement of the lightweight insulating concrete system.

3.02 PREPARATION

- A. General:** Remove water or any other substance that would interfere with bonding of the lightweight concrete system.

3.03 APPLICATION

- A. General:** Provide equipment and application procedures conforming to the material supplier's application instructions.
- B. Applications Not Incorporating Expanded Polystyrene Panels:** Place lightweight insulating concrete in a 2 inch (25 mm) minimum thickness over the top corrugation of metal decks, over the surface of a prepared substrate, or over the existing membrane surface in recover applications.
- C. Applications Incorporating Expanded Polystyrene Panels:** When the specified expanded polystyrene insulation panels are to be incorporated into the lightweight insulating concrete system, place a 1/8 inch (3 mm) minimum thickness of insulating concrete slurry coat over top of the prepared substrate or for metal deck applications, fill the flutes and place a 1/8 inch (3 mm) minimum slurry over the top corrugation of metal deck before embedding the expanded polystyrene insulation panels. Place the thickness of expanded polystyrene insulation panels shown in the approved shop drawings within 30 minutes of applying the insulating concrete slurry coat to the substrate. When metal deck substrates are used, place the expanded polystyrene insulation panels in a brick-like pattern. The maximum allowable panel step in a stair-step design is 1 inch (25 mm). Fill the holes in the expanded polystyrene insulation panels and place a 2 inch (51 mm) minimum thickness of insulating concrete over top of the expanded polystyrene insulation panels within the same day's application.

* NOTE Other regulatory or jobsite sequencing issues may require application of the top fill the next day. Contact Siplast Technical Department for specific information as required.

- D. Thermal Resistance:** Install the specified lightweight insulating concrete system to provide for an [average/minimum] thermal value of **R-25** or as shown on the architectural details/drawings.
- E. Slope:** Install the specified lightweight insulating concrete system to provide for a minimum positive roof slope of 1/4 inch per foot. See the structural drawings for slope provided by the roof framing system.

3.04 FIELD QUALITY CONTROL

- A. Protection:** Avoid roof-top traffic over the roof insulation system until one can walk over the surface without creating surface damage.
- B. Compressive Strength Testing:** The Architect has the option to select an independent testing laboratory to randomly sample the top placement of insulating concrete to verify the thickness and density, and to secure and test compressive strength cylinders in accordance with ASTM C 495. The Owner will be responsible for the cost and engagement of the independent testing laboratory services.

- C. Application Monitoring:** Monitor the thickness and wet density of the lightweight insulating concrete at the time of placement to determine conformance to the manufacturer's requirements. Monitor the placement of proper thickness of polystyrene insulation board in accordance with the contract documents.
- D. Fastener Withdrawal Testing:** Conduct a base ply fastener pull test 3 or more days following the application of the lightweight insulating concrete to ensure a minimum withdrawal resistance of 40 pounds (18 kg) per fastener.

3.05 PATCHING

- A. Patching:** Perform all patching and repairing of insulating concrete using Zono-Patch or other materials approved by the lightweight insulating concrete supplier.

END OF SECTION

SECTION 03 54 16
HYDRAULIC CEMENT UNDERLAYMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Liquid-applied self-leveling floor underlayment for resilient tile installation.
 - 1. Use hydraulic cement underlayment for application below interior floor coverings.

1.02 REFERENCE STANDARDS

- A. ASTM F710 - "Standard Practice for Preparing Concrete Floors To Receive Resilient Flooring".
- B. ASTM C1708 - "Standard Test Method for Self-Leveling Mortars Containing Hydraulic Cements".
- C. ASTM F2170 - "Standard Test Method for Determining Relative Humidity in Concrete Slabs Using in-situ Probes".
- D. ASTM F1869 - "Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride".
- E. ASTM C150 - "Standard Specification for Portland Cement".

1.03 SUBMITTALS

- A. See Section 01 33 00 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data sheets documenting physical characteristics and product limitations of underlayment materials. Include information on surface preparation, environmental limitations, and installation instructions.
- C. Environmental Product Declaration (EPD).
- D. Independent Laboratory Test Report: ASTM C1708 / C1708M-16.

1.04 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the work of this section, and approved by manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store all products indoors in original unopened packaging. Keep all materials dry and away from direct sun exposure in moderate conditions between temperatures of 50 °F to 90 °F (10 °C to 32 °C).

1.06 MOCK-UP

- A. Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - 1. Prepare mock-up in location designated by Architect.
 - 2. Area: 6 ft by 6 ft (2 m by 2 m).
- B. Mock-up may remain as part of the Work.

1.07 FIELD CONDITIONS

- A. Do not install underlayment until floor penetrations and peripheral work are complete.
- B. Maintain minimum ambient temperatures of 50 degrees F (10 degrees C) 24 hours before, during and 72 hours after installation of underlayment.

1.08 WARRANTY

- A. Provide minimum 10 year manufacturer system warranty for LVT installation utilizing all products required per the manufacturer to achieve. Basis of design warranty to be Uzin Utz Classic + 10 warranty.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Basis of Design : Uzin Utz North America, Inc.
- B. Mapei
- C. Sika USA
- D. Or approved equal (submitted for review during bid process)

MATERIALS

- A. **Basis of Design** Cementitious Underlayment: Blended cement mix, that when mixed with water in accordance with manufacturer's directions will produce a self-leveling underlayment.
 - 1. UZIN NC 150
 - Compressive Strength: Minimum 4500 psi (31.03 MPa) after 28 days, tested per ASTM C1708.
 - Flexural Strength: Minimum 900 psi (6.21 MPa) after 28 days, tested per ASTM C1708.
 - Thickness: Capable of thicknesses from 1/16" (1.5 mm) to maximum 1" (25mm).
 - 2. UZIN NC 157
 - Compressive Strength: Minimum 6000 psi (41.37 MPa) after 28 days, tested per ASTM C1708.
 - Flexural Strength: Minimum 1100 psi (7.58 MPa) after 28 days, tested per ASTM C1708.
 - Thickness: Capable of thicknesses from 1/4" (6 mm) to maximum 2" (50 mm).
 - 3. UZIN NC 170
 - Compressive Strength: Minimum 6000 psi (41.37 MPa) after 28 days, tested per ASTM C1708.
 - Flexural Strength: Minimum 1000 psi (6.89 MPa) after 28 days, tested per ASTM C1708.
 - Thickness: Capable of thicknesses from 1/16" (1.5 mm) to maximum NO DEPTH LIMITATION (_mm).
 - 4. UZIN NC 172
 - Compressive Strength: Minimum 8000 psi (55.16 MPa) after 28 days, tested per ASTM C1708. (24-hour compressive strength of 4500 psi (31.03 MPa).)
 - Flexural Strength: Minimum 1800 psi (12.41 MPa) after 28 days, tested per ASTM C1708.
 - Thickness: Capable of thicknesses from 1/16" (1.5 mm) to maximum NO DEPTH LIMITATION (_mm).
 - 5. UZIN NC 144 LW
 - Compressive Strength: Minimum 3000 psi (20.68 MPa) after 28 days, tested per ASTM C1708.
 - Flexural Strength: Minimum 600 psi (4.14 MPa) after 28 days, tested per ASTM C1708.
 - Thickness: Capable of thicknesses from 1/4" (6 mm) to maximum 2" (50 mm).
 - Lightweight: Dry Density of 67.0 ±2 lbs./ft³ (1.40 lbs./ft² at 1/4").
- B. Low Emitting
 - 1. VOC content: 0g/L. Compliant with SCAQMD rule 1113.

- 2. Certified: SCS Indoor Advantage Gold
- C. Water: Potable and not detrimental to underlayment mix materials.

2.02 MIXING

- A. Site mix materials in accordance with manufacturer's instructions.
- B. Mix to self-leveling consistency without over-watering.

2.03 ACCESSORIES

- A. Primer:
 - 1. Gypsum Concrete: Two coat application of UZIN PE 260 Primer (diluted to absorbency requirement to seal substrate).
 - 2. Standard Absorbent Concrete: UZIN PE 260 Primer (diluted to absorbency requirement to seal substrate).
 - 3. Extremely Absorbent Concrete: Two coat application of UZIN PE 260 Primer (diluted to absorbency requirement to seal substrate).
 - 4. Wood: UZIN PE 260 Primer (undiluted).
 - 5. Metal: UZIN PE 414 or PE 460 (seek technical guidance before proceeding).
 - 6. Other Non-Porous Substrates: UZIN PE 280 Primer.
- B. Joint Filler:
 - 1. Low-odor, 2-component, semi-rigid, polyurea joint filler: UZIN KR 518.
- C. Reinforcing Fibers: Can be used to improve impact resistance and control shrinkage of any UZIN self-leveling compound when used on demanding surfaces. Reduces cracking of the leveling compound when used on unsound substrates.
 - 1. Substrate Reinforcing Fibers – UZIN Bagged Fiber.
 - 2. Substrate Reinforcing Mesh (Sheets) – UZIN RR 201.
- D. Adhesive:
 - 1. Provide UZIN adhesive as required to achieve system warranty based on final system products needed to achieve the noted installation warranty type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are clean, dry, unfrozen, do not contain petroleum byproducts, or other compounds detrimental to underlayment material bond to substrate.
- B. Moisture Testing: Perform testing according to ASTM F2170. Provide 3 tests for the first 1,000 sq.ft. of floor area plus 1 additional test for each 1,000 sq.ft. thereafter.
 - 1. Relative Humidity Test: Using in situ probes, follow ASTM F2170. Proceed with installation only if the substrate is within spec of the underlayment, adhesive, and finished floor covering manufacturers' limitations.
 - 2. For concrete substrates with high residual moisture, notify owner, owner's rep and manufacturer for recommended preparation to achieve system installation warranty

3.02 PREPARATION

- A. Remove substrate surface irregularities. Fill voids and deck joints with filler. Finish smooth.
- B. Vacuum clean surfaces.
- C. Prime substrate in accordance with manufacturer's instructions. Allow to dry.
- D. Close floor openings.

3.03 APPLICATION

- A. Install underlayment in accordance with manufacturer's instructions. Always refer to the most current product information at us.uzin.com.

- B. Pump or pour material onto substrate. Do not retemper or add water.
 - 1. Pump, move, and screed while the material is still highly flowable.
 - 2. Be careful not to create cold joints.
 - 3. Wear spiked shoes while working in the wet material to avoid leaving marks.
- C. Place to indicated thickness, with top surface level to 1/8 inch in 10 ft (1:1000).
- D. If a fine, feathered edge is desired, steel trowel the edge after initial set, but before it is completely hard.

3.04 CURING

- A. Once underlayment starts to set, prohibit foot traffic until final set has been reached.

3.05 PROTECTION

- A. Protect against direct sunlight, heat, and wind; prevent rapid drying to avoid shrinkage and cracking.
- B. Do not permit traffic over unprotected floor underlayment surfaces.

**END OF
SECTION**

SECTION 04 09 00
MASONRY RESTORATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
1. Remove and Reinstall masonry units as required for patching and/or replace CMU units entirely.
- B. Related Sections include the following:
1. Division 01 Section "Quality Control" for Testing Laboratory Services.
 2. Division 07 Section "Sealants" for backer rod and sealant for expansion joints.

1.03 REFERENCES

- A. American Society for Testing and Materials (ASTM):
1. C 5 - Quicklime for Structural Purposes.
 2. C 91 - Masonry Cement.
 3. C 94 - Ready-mixed Concrete.
 4. C 144 - Aggregate for Masonry Mortar.
 5. C 150 - Portland Cement.
 6. C 207 - Hydrated Lime for Masonry Purposes.
 7. C 270 - Mortar for Unit Masonry - Packaged, Dry, Combined Materials for Mortar and Concrete.
 8. C 404 - Aggregate for Masonry Grout.
 9. C 780 - Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Masonry.
 10. C 1019 - Method of Sampling and Testing Grout.
- B. Brick Institute of America (BIA): Technical Notes.

1.04 PERFORMANCE REQUIREMENTS

- A. Material Compatibility: Provide replacement mortar and masonry materials that are compatible with one another and with existing mortar and masonry that remains in place adjacent to replacement materials.

1.05 SUBMITTALS

- A. Product List: Submit list of proposed Products and manufacturers, including all items specified in Part 2 – Products or otherwise required by the Work.
- B. Product Data: Provide complete descriptive data including design mixes, component proportions, admixtures limitations, requirements for mixing, expected pot life, required environmental conditions, and recommendations for curing. Indicate Proportion or Property method used.
- C. Samples: Submit one mortar joint sample 48-inches long, illustrating mortar color, type, texture, and joint configuration which are required to match existing adjacent intact joints.
- D. Quality Assurance/Control Data:
1. Certificates: Submit manufacturer's certification that products meet or exceed specified requirements.
 2. Test Reports: Provide test results for each type of mortar indicating strength achieved from proposed design mix. Certify mortar conformance to ASTM C-270 and grout conformance to ASTM C 476.
 3. Manufacturer's Installation Instructions: Include mixing requirements for specified and selected Products and admixtures.
 4. Manufacturer's Safety Data Sheets: Submit data for each proposed product, and maintain on site and available at all times.

1.06 QUALITY ASSURANCE

- A. Perform work in accordance with BIA Technical Notes 1A.
- B. Maintain one copy of each document accessible to site.

1.07 QUALIFICATIONS

- A. Manufacturer: Company specializing in the manufacturer of products specified in this Section with minimum three years documented experience.
- B. Installer: Company specializing in applying the work of this Section with minimum three years documented experience.
- C. Supervisor/Foreman: Individual that is a direct employee of Installation Company with minimum five years' experience using selected Products.

1.08 REGULATORY REQUIREMENTS

- A. Conform to applicable code for fire rated masonry construction.

1.09 Review conditions of installation, installation procedures, and coordination with related work.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Division 01 Section "Product Requirements".
- B. Accept and store products on site in Manufacturer's original, unopened and labeled containers. Remove damaged materials from site.
- C. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.
- D. Store solvents and cleaners in fully secured areas, outside enclosed building areas.

1.11 PROJECT/SITE CONDITIONS

- A. Environmental Requirements:
 - 1. Do not install mortar when predicted temperature and humidity are outside range recommended by manufacturer.
 - 2. Do not install mortar in freezing weather.
 - 3. Do not add anti-freeze or similar ingredients.
 - 4. Maintain materials and surrounding air temperature to minimum 50 degrees F prior to, during and 48 hours after completion of masonry work.

1.12 SCHEDULING

- A. Schedule work under provisions of Division 01 Section "Project Management and Coordination".
- B. Schedule work to allow mortar to cure prior to installation of base flashings or membranes that would inhibit proper curing.

1.13 WARRANTY

- A. Provide a two (2) year warranty under provisions of Division 1 Section "Product Requirements.
- B. Warranty: Include coverage against defects in materials and workmanship that result in deterioration of installed mortar or penetration of water through joints.

PART 2 PRODUCTS

2.01 MASONRY REPAIR MATERIALS

- A. Portland Cement: ASTM C150, Type I, gray color.
- B. Masonry Cement: ASTM C91, Type S.
- C. Mortar Aggregate: ASTM C144, standard masonry type; clean, dry, protected against dampness, freezing, and foreign matter.
- D. Hydrated Lime: ASTM C207, Type S.
- E. Quicklime: ASTM C5, non-hydraulic type.
- F. Premix Mortar: ASTM C387, using gray cement, Normal strength.
- G. Grout Aggregate: ASTM C404.

- H. Water: Clean and potable.
- I. Bonding Agent: Two component modified epoxy resin.
- J. Sealant: As specified in Division 07 Section "Roofing Sealants".

2.02 MASONRY UNITS

- A. Concrete Masonry Units (CMU): Conform to ASTM C-90. Unit size, face texture and color to match existing as closely as possible, as selected and approved by Owner's Representative. Provide solid units where required.
- B. Face Brick: Conform to ASTM C-216, SW, Type FBS. Brick size, face texture and color to match existing as closely as possible, as selected and approved by Owner's Representative. Provide solid units where required.

2.03 MORTAR MIXES

- A. Mortar for Masonry (if required): ASTM C270, Type S using the Property Method.
- B. Pointing Mortar: ASTM C270, Type N using the Property Method; with maximum 2 percent ammonium stearate or calcium stearate per cement weight; strength to match existing as determined from testing.

2.04 MORTAR MIXING

- A. Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with ASTM C270.
- B. Do not use anti-freeze compound to lower the freezing point of mortar.
- C. If water is lost by evaporation, retemper only within two hours of mixing.
- D. Use mortar within two hours after mixing.

2.05 GROUT MIXES

- A. Bond Beams, Lintels, and Engineered Masonry: 3000 psi strength at 28 days; 7-8 inches slump; premixed type in accordance with ASTM C94.

2.06 GROUT MIXING

- A. Mix concrete in accordance with ASTM C94.
- B. Do not use anti-freeze compound to lower the freezing point of grout.

2.07 SOURCE QUALITY CONTROL

- A. Provide testing and analysis of existing mortar under provisions of Division 01 Section "Quality Requirements".
- B. Select locations for testing existing joints that are sound undamaged. Consult with Owner's Representative for approved locations.
- C. Test samples in accordance with approved and recognized methods.
- D. Verification of Performance: Determine strength of existing mortar and develop a design mix to achieve similar strengths for pointing mortar.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable, surfaces are ready to receive work, and existing masonry and brick work will not be damaged from flashing installation work.
- B. Report any unsatisfactory conditions in writing to Owner's Representative.
- C. Do not proceed until unsatisfactory conditions are corrected.
- D. Beginning of installation means acceptance of existing surfaces and substrate.

3.02 PREPARATION

- A. Protect adjacent surfaces not being modified, including vegetation, from damage or spatter from flashing installation.
- B. Remove and store all loose masonry and brick units that are to be reused. Clean removed units of all mortar and deleterious materials prior to reinstallation.
- C. Apply bonding agent to existing concrete surfaces.
- D. Plug cleanout holes with block masonry units to prevent leakage of grout materials. Brace masonry for wet grout pressure.

3.03 INSTALLATION

- A. Install mortar and grout in accordance with BIA recommendations.
- B. Work grout into masonry cores and cavities to eliminate voids.
- C. Do not displace reinforcement while placing grout.
- D. Clean grout spaces of excess mortar.

3.04 BRICK REMOVAL

- A. Remove masonry units brick in sections as required for the renovation work outlined, but not large enough to allow deflection in masonry to remain in place unless properly braced.
 1. Remove masonry units brick in a manner to avoid damage.
 2. Remove mortar from undamaged masonry units bricks and store for reinstallation.
 3. Discard masonry units brick that are broken, cracked or chipped.
 4. Maximum Recommended (Removal) Section Size: Four (4) courses high by 4-feet wide.
- B. Site Tolerances:
 1. Maximum Variation from Plan or Location Indicated on Drawings: 1/8-inch in 10-feet.
 2. Maximum Offset from True Alignment Between Adjacent Members Butting or In Line: 1/8-inch in any 10 linear feet.
 3. Joint Size: 3/8-inch or match existing.
 4. Maximum Variation of Joint Thickness: + 1/16-inch.

3.05 BRICK/BLOCK INSTALLATION

- A. Perform moisture absorption testing on brick masonry units to be reinstalled in presence of Owner's Representative.
- B. Lay brick/block plumb, level and true to line in full beds of mortar.
 1. Lay units in bond pattern to match existing.
 2. Lay with completely filled mortar joints.
 3. Butter ends of brick with sufficient mortar to fill head joints.
 4. If unit is moved after setting, remove, clean and reset.
 5. Tool all joints to match existing joints.

3.06 FIELD QUALITY CONTROL

- A. Site inspection and testing will be performed under provisions of Division 01 Section "Quality Requirements".

3.07 CLEANING

- A. Clean work under provisions of Division 01 Section "Execution".
- B. Remove excess mortar and mortar smears from building and work areas daily.
- C. Replace defective mortar. Match adjacent work.
- D. Clean soiled surfaces with cleaning solution that will not harm masonry of adjacent materials. Consult manufacturer of materials for acceptable cleaners.
- E. Use non-metallic tools in cleaning operations.
- F. Clean grounds and roofing surfaces free of mortar and masonry debris.

3.08 PROTECTION

- A. Protect finished installation under provisions of Division 01 Section "Execution".
- B. Provide protection without damaging completed work.
- C. At end of day, cover unfinished areas to prevent moisture infiltration.
- D. Do not permit traffic over unprotected roof surfaces.

END OF SECTION

SECTION 04 20 00
UNIT MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Concrete Block
- B. Clay Facing Brick
- C. Mortar and Grout
- D. Reinforcement and Anchorage
- E. Lintels
- F. Accessories

1.2 RELATED REQUIREMENTS

- A. Section 03 20 00 - Concrete Reinforcing: Reinforcing steel for grouted masonry.
- B. Section 05 50 00 - Metal Fabrications: Loose steel lintels.
- C. Section 06 10 00 - Rough Carpentry: Nailing strips built into masonry.
- D. Section 07 25 00 – Weather Barriers.
- E. Section 07 21 00 - Thermal Insulation: Insulation for cavity spaces.
- F. Section 07 21 23 - Loose Fill Insulation: Granular insulation for masonry unit cores.
- G. Section 07 62 00 - Sheet Metal Flashing and Trim: Through-wall masonry flashings.
- H. Section 07 81 20 – Firestopping, Penetrations, Seals.
- I. Section 07 90 05 - Joint Sealers: Backing rod and sealant at control and expansion joints.

1.3 REFERENCE STANDARDS

- A. ACI 530/530.1/ERTA - Building Code Requirements and Specification for Masonry Structures and Related Commentaries; American Concrete Institute International; 2011.
- B. ASCE / SEI 7 - Minimum Design Loads for Buildings and Other Structures.
- C. ASTM A82/A82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement; 2007.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- E. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2013.
- F. ASTM C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile; 2013.
- G. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2013.
- H. ASTM C91/C91M - Standard Specification for Masonry Cement; 2012.
- I. ASTM C109/ C109M-13 "Standard Test Method for Compressive Strength of Hydraulic Cement Mortars".
- J. ASTM C140/C140M - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units; 2013.
- K. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2011.
- L. ASTM C150/C150M - Standard Specification for Portland Cement; 2012.
- M. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2006 (Reapproved 2011).

- N. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale); 2013.
- O. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2012.
- P. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2011.
- Q. ASTM C476 - Standard Specification for Grout for Masonry; 2010.
- R. ASTM C652 - Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale); 2013.
- S. ASTM C744 - Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units; 2011.
- T. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2010.
- U. ASTM C1019-13- Standard Test Method for Sampling and Testing Grout.
- V. ASTM C1148 - Standard Test Method for Measuring the Drying Shrinkage of Masonry Mortar; 1992a (Reapproved 2008).
- W. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2012.
- X. ASTM C1357 - Standard Test Methods for Evaluating Masonry Bond Strength; 2009.
- Y. ASTM C 1506-09 "Standard Test Method for Water Retention of Hydraulic Cement-Based Mortars and Plasters"
- Z. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2009.
- AA. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry; 2011.
- AB. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.
- AC. ACI 315 "Details and Detailing of Concrete Reinforcement" For Reinforcing Steel. Detail bending and placement of unit masonry reinforcing bars.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meeting: Convene a pre-installation meeting one week before starting work of this section; require attendance by all relevant installers.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- C. Samples: Submit four samples of decorative block units to illustrate color, texture, and extremes of color range.
- D. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
- E. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.
- F. Test Reports: Concrete masonry manufacturer's test reports for units with integral water repellent admixture.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.6 QUALITY ASSURANCE

- A. Comply with provisions of ACI 530/530.1/ERTA & ASCE 7 / TMS 602, except where exceeded by requirements of the contract documents.
 - 1. Maintain one copy of each document on project site.
- B. Where indicated or as required, provide materials and construction which is identical to assemblies whose fire endurance has been determined by testing in compliance with ASTM E119 by U.L.
- C. Single Source Responsibility:
 - 1. Obtain masonry units of uniform texture and color, or a uniform blend within the accepted ranges for those characteristics, from one manufacturer.
 - 2. Brands of cementitious materials and admixtures, and the source of supply of sand and aggregates shall remain the same throughout the Work.

1.7 REQUIRED TEST, INSPECTIONS, AND COORDINATION

- 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 the Contractor of responsibilities for providing materials and procedures which comply with Contract Documents.
- B. Opening and chases for heating, plumbing, electrical ducts, pipes, and conduits shall be built into masonry wall 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 for steel reinforcement for reinforced masonry. Coordinate placement of concrete in masonry beams, lintels, soffits and pilasters.
- C. Require coordination with work of Section 07 25 00 Weather Barriers and all sections of Work built-in, adjacent to, or applied to unit masonry work.

1.8 WARRANTY

- A. Contractor shall provide warranty for the work for one year beyond final acceptance of the project against becoming unserviceable or causing objectionable appearance resulting from either defective or non conforming materials or workmanship.
 - 1. Defects shall include noticeable deterioration of unit or mortar finish, chalking or dusting excessively, changing color in irregular fashion, cracking or spalling, releasing from substrate and staining or discoloring, including efflorescence.

1.9 MOCK-UP

- A. Construct a masonry wall as a mock-up panel sized 8 feet (2.4 m) long by 7 feet (2.13 m) high; include mortar and accessories and structural backup in mock-up.
- B. Locate where directed. For renovation projects locate adjacent to existing building to allow side by side comparison.
- C. Mock-up may remain as part of the Work.
- D. Installation of all materials and products shall be in accordance with all applicable specifications as noted in the project manual and as indicated in the drawings.
- E. No work shall proceed until the mock-up wall is approved.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.1 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and refer to drawings for Block types:
1. Standard concrete block: Best Block is basis of design, other approved only if matching existing: Upchurch Kimbrough, Headwaters, Oldcastle, Featherlite, Spectra, Trenwyth.
 - a. Sizes: 16 x 8 inches (400 x 200 mm), 16 x 6 inches (400 x 150 mm), 16 x 4 inches (400 x 100 mm) and nominal depths as indicated in the drawings.
 2. Basis of Design to match existing in building:
 - a. Size: Standard units with nominal face dimensions of 16 x 8 inches (400 x 200 mm), 16 x 4 inches (400 x 100 mm) and nominal depths as indicated on the drawings for specific locations.
 3. Special Shapes: Provide non-standard blocks configured for corners, lintels, headers, control joint edges, and other detailed conditions.
 4. Units with Integral Water Repellent (At all exterior and wet locations): Concrete block units as specified in this section with polymeric liquid admixture added to concrete masonry units at the time of manufacture.
 - a. Performance of Units with Integral Water Repellent:
 - 1) Water Permanence: When tested per ASTM E514 and for a minimum of 72 hours.
 - (a) No water visible on back of wall above flashing at the end of 24 hours.
 - (b) No flow of water from flashing equal to or greater than 0.032 gallons per hour (0.05 L per hour) at the end of 24 hours.
 - (c) No more than 25% of wall area above flashing visibly damp at end of test.
 - 2) Flexural Bond Strength: ASTM C1357; minimum 10% increase.
 - 3) Compressive Strength: ASTM C1314; maximum 5% decrease.
 - 4) Drying Shrinkage: ASTM C1148; maximum 5% increase in shrinkage.
 - b. Use only in combination with mortar and grout that also has integral water repellent admixture.
 - c. Use water repellent admixtures for masonry units, mortar and grout by a single manufacturer.
 - d. Manufacturers:
 - 1) W.R. Grace & Co. "Dry-Block Block Admixture".
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
 5. Comply with ASTM C90 (Class D-2 (2 hour)) and Class B-4 (4 hour)) at rated walls with a type N grade for the highest standard for typical cavity block and interior use. Type S, for exterior exposed masonry walls. Aggregate should be lightweight in accordance with ASTM C331.
 - a. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
 - b. Density Classification: Lightweight.
 6. Curing should be a rotary kiln process.
 7. Provide bullnose units at all outside corners, except where ceramic wall tile is scheduled.
 8. Provide Graffiti protection on split faced CMU or prefinished/burnished CMU.
 9. Provide bond beams, control joints, jambs, lintels, soaps, cap blocks, and filler to match and compliment block units as shown or required.
 10. Non loadbearing units: ASTM C 129 lightweight.
 11. 4" wide units shall be provided as hollow cell units.

2.2 BRICK UNITS

- A. Manufacturers:
1. Basis of Design: Acme Brick; To match existing.
 2. Acceptable manufacturers: Boral, Elgin Butler, Edicott. only if identical match to existing.
 2. Substitutions: Not permitted.
- B. Facing Brick: ASTM C216, Type FBX, Grade SW.

1. Nominal size: As indicated on drawings or to match existing.
2. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect and to match existing.
3. Initial rate of absorption less than 30g/ 30 sq in per minute when tested per ASTM C67.

2.3 MORTAR AND GROUT MATERIALS

A. Mortar:

1. Portland Cement: ASTM C150, Type I or II, except Type III may be used for cold-weather; color as required to produce approved color sample.
2. Hydrated Lime: ASTM C207, Type N typical. Type "S" for load-bearing masonry.
3. Mortar Aggregate: sand conforming to ASTM C144.
4. Clean and Potable Water.
5. Admixtures for Mortar include spectrum mortar color for face brick and concrete masonry units. In general do not use Calcium chloride.
6. Mix Design (Proportions by volume) (Unless stated otherwise on Structural Drawings)
 - a. Typical Non-load bearing masonry shall comply with ASTM C270 Type "N" in proportions of 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 shall comply with Type ASTM C270, Type "S" with proportions of 1 part cement, 1/2 part hydrated lime and 4-1/2 parts sand to provide compressive strength of 1800 psi in 28 days. Do not use calcium chloride.

B. Grout:

1. Hydrated Lime: ASTM C207, Type "S"
2. Portland Cement: ASTM C 150, Type I or II, except III may be used in cold weather;
3. Grout Aggregate: conform to ASTM C404
4. Fine Aggregate: conform to ASTM C144
5. Mix Design shall comply with ASTM C476 to provide compressive strength of 2,500 psi in 28 days, unless noted otherwise in the structural drawings. Do not use calcium chloride.
 - a. 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.
 - b. 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.

C. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979.

1. Color(s): to match existing at each masonry coursing.
2. In general, do not use calcium chloride.

D. Water: Clean and potable.

E. Integral Water Repellent Admixture for Mortar and Grout: Polymeric liquid polymeric admixture added to mortar and grout at the time of manufacture.

1. Basis of Design WR Grace & Co "Dry Block Admixture" or equal.
2. Use only in combination with masonry units manufactured with integral water repellent admixture.
3. Use only water repellent admixture for mortar and grout from the same manufacturer as water repellent admixture in masonry units.
4. Meet or exceed performance specified for water repellent admixture used in masonry units.

2.4 REINFORCEMENT AND ANCHORAGE

A. Acceptable Manufacturers:

1. Hohmann & Barnard, Inc.
2. Dur-o-Wal.
3. Wire-bond.

- B. Single Wythe Joint Reinforcement: Truss or ladder type; ASTM A82/A82M steel wire, hot dip galvanized after fabrication to ASTM A153/A153M, Class B-2; 0.1875 inch (4.8 mm) side rods with 0.1875 inch (4.8 mm) cross rods; width as required to provide not more than 1 inch (25 mm) and not less than 1/2 inch (13 mm) of mortar coverage on each exposure. Pre-fab corners and tees shall be used at all corners and intersections. Provide Joint reinforcement in lengths greater than 10 feet with prefabricated corners and tee units.
- C. Multiple Wythe Joint Reinforcement: Truss type; fabricated with moisture drip; ASTM A 82/A 82M steel wire, hot dip galvanized after fabrication to ASTM A 153/153M, Class B-2; 0.1875 inch (4.8 mm) side rods with 0.1875 inch (4.8 mm) cross rods; width as required to provide not more than 1 inch (25 mm) and not less than 1/2 inch (13 mm) of mortar coverage on each exposure. Pre-fab corners and tees shall be used at all corners and intersections. Provide Joint Reinforcement in lengths greater than 10 feet with prefabricated corners and tee units.
- D. Strap Anchors: Bent steel shapes configured as required for specific situations, 1-1/4 in (32 mm) width, 0.105 in (2.7 mm) thick, lengths as required to provide not more than 1 inch (25 mm) and not less than 1/2 inch (13 mm) of mortar coverage from masonry face, corrugated for embedment in masonry joint, hot dip galvanized to ASTM A 153/A 153M, Class B.
- E. Wall Ties: Adjustable of appropriate configuration, 7/8 inch (22 mm) wide by 0.05 inch (1.22 mm) thick, hot dip galvanized to ASTM A 153/A 153M, Class B, sized to provide not more than 1 inch (25 mm) and not less than 1 inch (25 mm) of mortar coverage from masonry face. Maximum interval of 24" each way.
- F. Headed Stud Anchor shall be welded by full-fusion process
- G. Bolts shall comply with ASTM A307. Furnish with carbon steel washers
- H. Deformed Bar anchors shall be welded by full-fusion process.
- I. Reinforcing Bars to be welded as per ASTM A706.
- J. Anchors detailed on Structural Drawings supersede.

2.5 FLASHINGS

- A. Metal Flashing Materials: Copper, as specified in Section 07 62 00.
- B. Flashing cement shall be "Neverplast" cold setting mastic.
- A. Rubberized Asphalt Flashing-
 - 1. Manufacturers:
 - a. Hohmann & Barnard Inc; Flex-Flash Flashing System
 - b. Hyload, Inc. Cloaked Flashing System
 - 2. Provide 40 mil Flexible rubberized asphalt, self-sealing through wall flashing with silicone release sheet, wall flashing accessories, flashing at spandrels and cavities; under copings , band courses, ad sills; over lintels and shelf angles, flashings at low roof to high wall conditions and all other wall conditions necessary to provide a watertight wall assembly.

2.6 ACCESSORIES

- A. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
 - 1. Full-Height Airspace Maintenance and Drainage Material: Mesh panels, fitted between masonry ties.
 - 2. Basis of design: Mortar net USA.
- B. Building Paper: ASTM D226/D226M, Type I ("No.15") asphalt felt.

- C. Nailing Strips: Softwood lumber, preservative treated for moisture resistance, dovetail shape, sized to masonry joints.
- D. Weeps: Molded PVC grilles, insect resistant.
- E. Cavity Drainage Protection: recycled polyester/ polyethylene mesh
 - 1. 2 inch thick by 10 inch high by 5 feet long
 - 2. Trapezoidal shaped, continuous at foundation, at heads above openings and shelf angles
- F. Reinforcing Steel: ASTM A 615, Grade 60
- G. Form grade plywood with wood studs and wales as required
- H. Patented shores of design and manufacture sufficient to safely support imposed loads
- I. Pre-molded filler shall be fibrous mastic strips containing 35 percent to 50 percent asphaltic impregnation, ASTM D1751
- J. Bond Break Material: Provide one layer of 6 mil polyethylene equal to “Visqueen Vapour Barrier” as a bond breaker between all clay masonry and CMU in the same wythe. Rake joint back 3/8” and provide continuous sealant at joint.
- K. Lintels: All concrete masonry lintels, not including 4” nominal concrete masonry veneer lintels, shall be reinforced concrete masonry lintels as specified in the Structural Drawings unless steel beam supports are shown in the structural drawings. Where steel beam supports are shown, the concrete masonry shall be bonded to the top of the steel beam with ½” diameter Nelson D2Lbars x 24” long at 16” o.c.

2.7 MORTAR AND GROUT MIXES

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification, unless stated otherwise in Structural drawings.
 - 1. Masonry below grade and in contact with earth: Type S.
 - 2. Exterior, loadbearing masonry: Type S, with proportions of 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. Type N per Alief isd
 - 3. Exterior, non-loadbearing masonry: Type N, with proportions of 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.
 - 4. Interior, loadbearing masonry: Type N.
 - 5. Interior, non-loadbearing masonry: Type O.- Type N per Alief ISD
 - 6. Pointing mortar for prefaced or specially faced unit masonry: One part Portland cement, 1/8 part hydrated lime, and two parts graded (80 mesh) aggregate, proportioned by volume. Add aluminum tristate, calcium stearate, or ammonium separate equal to 2 percent of Portland cement by weight.
 - 7. Glass unit masonry: Type N mortar and Type O pointing mortar.
- B. Grout: ASTM C476. Consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches (50 mm) or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches (50 mm).
 - 1. Mix design shall provide a compressive strength of 2,500 psi in 28 days, unless noted otherwise. Do not use calcium chloride.
 - a. Fine grout conforming to ASTM 476 and consisting of 1 part Portland cement, 0 to 1/10 part lime and 2-1/4 to 3 parts sand by volume.
 - b. Course grout conforming to ASTM 476 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.
 - c. Bond Beams and lintels: 2,500 psi at 28 days; 8-10 inches slump; provide premixed type in accordance with ASTM C94/C 94M.
 - d. Fine grout for spaces with smallest horizontal dimension of 2 inches or less.
 - e. Coarse grout for spaces with smallest horizontal dimension greater than 2 inches.

- C. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing. Provide forms and shores sufficiently strong and rigid as required to support soffits, beams, and lintels during construction.

3.3 COLD AND HOT WEATHER REQUIREMENTS

- A. Comply with requirements of ACI 530/530.1/ERTA or applicable building code, whichever is more stringent.

3.4 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
 - 1. Bond: As indicated for different locations.
 - 2. Mortar Joints: Concave.
- D. Brick Units:

3.5 PLACING AND BONDING

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Building 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, and properly brace or tie together so as to maintain position and shape.
- C. Concrete Masonry Units: where cutting is required, masonry shall be cut with a sharp masonry saw. Ensure concrete masonry units to receive sand fill are ready for filling and cutouts are protected from material spillage.
- D. Dampen brick before laying in a manner consistent with the nature of the brick, the mortar and the weather conditions.
- E. Mortar and Grout:
 - 1. Use suitable containers for material measurement. Measuring sand by the shovel is not acceptable. Thoroughly machine mix a minimum of five minutes after all materials are in mixer. Consistency will completely fill all spaces intended to receive grout. Use within 2-1/2 hours of initial mixing. Mortar or grout shall not be used if curing has progressed to yield a stiff consistency.
- F. Reinforcement:
 - 1. Reinforcement shall be free from loose rust and other coatings that would reduce the bond. Cut accurately to length and bend by such methods as will prevent injury to the material. Straighten out kinks or bends.
- G. 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. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
 4. Exposed masonry at exterior corners shall be solid units.
 5. Clean surface of masonry smooth and free from projections which might puncture or otherwise damage flashing material.
 6. Place through-wall flashing as follows:
 - a. Place on bed of mortar and over 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.
 7. Lay masonry units plumb, true to line, and with level courses accurately spaced with allowable tolerances.
 8. Do not furrow bed joints.
 9. Stop off horizontal run by racking back in each course; toothing is not permitted.
 10. Adjust units to final position while is soft and plastic.
 11. If units are displaced after mortar has stiffened, remove, clean joints and units and re-lay with fresh mortar and clean and lightly wet exposed surface of set masonry prior to laying fresh mortar.
- H. Fill Metal Door Jamb frames with solid mortar. Build in anchors.
- I. For Lintels and Bond Beams, provide reinforced unit type, except where steel lintels are shown. Use reinforcing bars as shown on the drawings or as required. Completely fill in lintel block and bond beams with grout. Provide 8 inch bearing at end of lintels.
- J. Connect corners with No. 9 galvanized wire or corrugated tie using one tie for each 4 inches of nominal wall thickness.
- K. 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.
- L. 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 jabs must be made after mortar has started to set, remove mortar and replace with fresh mortar.
- M. Mortar Joints and Patterns:
1. Lay CMU in running one-half (1/2) bond pattern unless otherwise noted.
 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 damp proofing 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.

- N. Reinforcement, Anchor and Tie Systems:
1. Completely embed in mortar or grout.
 2. 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.
 3. Where modular brick is used with brick coursing at 16 inches on center, provide ladder reinforcing within each Wythe at 16 inches on center vertically for exterior Wythe and back-up Wythe, whether detailed or not.
 4. 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.
 5. Veneer anchors at interior brick walls with metal stud back-up shall be the same as Paragraph "4" above, except anchors shall be attached directly to metal stud with recommended corrosion resistant fasteners in accordance with manufacturer's recommendations.
 6. At intersection of all perpendicular masonry walls provide two vertical rows of ladder type reinforcing at 16 inches o.c. vertically.
 7. 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 damages coating in accordance with manufacturer's recommendations.
 8. In cavity walls with CMU back-up, embed truss type horizontal reinforcement with integral adjustable pintle wall ties every 16 inches o.c. vertically.
 9. 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 8 inches. Welded or mechanical connection shall develop the strength of the reinforcement.
 10. Corrugated strap ties shall not be used as veneer anchors at exterior or where subject to moisture. Their use in interior, dry conditions is acceptable.
 11. Place joint reinforcement in the first two bed joints above and the first two bed joints below masonry openings. Extend extra reinforcing two feet beyond jambs. Provide masonry ties at floor and roof decks as indicated.
- O. Lay masonry 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.
- P. Reinforcing Bars:
1. Hold vertical bars in position at top and bottom and at intervals not exceeding less than one 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 horizontal in six 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.
- Q. 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 areas.
 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 equivalent means and held in place to prevent movement.
5. 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.
6. 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. 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	3x3	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.
- R. Concreting: Supervise placing of concrete in cores of masonry beams and lintels and over masonry soffits where structural concrete is detailed. Report any discrepancies or procedures which may adversely affect performance of masonry work.
- S. 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. Both weep holes and thru-wall flashings shall be above the first course of brick above the sidewalks and at least one course below finished floor elevation except where sidewalks are adjacent to exterior brick face. 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- most stringent applies.
 5. Keep weep holes and area above flashing free of mortar droppings.
 6. Coordinate weep holes to be located above sidewalks and paving.
- T. Sealant Joints:

1. Allow for sealant joints around outside perimeters of exterior doors, window frames and other wall openings. Have a uniform depth of 3/4 inch and a uniform width as shown on the drawings but not less than 1/4 inch.
- U. 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. 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.
 - b. Mortar and joint reinforcement shall not bridge brick movement joints.
 - c. 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.
 - d. Vertical Expansion Joints should be located on long straight walls without openings maximum 25 feet 0 inches.
 - e. 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 in a straight wall is 25 feet-0 inches, then the spacing of expansion joints around the 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.
 - f. Offsets and Setback expansion joints shall be located 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 joint corners of perpendicular walls to one corner above for example of spacing.
 - g. 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 less than 6 feet-0 inches in width shall have expansion joint on one side of the edge or jamb of the opening unless shown otherwise on the drawings. Windows and doors 6 feet-0 inches and over in width shall have expansion joints on both sides of the edge or jamb 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 alongside 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 be located halfway between the openings.
 - h. Intersections and Junction expansion joints shall be located 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. Locate expansion joint to separate adjacent walls of different heights to avoid differential movement, especially if the difference is very large.
 - i. All vertical expansion joints shall be carried through the parapets. 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.
 - j. Locate horizontal expansion joints at shelf angles supporting brick masonry.
 - k. Locate CMU control joints directly over concrete slab control joints. 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. Locate control joints at structural columns to isolate movement from continuing or intersecting walls and columns. Install backer rod and sealant in accordance with manufacturer's instructions.

- V. Block insulation: (As shown or required)
1. Rigid Core Inserts: Fill concrete masonry unit cells completely with insulation in accordance with manufacturer's instructions.
 2. Loose Core Fill: Fill concrete masonry unit cells shown or required completely with loose core fill. Ensure concrete masonry units to receive loose core fill are ready for filling and cutouts are protected from material spillage. Place signs on filled walls stating "Do Not Cut Openings or Drill Into This Wall" once fill is placed.
 3. Foamed-in Place Block Insulation: Make sure concrete masonry units to receive foamed in place insulation are ready for drilling and filling. Drill holes and fill concrete masonry unit cells completely with insulation in accordance with manufacturer's instructions. Plug holes with cement mortar and leave surface smooth in accordance with manufacturer's instructions.
 4. Sand Fill: Fill concrete masonry unit cells shown or required completely with sand. Ensure concrete masonry units to receive sand fill are ready for filling and cutouts are protected from material spillage. Place signs on filled walls stating "Do Not Cut Openings or Drill Into This Wall" once fill is placed.

3.6 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)

3.7 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: Beams 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.

3.8 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. Sash, metal lintels and other corrodible parts shall be thoroughly protected.
1. Clean all exposed surfaces of new masonry of excess mortar, efflorescence, stains, and job dirt, using materials specified.
 2. Clean from bottom up: prevent cleaning materials and rinse water from contacting non-cementitious materials.

3. Clean in accordance with manufacturer's instruction and recommendations, product data, and container label instructions.
 4. Mix materials in strict accordance with manufacturer's instructions; do not dilute unless permitted by manufacturer.
 5. Prevent overspray, wind drift, and splash onto surfaces not to be treated.
 6. No high pressure washers are permitted.
 7. 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).
 8. No metal tools or wire brushes are allowed for cleaning of masonry. Use a waste piece of some masonry material for scraping of installed material.
- C. For 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.

END OF SECTION 04 20 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 31 13 "Steel Floor Decking".
 - 3. Section 05 31 23 "Steel Roof Decking".
 - 4. Section 05 50 00 "Metal Fabrications".
 - 5. Section 05 51 00 "Metal Stairs."

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 the 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. Delegated Design: Prepare submittal documents including connection design calculations and drawings signed and sealed by registered design professional, licensed in state where project is located, employed by the steel fabricator.
- B. Design all structural steel framing connections complying with specified performance:
1. Load Capacity: Resist loads indicated on drawings or resist full capacity of supported framing member if reaction not indicated. Account for connection and member loads and eccentricities.
 - a. Request additional design criteria when necessary to complete connection design.
 2. Configuration: Design and detail all connections for each member size, steel grade and connection type to resist the loads and reactions indicated on the drawings or specified herein. Use details consistent with details shown on drawings, supplementing where necessary. The details shown on drawings are conceptual and do not indicate the required weld sizes or number of bolts unless specifically noted. Use rational engineering design and standard practice in detailing, accounting for all loads and eccentricities in both the connection and the members. Promptly notify the design professional in charge of any location where the connection design criteria is not clearly indicated. The design of all connections is subject to the review and acceptance of the design professional in charge. Submit structural calculations prepared and sealed by a qualified engineer registered in the state where the project is located. Submit calculations for review before preparation of detail drawings.
- 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 with a minimum of (5) years of experience that participates in the AISC Quality Certification Program for Category I or higher structures and is designated and is designated an AISC-Certified Plant, Category STD. An otherwise qualified fabricator who is not a member of the AISC Quality Certification Program will be accepted if satisfactory evidence of qualifications is submitted prior to award of Contract. For non-certified fabricators, Contractor shall submit a resume describing plant size, equipment quality control procedures and personnel, and experience on comparable work in the last five (5) years.

- 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.

2.8 GALVANIZING

- A. 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.

2.9 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 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. Joist accessories.
 - a. Extended ends.
 - b. Ceiling extensions.
 - c. Bearing plates.
 - d. Bridging.
 - e. 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.
1. AWS D1.1 Structural Welding Code
 2. SJI "Standard Specification Load Tables and Weight Tables for Steel Joists and Joist Girders".
 3. SDI "Design Manual for Composite Decks, Form Decks, Roof Decks, Cellular Metal Floor Deck with Electrical Distribution".
 4. SSPC Steel Structures Painting Council 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 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.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Laboratory Test Reports for Credit EQ 4: For primers, documentation indicating that products 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."
- C. 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."
 - 1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
- B. 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.
 - 1. Use ASD; data are given at service-load level.
 - 2. Design special joists to withstand design loads with live-load deflections no greater than the following:
 - a. Floor Joists: Vertical deflection of 1/360 of the span.
 - b. Roof Joists: Vertical deflection of 1/360 of the span.
- B. 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 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.

2.5 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.
 - 1. 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.
 - 1. 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.

2.6 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 1.5 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.
 - 1. Before installation, splice joists delivered to Project site in more than one piece.
 - 2. Space, adjust, and align joists accurately in location before permanently fastening.
 - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
 - 4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.
- C. 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.
- D. 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.
- E. 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.
 - 1. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2, or power-tool cleaning according to SSPC-SP 3.
 - 2. Apply a compatible primer of same type as primer used on adjacent surfaces.

- C. 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 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. Noncomposite vented roof deck.
- B. Related Requirements:
 - 1. Section 01 45 23 "Structural Testing and Inspection Services"
 - 2. Section 05 12 00 "Structural Steel Framing".
 - 3. Section 05 50 00 "Metal Fabrications".

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. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 2. Laboratory Test Reports for Credit EQ 4: For primers, documentation indicating that products 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."

- C. 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 from an 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, G90 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 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, G90 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.

2.4 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 the 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 them according to the 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 the steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 31 23

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. Load bearing wall framing.
 2. Exterior non-load bearing wall framing.
 3. Floor joist framing.
 4. Roof rafter framing.
 5. Ceiling joist framing.
 6. Soffit framing.
 7. Accessories necessary for a complete installation.

1.3 RELATED SECTIONS

- A. Section 05 50 00 – Metal Fabrications.
- B. Section 09 21 16 – Gypsum Board.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, licensed in the State of Texas, to design cold formed steel framing.
- B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
 1. Design Loads: Indicated on Structural Drawings.
 2. Coordinate the requirements on the Structural 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:
 - AISI Design of Cold-Formed Steel Structural Members Wind Load Minimum Design Loads
 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: 18 gauge minimum, unless noted otherwise.
 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.
- C. Supplementary Design Details: The general design is presumed adequate to permit compliance with the specified performance. Provide engineering calculations to supplement the general design. Calculations shall bear the seal of a Registered Professional Engineer, licensed in the State of Texas. Calculations 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.
 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.
 - b. Comply with AISI S230 Standard for Cold Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings.

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*.
- 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. SCAFCO Corporation.
 6. The Steel Network.

2.2 LOAD BEARING WALL FRAMING

- A. Steel Studs: C shaped steel studs, of web depths indicated, punched, with stiffened flanges:
 1. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
 2. Flange Width: 1-5/8 inches (41 mm).
 3. Section Properties: Refer to the Drawings.
- B. Steel Track: U shaped steel track, of web depths indicated, unpunched, with straight flanges:
 1. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
 2. Flange Width: 1-1/4 inches (32 mm).
- C. Steel Box or Back to Back Headers: C shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges:
 1. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
 2. Flange Width: 1-5/8 inches (41 mm).

- D. Steel Single or Double L Headers: L shapes used to form header beams, of web depths indicated:
 - 1. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
 - 2. Top Flange Width: 1-5/8 inches (41 mm).
 - 3. Section Properties: Refer to the Drawings.

2.3 EXTERIOR NONLOAD BEARING WALL FRAMING

- A. Steel Studs: C shaped steel studs, of web depths indicated, punched, with stiffened flanges:
 - 1. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
 - 2. Flange Width: 1-5/8 inches (41 mm).
 - 3. Section Properties: Refer to the Drawings.
- B. Steel Track: U shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - 1. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
 - 2. Flange Width: 1-1/4 inches (32 mm).
- C. Vertical Deflection Clips: Head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AllSteel & Gypsum Products, Inc.
 - b. ClarkDietrich Building Systems.
 - c. Marino\WARE.
 - d. SCAFCO Corporation.
 - e. Simpson Strong-Tie Co., Inc.
 - f. Steel Network, Inc. (The).
 - g. Steeler, Inc.
- D. Single Deflection Track: Single, deep leg, U shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure:
 - 1. Minimum Base Metal Thickness: 0.0428 inch (1.09 mm), 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
 - 2. Flange Width: 1 inch (25 mm) plus the design gap for one story structures and 1 inch (25 mm) plus twice the design gap for other applications.
- E. Double Deflection Tracks: Double, deep leg, U shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
 - 1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure:
 - a. Minimum Base Metal Thickness: 0.0428 inch (1.09 mm), 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
 - b. Flange Width: 1 inch (25 mm) plus the design gap for one story structures and 1 inch (25 mm) plus twice the design gap for other applications.
 - 2. Inner Track: Of web depth indicated:

- a. Minimum Base Metal Thickness: 0.0428 inch (1.09 mm), 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
 - b. Flange Width: 1 inch (25 mm) plus the design gap for one story structures and 1 inch (25 mm) plus twice the design gap for other applications.
- F. Drift Clips: Bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.4 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.

2.5 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. Provide accessories of appropriate thickness and configuration, unless otherwise indicated:
1. Supplementary framing.
 2. Bracing, bridging, and solid blocking.
 3. Web stiffeners.
 4. Anchor clips.
 5. End clips.
 6. Foundation clips.
 7. Gusset plates.
 8. Stud kickers and knee braces.
 9. Joist hangers and end closures.
 10. Hole reinforcing plates.
 11. Backer plates.
- C. 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.
- D. 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.

2.6 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. Runner Tracks:
 - 1. Install continuous tracks sized to match studs.
 - 2. Align tracks accurately to layout at base and tops of studs.
 - 3. Secure tracks as recommended by stud manufacturer, except do not exceed 24 inches on center for nail or power-driven fasteners, nor 16 inches on center for other types of attachment.
 - 4. Provide fasteners at corners and ends of tracks.
 - 5. Tracks shall be anchored to structural steel prior to installing sprayed on insulation.
 - 6. Provide Deflection Track (DT), at top of stud walls at floor or roof above, typically. Allow for 1/2 inch movement of primary structure. Do not attach studs directly to Deflection Track.
 - 7. Vertical Deflection Clips: Provide manufacturer's standard bypass and head clips, capable of accommodating upward and downward vertical displacement of primary structure
- D. 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. Frame wall openings with extra studs, equal to the number of studs interrupted by wall openings, placed at each side of wall openings. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with shoes or by welding, and space jack studs same as full-height studs of the wall. Secure stud system all around to wall opening frame in the manner indicated.
- I. Install bracing/bridging in accordance with manufacturer's instructions and design conditions.
- J. Touch up field welds and damaged galvanized coating, except touch up of field cut studs is not required.
- K. Frame both sides of expansion and control joints with separate studs; do not bridge the joint with components of stud system.
- L. 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 52 13
PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall mounted handrails.
- B. Stair railings and guardrails.
- C. Free-standing railings at steps.
- D. Balcony railings and guardrails.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Placement of anchors in concrete.
- B. Section 04 20 00 - Unit Masonry: Placement of anchors in masonry.
- C. Section 06 20 00 - Finish Carpentry: Wood handrail.
- D. Section 08 80 00 - Glazing: Glass baluster infill.
- E. Section 09 21 16 - Gypsum Board Assemblies: Placement of backing plates in stud wall construction.
- F. Section 09 90 00 - Painting and Coating: Paint finish.

1.03 REFERENCE STANDARDS

- A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2013.
- C. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2012e1.
- D. ASTM B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold-Finished Bar, Rod, and Wire (Metric); 2012e1.
- E. ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube; 2012.
- F. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube; 2010.
- G. ASTM B483/B483M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Tubes and Pipe for General Purpose Applications; 2013.
- H. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2000 (Reapproved 2006).
- I. SSPC-Paint 15 - Steel Joist Shop Paint; 1999 (Ed. 2004).

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittals, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
- C. Samples: Submit two, 6 inch (15.24 mm) long samples of handrail. Submit two samples of elbow, wall bracket, and end stop.

PART 2 PRODUCTS

2.01 RAILINGS - GENERAL REQUIREMENTS

- A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of ASTM E985 and applicable local code.

- B. Allow for expansion and contraction of members and building movement without damage to connections or members.
- C. Dimensions: See drawings for configurations and heights and match existing adjacent railing materials and finishes.
- D. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
- E. Provide slip-on non-weld mechanical fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

2.02 ALUMINUM MATERIALS

- A. Aluminum Pipe: Schedule 40; ASTM B429/B429M, ASTM B241/B241M, or ASTM B483/B483M.
- B. Aluminum Tube: Minimum wall thickness of 0.127 inch (3.2 mm); ASTM B429/B429M, ASTM B241/B241M, or ASTM B483/B483M.
- C. Solid Bars and Flats: ASTM B211 (ASTM B211M).
- D. Non-Weld Mechanical Fittings: Slip-on cast aluminum, for Schedule 40 pipe, with flush setscrews for tightening by standard hex wrench, no bolts or screw fasteners.
- E. Welding Fittings: No exposed fasteners; cast aluminum.
- F. Exposed Fasteners: No exposed bolts or screws.

2.03 STEEL RAILING SYSTEM

- A. Non-Weld Mechanical Fittings: Slip-on, galvanized malleable iron castings, for Schedule 40 pipe, with flush setscrews for tightening by standard hex wrench, no bolts or screw fasteners.
- B. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.
- C. Exposed Fasteners: No exposed bolts or screws.

2.04 FABRICATION

- A. Accurately form components to suit specific project conditions and for proper connection to building structure.
- B. Fit and shop assemble components in largest practical sizes for delivery to site.
- C. Fabricate components with joints tightly fitted and secured.
- D. Welded Joints:
 - 1. Exterior Components: Continuously seal joined pieces by continuous welds. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
 - 2. Interior Components: Continuously seal joined pieces by continuous welds.
 - 3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. Apply one coat of bituminous paint to concealed aluminum surfaces that will be in contact with cementitious or dissimilar materials.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
- C. Anchor railings securely to structure.

- D. Field weld anchors as indicated on drawings. Touch-up welds with primer. Grind welds smooth.
- E. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch (6 mm) per floor level, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch (6 mm).
- C. Maximum Out-of-Position: 1/4 inch (6 mm).

END OF SECTION

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SECTION 06 10 00
ROUGH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Sheathing.
- B. Roof-mounted curbs.
- C. Roofing nailers.
- D. Roofing cant strips.
- E. Preservative treated wood materials.
- F. Fire retardant treated wood materials.
- G. Communications and electrical room mounting boards.
- H. Concealed wood blocking, nailers, and supports.
- I. Miscellaneous wood nailers, furring, and grounds.

1.2 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 05 50 00 - Metal Fabrications: Miscellaneous steel connectors and support angles for wood framing.
- C. Section 07 62 00 - Sheet Metal Flashing and Trim: Sill flashings.
- D. Section 09 21 16 - Gypsum Board Assemblies: Gypsum-based sheathing.

1.3 REFERENCE STANDARDS

- A. AFPA (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings; American Forest and Paper Association; 2012.
- B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2013.
- C. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.
- D. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2013.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2013a.
- F. AWPA U1 - Use Category System: User Specification for Treated Wood; American Wood Protection Association; 2012.
- G. PS 1 - Structural Plywood; 2009.
- H. PS 20 - American Softwood Lumber Standard; National Institute of Standards and Technology, Department of Commerce; 2010.
- I. American Lumber Standards "Simplified Practice Recommendations R-16" and to grading rules of manufacturer's association under whose rules the lumber is produced.
- J. American Wood Protection Association AWPA Standards.
- K. National Woodwork Manufacturers Association Standards.

1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittals, for submittal procedures.
- B. Product Data: Provide technical data on insulated sheathing, wood preservative materials, and application instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

1.6 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Lumber should be treated No. 2, S4S Southern Yellow Pine, #1 Kiln dried, complying with NWMA Standards. Use for blocking, stripping, grounds, cants, and miscellaneous wood items in contact with concrete, roofing or exposed to the weather.
 - 1. No. 2, S4S Southern Yellow Pine should be used for framing, blocking, stripping and miscellaneous concealed interior lumber not exposed to concrete, roofing weather or moisture, when FRS lumber is not required by building code.
 - 2. Fire Retardant No. 2, S4S Southern Pine should be used for framing, plates and blocking in all walls and partitions required by building code.
- B. Plywood should comply with APA Standards:
 - 1. APA A-D, Group 1 Interior shall be used where appearance of only one side is exposed to view for interior locations. Use for wall liner at MDF/IDF closet and telephone boards in mechanical and telephone rooms where shown or required, 3/4 inch thick fire rated and painted unless shown or required otherwise. Plywood to be held a minimum of 1" from finish floor.
 - 2. Exterior plywood shall be Group 1 with an APA rated sheathing. Use where miscellaneous plywood is exposed to concrete or weather, or at roof construction.
 - 3. Fire Retardant Treated Plywood shall be used when required by the building code or noted on drawings.
 - 4. Underlayment, if shown or required, shall be APA rated Sturdi-floor, exterior grade, tongue and groove edges.
- C. Rough Hardware:
 - 1. Nails, Spikes and Staples shall be 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 shall be medium carbon steel; size and type to suite application. Galvanized for exterior locations, high humidity locations, and treated wood; plain finish for all other interior locations.
 - 3. 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 into contact with preserved wood.

- D. Wood Treatment:
1. Preservative Treatment (Concealed Conditions):
 - a. Micronized Copper Quaternary (MCQ), a pressure impregnate preservative to net retention of 0.15 lbs/cu.ft. in plant licensed by manufacturer.
 - b. Borate, a pressure impregnate preservative to net retention of 0.28 lbs/cu.ft. in plant licensed by manufacturer in accordance with: Preservative Treatment Standard: AWPA P5, Structural Lumber Treatment Standard: AWPA C31 and Plywood Treatment Standard AWPA C9.
 - c. Brush two coats of preservative on bored or sawn surfaces of treated lumber. Provide Quality mark Stamp or end tag identifying third party inspection agency on treated wood for identification.
 - d. Conditions that are interior, above ground, not exposed to direct standing water, in contact with natural grade, or exposed to weather.
 - e. ACQ and CCA preservatives not permitted.
 2. Fire Retardant Treatment: Use in locations prescribed and required by codes and authorities having jurisdiction. Typical locations may include roof hatch and skylight blocking, blocking in rated wall or ceiling assemblies, and smoke vents.
 - 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 PREPARATION

- A. Where wood framing bears on cementitious foundations, install full width sill flashing continuous over top of foundation, lap ends of flashing minimum of 4 inches (100 mm) and seal.
- B. Coordinate installation of rough carpentry members specified in other sections.

3.2 INSTALLATION – GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.3 FRAMING INSTALLATION

- A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members. Avoid shims and wedges.
- B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.
- C. Install structural members full length without splices, unless otherwise specifically detailed.
- D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AFPA Wood Frame Construction Manual.
- E. Spiking and nailing shall be done using largest size spikes and nail practicable.

- F. 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 partitions. Provide single bottom plate and double-top plates 2 inches thick by width of studs.
- G. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

3.4 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. Bolt nailers and blocking to steel, masonry or concrete members with bolts or proportionate strength members attached from each end, except as otherwise noted on plans.
- C. Provide blocking, bucks and framing as necessary and for other trades as required. Drill lumber accurately for bolts and fit all bolts with suitable washers.
- D. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- E. Specifically, provide the following non-structural framing and blocking:
 - 1. Cabinets and shelf supports.
 - 2. Wall brackets.
 - 3. Handrails.
 - 4. Grab bars.
 - 5. Towel and bath accessories.
 - 6. Wall-mounted door stops.
 - 7. Chalkboards and marker boards.
 - 8. Wall paneling and trim.
 - 9. Joints of rigid wall coverings that occur between studs.
 - 10. As required.

3.5 ROOF-RELATED CARPENTRY

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
- B. Provide wood curb at all roof openings except where prefabricated curbs are specified and where specifically indicated otherwise. Form corners by alternating lapping side members.

3.6 PLYWOOD

- A. Install plywood over framing in accordance with instruction of American Plywood Association Construction Guide Form No. E30C.
- B. 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 inches at edges and eight inches in field each way.

3.7 INSTALLATION OF CONSTRUCTION PANELS

- A. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.
 - 1. At long edges provide solid edge blocking where joints occur between roof framing members.
 - 2. Nail panels to framing; staples are not permitted.

- B. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.
 - 1. Use plywood or other acceptable structural panels at building corners, for not less than 96 inches (2440 mm), measured horizontally.
 - 2. Provide inlet diagonal bracing at corners.
 - 3. Place water-resistive barrier horizontally over wall sheathing, weather lapping edges and ends.
- C. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches (610 mm) on center on all edges and into studs in field of board.
 - 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
 - 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
 - 3. Install adjacent boards without gaps.
 - 4. Size: 48 by 96 inches (2440 by 4880 mm), installed horizontally at ceiling height.

3.8 TOLERANCES

- A. Framing Members: 1/4 inch (6 mm) from true position, maximum.
- B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet (2 mm/m) maximum, and 1/4 inch in 30 feet (7 mm in 10 m) maximum.

3.9 CLEANING

- A. Waste Disposal: Comply with the requirements of Section 01 74 00.
 - 1. Comply with applicable regulations.
 - 2. Do not burn scrap on project site.
 - 3. Do not burn scraps that have been pressure treated.
 - 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.
- B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION 06 10 00

SECTION 06 10 55
ROOFING CARPENTRY

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 the following:
1. Wood blocking, cants, and nailers.
 2. Fire treated plywood for IDF/MDF closets
 3. Any other misc wood materials.

1.3 DEFINITIONS

- A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
1. NeLMA: Northeastern Lumber Manufacturers' Association.
 2. NHLA: National Hardwood Lumber Association.
 3. NLGA: National Lumber Grades Authority.
 4. SPIB: The Southern Pine Inspection Bureau.
 5. WCLIB: West Coast Lumber Inspection Bureau.
 6. WWPA: Western Wood Products Association.

1.4 REFERENCES

- A. American Lumber Standards Committee (ALSC): National Design Specification for Wood Construction.
- B. Product Standard of NBS (PS):
1. PS 1 - Construction and Industrial Plywood.
 2. PS 20 - American Softwood Lumber Standard.

1.5 SUBMITTALS

- A. Product List: Submit list of proposed Products and manufacturers, including all items specified in Part 2 – Products or otherwise required by the Work.
- B. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.

2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 3. For fire-retardant treatments specified to be High-Temperature (HT) type include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
- C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, finishes, accessories, and locations to a minimum scale of 1-1/2 inch to one foot.
- D. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:
1. Power-driven fasteners.
 2. Powder-actuated fasteners.
 3. Expansion anchors.

1.6 QUALITY ASSURANCE

- A. Rough Carpentry Lumber: Visible grade stamp, of agency certified by National Forest Products Association (NFPA).

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.
- B. Deliver interior wood materials that are to be exposed to view only after building is enclosed and weatherproof, wet work other than painting is dry, and HVAC system is operating and maintaining temperature and humidity at occupancy levels.

PART 2 – PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
 3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
- B. Provide dressed lumber, S4S, unless otherwise indicated.

2.2 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
1. Blocking.

2. Nailers.
 3. Cants.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 15 percent maximum moisture content and any of the following species:
1. Mixed southern pine; SPIB.
 2. Spruce-pine-fir; NLGA.
 3. Hem-fir; WCLIB, or WWPA.
 4. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
- C. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.3 PLYWOOD

- A. DOC PS 1, Exposure 1, C-D Plugged, in thickness indicated or, if not indicated, minimum 3/4-inch thickness.

FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.
 2. Where lumber is pressure-preservative treated with ACQ (Alkaline Copper Quaternary), provide fasteners of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: ASME B18.2.1.
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
 2. Material (for fastening into ACQ treated lumber): Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Verify that surfaces are ready to receive work and field measurements are as shown on shop drawings.
- B. Verify mechanical, electrical, and building items affecting work of this Section are placed and ready to receive this Work.
- C. Before installation, prime paint surfaces of items or assemblies to be in contact with cementitious materials.

3.2 INSTALLATION, GENERAL

- A. Discard units or material with defects that might impair quality of work and units that are too small to use in fabricating work with minimum joints.
- B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- C. Do not splice structural members between supports, unless otherwise indicated.
- D. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- E. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- F. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
- G. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated.
- H. Install components with fasteners suited to materials.
 - 1. Nailable Surfaces: Galvanized or galvanically compatible nails or stainless steel into ACQ treated lumber; sized as follows:
 - a. 3/4 and 1-inch materials: 8d nails.
 - b. 1-1/2 or 2-inch materials: 16d nails.
 - 2. Hollow Masonry Walls: Toggle bolts.
 - 3. Solid Masonry: Rawl Zamac pin drive.
 - 4. Steel Members: Bolts or Power actuated Hilti pin.
 - 5. Maximum Spacing: 12-inches on center, unless noted otherwise.
 - 6. Top of Hollow Masonry Wall: Set 12-inch minimum J-bolts in fully set bed of concrete; minimum 18-inches on center.
- I. Remove all bent or deformed nails from finished work and dispose of.
- J. Any exposed materials in occupied space shall have a smooth finish and shall be painted or stained.
- K. Roof nailers shall be appropriately treated lumber per roofing manufacturer's requirements.
- L. Provide appropriately treated wood blocking for support of any/all scheduled work, including but not limited to marker boards, classroom technology, casework, restroom accessories, stairway handrails, etc. Metal plate blocking is not allowed.
- M. In IDF closets provide one (1), 4' x 8' painted 3/4" fire treated plywood for telephone punch down blocks and video equipment. Plywood to be held a minimum of 1" from floor.
- N. In MDF closets provide a 4' x 8' painted 3/4" fire treated plywood on all walls from floor to 8'-0"
- O. AFF. Plywood to be held a minimum of 1" from floor.

3.3 WOOD BLOCKING AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.
- C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.4 PROTECTION

- A. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protective Walkways - Traffic Area Protection: Install full sheets of 3/4-inch exterior grade plywood and min. 1/2-inch wood fiber insulation to those areas of new roof surface to be trafficked by personal and wheeled vehicles.

3.5 CLEANING

- A. Pick up spilled and unused nails and fasteners daily.

END OF SECTION 06 10 55

SECTION 06 20 00
FINISH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Finish carpentry items.
- B. Plastic Laminate
- C. Hardware and attachment accessories.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 06 10 00 - Rough Carpentry: Support framing, grounds, and concealed blocking.
- C. Section 08 14 16 - Flush Wood Doors.
- D. Section 09 90 00 - Painting and Coating: Painting and finishing of finish carpentry items.

1.03 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2009.
- B. AWI (QCP) - Quality Certification Program, www.awiqcp.org; current edition at www.awiqcp.org.
- C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2009.
- D. BHMA A156.9 - American National Standard for Cabinet Hardware; Builders Hardware Manufacturers Association; 2010 (ANSI/BHMA A156.9).
- E. NEMA LD 3 - High-Pressure Decorative Laminates; National Electrical Manufacturers Association; 2005.

1.04 SUBMITTALS

- A. See Section 01 33 00 – Submittals for submittal procedures.
- B. Product Data:
 - 1. Provide data on fire retardant treatment materials and application instructions.
- C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Minimum Scale of Detail Drawings: 1-1/2 inch to 1 foot (1:8).
 - 2. Provide the information required by AWI/AWMAC/WI Architectural Woodwork Standards.
 - 3. Include certification program label.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- B. Quality Certification: Provide AWI Quality Certification Program inspection report and quality certification of completed work.
 - 1. Provide labels or certificates indicating that the work complies with requirements of AWS Grade or Grades specified.
 - 2. Prior to delivery to the site provide shop drawings with certification labels.
 - 3. Provide labels on each product when required by certification program.
 - 4. Upon completion of installation provide certificate certifying that the installation and products meet the specified requirements.
 - 5. Arrange and pay for inspections required for certification.
 - 6. Replace, repair, or rework all work for which certification is refused.
- C. Coordinate the Work of this Section with plumbing work specified in Division 22.
- D. Coordinate location of blocking in walls for installation and support for wall cabinets.

- E. Fabricate millwork and cabinetry in accordance with ANSI A161.1, NEMA LD3 and general static load testing performed and certified by an independent testing laboratory.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect work from moisture damage.

1.07 WARRANTY

- A. Provide warranty for five years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
 - 1. Defects shall include rough or difficult operation, or loose or missing parts, delamination of surfaces, noticeable deterioration of finish and warped or misaligned surfaces or telegraphing of subsurface imperfections.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS

- A. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI/AWMAC/WI Architectural Woodwork Standards for Premium Grade.
- B. Surface Burning Characteristics: Provide materials having fire and smoke properties as required by applicable code.

2.02 WOOD-BASED COMPONENTS

- A. Wood fabricated from old growth timber is not permitted.
- B. Provide sustainably harvested wood, certified or labeled as specified in Section 01 60 00.
- C. Provide wood harvested within a 500-mile (805 km) radius of the project site.

2.03 SHEET MATERIALS

- A. Hardwood Plywood: Face species as indicated, plain sawn, book matched, medium density fiberboard core; Plywood shall be 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, glue type as recommended for application.
- B. Particleboard: ANSI A208.1; composed of wood chips, sawdust, or flakes of min 45 pcf density, made with waterproof resin binders; of grade M-3; sanded faces.
- C. Water Resistant Treated Plywood (marine grade): shall have 24 hr. thickness swell factor for five percent or less and 24-hour water absorption factor of ten percent or less: P.S. 51, Type II or better.

2.04 CABINET COMPONENTS:

- A. Cabinet backs, drawer body, and drawer bottoms: 1/2-inch particleboard. Stand alone units shall have individual backing for moving purposes.
- 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 laminated plywood.
- C. Work surfaces and countertops shall be a minimum 1-inch particleboard or plywood, except use water resistant treated plywood core at counters with sinks.
- D. Shelves shall be 3/4-inch plywood core for 30 inches long or less, 1-inch thick plywood core for more than 30 inches long; 14 inches deep, unless otherwise noted. Provide vertical dividers for shelves over 36 inches long.
- E. Cabinet Toe-Base shall be 3/4-inch non moisture wicking/absorbing material, komatex or equal. No particleboard within four inches of floor.
- F. Countertops and Backsplashes:
 - 1. 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. The backsplash shall be integral to countertop, 4 inches high unless noted otherwise. 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 opening.
 - 3. At exposed countertop end corners, provide 1-inch radius or more.

4. Backsplashes shall be caulked at all walls.
 5. All cabinets shall have locks.
- G. Leave toe spaces unfinished for installation of resilient base, unless otherwise shown.
- H. End Panels and Filler Strips should match adjacent case-piece.
- I. Edging:
1. Flat Edge PVC edging shall be 0.02 inch. Solid, high impact, purified, color thru, acid resistant, machine-applied with hot melt adhesives. 3 mm PVC shall be 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.

2.05 PLASTIC LAMINATE MATERIALS

- A. Plastic Laminate: NEMA LD 3, HGS; color as selected; finish as selected.
1. Exposed doors finished end panels, other vertical surfaces and horizontal surfaces other than tops shall be GP28 (0.028-inch-thick nominal).
 2. Cabinet liner shall be CL20 (0.02-inch nominal), white
 3. Work Surfaces and countertops shall be GP50 (0.050-inch-thick nominal) with BK20 (0.20-inch-thick) backer sheet
 4. Backsplash shall be PH42 (0.042-inch nominal) with nominally balanced backer sheet.

2.06 FASTENINGS

- A. Use a PVA water resistant adhesives. Contact adhesives are not permitted.
- B. Pressured Fused Laminate: NEMA LD3 VGL, and NEMA LD3 CLS shall be melamine resin impregnated, 120-gram PSM minimum, thermofused to core under pressure. Closed interiors and underside of wall cabinets should be white. On exposed and Semi-exposed open cabinets, the color should match the exterior. Provide balanced construction with same thermofused melamine. Unsurfaced coreboard or simple backers are not allowed.

2.07 HARDWARE

- A. Hardware: Comply with ASNI 156.9 and BHMA A156.9. All keying shall match existing master key system and be approved by the Owner.
- B. Hinges shall be heavy duty, five-knuckle 2 3/4-inch institutional type hinge shall meet ANSI/ BHMA A 156.9 Grade 1 requirements and shall be 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. One pair per door to 48-inch height. Hinge shall accommodate 13/16 thick laminated door and allow 270-degree swing. The finish should be US 26D.
- C. Pulls shall be wire design, 4 inches, chrome with a US26D finish.
- D. Sliding Door Hardware should be frameless 1/4-inch glass sliding doors with double track rolling door assembly. 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 should have a 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 should be 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 manufacturers 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 should be 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.
- F. Catches should have opening resistance in compliance with ADA/ TDLR. Provide top-mounted magnetic catch for base and wall cabinet door. Provide two at each tall cabinet door.

- G. Adjustable Shelf Supports shall be dual-pin design with anti-tip-up shelf restraints for both 3/4 inch and 1-inch selves. Include keel to retard shelf slid-off, and slot for mechanical attachment for shelf to clip. Load rating shall be minimum 300 pounds each support without failure.
- H. Wardrobe Rod should be 1-1/6-inch diameter plated steel rod, with captive sockets.
- I. Coat hooks can be single or double prong, wall mounted in satin aluminum.
- J. All casework in one room shall be keyed alike; all casework in school shall be on one owner's master key. National Model C8053 Disk Tumbler lock, non removable cores. The master key for all casework is E41A with the exception of casework in the clinic area to be CCL cam lock Model no. B15760-US26D keyed to AUE39. All clinic cabinet locksets shall function so that the key to the lock can only be removed when the lock is in the LOCKED position. Contractor to provide two (2) keys per lock. Key number to be stamped on face of cam lock. All casework shown shall have locks including all doors, drawers, etc.
- K. Contractor to provide all casework keys in individually labeled envelopes per classroom. A Transmittal showing room number, key number and quantity of keys shall be included.
- L. Hanging rod in teacher wardrobe shall be mechanically fastened and non-removable.

2.08 SPECIALTY ITEMS

- A. Grommets shall be 2-1/2 inches in diameter with "Flip-Top" tab in cap and should be located where electrical, telephone, and computer data wiring need to pass through tops whether shown or not.
- B. Keyboard Drawers to be located at all knee spaces.
- C. Molded Personal Pencil Drawer should be 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 shall be Brass and card size 1/2" x 2-3/16", one per opening and on both sides of the mailbox if open on both sides.

2.09 SOLID STOCK

- A. Moisture content should be in relation to over-dry weight shall be between 8 percent and 13 percent at time of installation.
- B. Natural Finish Hardwood allows for an occasional knot provided it is tight and smooth with a rift-cut grain pattern. The species should be AWI "Premium" Grade, White Oak.
- C. Paint Grade Hardwood shall be any species, including Parana Pine. Do not use Oak, Elm or similar species which have coarse grain.

2.10 MISCELLANEOUS

- A. Utility Shelving: AWI "Economy" Grade.
- B. Clothes Rod: should be 2 1/2" diameter smooth wooden dowel by length required, with end supports and fasteners of type recommended to suit application.
- C. Provide minimum 4 foot by 8 foot by 3/4-inch-thick plywood for telephone/data punch down blocks and video equipment.

2.11 FABRICATION

- A. Detailed Requirements for Cabinet Construction:
 - 1. Toe-Base should be a continuous, ladder type platform with concealed fastening to cabinet bottom, level and secured to floor. Toe-base at exposed cabinet end panels shall be recessed 1/4 inch from face to finished end, for flush installation of finished base material. No cabinet sides-to-floor will be allowed.
 - 2. Cabinet Top and Bottom shall have solid sub-top. At cabinets over 36 inches bottoms and tops shall be mechanically joined by a fixed divider. Assembly devices shall be concealed on bottom side of wall cabinets.
 - 3. Cabinet Sides shall be side bound, captured in grooves, recessed from cabinet rear, and securely fastened at top and bottom. Hang rails shall be located at rear of cabinet back and fastened to cabinet sides. Provide minimum of two at base, two at wall and three at tall cabinets as instructed

- by casework manufacturer. Provide removable back panels and closure panels for plumbing access at all sink cabinets, and where shown on drawings.
4. Exposed end corner and face frame attachment shall be butt jointed, glued and finish nailed; or attached with fully concealed interlocked mechanical fasteners.
 5. Door and Drawer Fronts:
 - a. Drawer fronts and hinged doors shall overlay the cabinet body. Maintain a maximum 1/8-inch reveal between multiple drawer fronts within the cabinets.
 - 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.
- B. Drawers:
1. Drawer fronts shall be applied to separate drawer body component sub-front.
 2. Drawer sides shall be doweled to receive front and back, glued under pressure, machine squared.
 3. Drawer bottom shall be 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 shall be fitted with full width hood at back.
 5. Hanging file drawers shall be fabricated to accept letter size hanging folders.
- C. Vertical and Horizontal Dividers are as required by manufacturer for type and style of component.
- D. Door/ Drawer Front Rail, as required by manufacturer for type and style of component, and hardware placement.
- E. The following requirements shall be met, where specifically indicated on architectural plans as "ADA" or even if not marked where ADA items are drawn: 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 must be a minimum of 29 inches A.F.F. at apron, and 30 inches clear span width.
 3. 12-inch-deep shelving, adjustable or fixed should not exceed a range from 9 inches A.F.F. to 54 inches A.F.F.
 4. In addition to the above, upper kneespace frontal depth for sink cabinets, 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.
- F. Typical Desk or Counter Height at Kneespace locations shall be 30 inches A.F.F.
- G. The casework supplier shall be responsible for all cutouts necessary to receive plumbing items. Provide "J" clamps to secure sinks to countertops.
- H. All units with exposed backs, interiors, ends and/or basis shall be plastic clad with colors as selected by the Architect.
- I. Provide backsplashes and end splashes wherever a back or end is next to a wall, whether shown or not.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.

3.02 INSTALLATION

- A. Install work in accordance with AWI/AWMAC/WI Architectural Woodwork Standards requirements for grade indicated.
- B. Set and secure materials and components in place, plumb and level.
- C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch (1 mm). Do not use additional overlay trim to conceal larger gaps.

- D. Where field cutting, or trimming is necessary, perform in a neat, accurate, professional manner without damaging the products and adjacent work.
- E. Anchorage: Attach securely so the products will perform to their maximum ability without damage from inadequate fastenings.
- F. Fasten tops to frames with concealed clips, screws and glue.
- G. 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.
- H. 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.
- I. 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.
- J. Fit all surface-applied hardware accurately.
- K. After hardware is installed, protect exposed surfaces by use of heavy paper and masking tape and maintain until job completion.
- L. Remove all finish 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.
- M. Installation of work furnished by the various trades shall be coordinated to assure properly functioning equipment at the completion of the job.
- N. Ensure HVAC systems are operating, and temperature and humidity have been stabilized for at least one week prior to installation. Once installed humidity levels shall be controlled between 25 and 55 percent.

3.03 TOLERANCES

- A. Maximum Variation from True Position: 1/16 inch (1.5 mm).
- B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch (0.7 mm).

END OF SECTION

Section 06 65 20

SOLID SURFACE FABRICATIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes furnishing and installing solid polymer fabrications (solid surfacing) as follows:
 - 1. Countertops with matching aprons and splashes.
 - 2. Window sills

1.03 SUBMITTALS

- A. Submit shop drawings detailing fabrication of solid surfacing. Include plans, elevations, sections, and details of fabrication construction, including related work such as blocking to be built into other work, holes and other pertinent data. Show and note field dimensions requiring field measurement for verification and coordination with related work. Include, as applicable, a schedule of finishes and similar information.
- B. Submit solid surfacing samples for color selection.

1.04 PROJECT CONDITIONS

- A. Take field measurements at each location to assure fit of fabricated units to existing conditions.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Solid Surfacing:
 - 1. Silestone Quartz or as indicated in Finish Schedule.
 - 2. Countertop, Sills, Apron and Splash Thickness and Size: 3/4" (19 mm) thick x full depth x maximum length pieces to limit joints.

- B. Accessory Materials: Provide solvent adhesive, joint sealant and other similar materials recommended by solid surfacing manufacturer for fabrication and installation of solid surfacing.

2.02 FABRICATION

- A. Fabricate solid surfacing material as shown and in accordance with manufacturer's recommendations and instructions, and to provide a quality uniform appearance with a minimum of joints.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Confirm that supporting work is securely fastened in place, is plumb, level and ready to receive subsequent construction. Do not proceed with installation until unacceptable conditions have been corrected.

3.02 EXECUTION

- A. Install the work rigid, plumb, level and true with no distortions. Shim as required using concealed shims. Install to a tolerance of 1/8 inch in 8'-0" for plumb and level, and with no variations in flushness of adjoining surfaces. Install solid surfacing in accordance with manufacturer's instructions, including joint adhesives and sealers.
- B. Scribe and cut work to fit adjoining work leaving gap of 1/32 inch to adjacent surfaces. Repair or replace damaged finish at cuts. Do not use seam sealer or adhesive for this purpose.
- C. Where field cutting or trimming is necessary, perform Work in a neat, accurate, professional manner without damaging solid surfacing and adjacent Work.
- D. Anchor solid surfacing to supporting subtops and blocking built-in or directly attached to substrates with adhesives and concealed fasteners.
- E. Repair damaged and defective solid surfacing and finishes; where possible eliminate functional and visual defects; where repair is not possible, replace item.
- F. Clean completed work and protect in accordance with solid surfacing manufacturer's recommendations.

END OF SECTION

06 65 20- 2 SOLID SURFACE FABRICATIONS

SECTION 07 13 00
SHEET WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sheet membrane waterproofing.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete substrate.
- B. Section 07 62 00 - Sheet Metal Flashing and Trim: Metal parapet, coping, and counterflashing.
- C. Section 07 90 05 - Joint Sealers: Sealant for joints in substrates.

1.03 REFERENCE STANDARDS

- A. ASTM D5385 - Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes; 1993 (Reapproved 2006).
- B. ASTM E96/E96M - Standard Test Methods For Water Vapor Transmission of Materials; 2012.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittals, for submittal procedures.
- B. Product Data: Provide data for membrane.
- C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.
- D. Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer's Installation Instructions: Indicate special procedures.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Membrane Manufacturer Qualifications: Company specializing in waterproofing sheet membranes with five years experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years experience.

PART 2 PRODUCTS

2.01 MEMBRANE MATERIALS

- A. Specifications are based on named manufacturer. Other manufacturer must have a minimum five years experience manufacturing equivalent products to those specified to be considered.
 - 1. Carlisle Coatings and Waterproofing Incorporated
 - 2. Grace Construction Products
 - 3. WR Grace & Co.
- B. Waterproofing membrane: Composite sheet comprising a thick HPDE film, an aggressive pressure sensitive adhesive and a weather resistant protective coating. Membrane provides a continuous seal that resist water ingress and migration between the membrane and the structure. The waterproofing system shall conform to the following as manufactured by WR 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), sue 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 the drawings.

- D. Seaming Materials: As recommended by membrane manufacturer.
- E. Membrane Sealant: As recommended by membrane manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.
- C. Verify that items that penetrate surfaces to receive waterproofing are securely installed.

3.02 PREPARATION

- A. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions.
- B. Do not apply waterproofing to surfaces unacceptable to membrane manufacturer.
- C. Seal cracks and joints with sealant using depth to width ratio as recommended by sealant manufacturer.

3.03 INSTALLATION - MEMBRANE

- A. Install membrane waterproofing in accordance with manufacturer's instructions.
- B. Roll out membrane. Minimize wrinkles and bubbles.
- C. Overlap edges and ends and seal by method recommended by manufacturer, minimum 3 inches (75 mm). Seal permanently waterproof. Apply uniform bead of sealant to joint edge.
- D. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.
- E. Weather lap joints on sloped substrate in direction of drainage. Seal joints and seams.
- F. Install flexible flashings. Seal items penetrating through membrane with flexible flashings. Seal watertight to membrane.
- G. Seal membrane and flashings to adjoining surfaces. Install termination bar at all edges. Install counterflashing over all exposed edges.

END OF SECTION

SECTION 07 21 00
THERMAL INSULATION

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Board insulation and integral vapor retarder at cavity wall construction, perimeter foundation wall, underside of floor slabs, over roof deck, over roof sheathing, and exterior wall behind wall finish.
- B. Batt insulation and vapor retarder in exterior wall and ceiling construction, as shown on drawings or as required.
- C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.
- D. Batt insulation at interior walls and above lay-in ceiling panels for sound insulation and where shown on drawings or required.

1.2 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 07 25 00 - Weather Barriers: Separate air barrier and vapor retarder materials.
- C. Section 07 52 00 - Modified Bituminous Membrane Roofing: Installation requirements for board insulation over low slope roof deck specified in this section.
- D. Section 07 81 20 – Firestopping, Penetration, Seals.

1.3 REFERENCE STANDARDS

- A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2013.
- B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.

1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittals, for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- C. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.5 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Rigid Board Insulation:
 - 1. Basis of Design: Owens-Corning FOAMULAR 250/FOAMULAR CW25.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Batt Insulation:
 - 1. Owens Corning
 - 2. John Mansville
 - 3. Certainteed
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 MATERIALS

- A. Rigid Wall Insulation: (In Exterior Cavity Walls)
 - 1. Extruded Polystyrene Foam Board:
 - a. Specification ASTM C578 Type IV.
 - b. Thermal Resistance: R= 5.0 per inch minimum
 - c. Water Absorption (% by volume): 0.1 maximum
 - d. Compressive Strength: 15 psi minimum.
 - e. Thickness: 1-1/2 inch, unless shown otherwise
 - f. Size: 16 inch x 96 inch sheets.
- B. Batt Insulation:
 - 1. Thermal Insulation:
 - a. Type ASTM C665, Type 1 unfaced glass fiber complying with ASTM C665 Type I.
Basis of Design: Owens Corning Unfaced Thermal Batt Insulation.
 - b. Thickness / R -Values (minimum):
 - 1) 3 1/2 inches /R-11 where shown on drawings or as required.
 - 2) 6 inches R-19 where shown on drawings or as required.
 - c. Surface Burning Characteristics:
 - 1) Flame Spread: 25 or less
 - 2) Smoke Developed: 50 or less
 - 2. Acoustical (Sound Attenuation) Insulation:
 - a. Type ASTM C665, Type 1, unfaced glass fiber insulation complying with ASTM C665 Type I. Basis of Design: Owens Corning- SAB Unfaced Insulation.
 - b. Surface Burning Characteristics:
 - 1) Flame Spread: 25 or less
 - 2) Smoke Developed: 50 or less
 - c. Thickness / R-Values (Minimum):
 - 1) 3-1/2 inches / R-11 where shown on drawings or as required
 - 2) 6 inches / R-19 or above, lay in ceiling specified and where shown on drawings.
- C. Safing Insulation: As specified in Section 07 84 00 Fire Stopping and Fire Safing.
- D. Miscellaneous Materials:
 - 1. Mechanical Fasteners: Impaling clip of galvanized steel with washer retainer and clips, to be adhered or mechanically fastened to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.
 - 2. Adhesive: Type recommended by insulation manufacturer for application.

- E. Other Approved Manufacturers:
 - 1. Johns Mansville
 - 2. Dow Chemical Company
 - 3. UC Industries Foamular

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation and adhesive.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.2 BOARD INSTALLATION AT EXTERIOR WALLS

- A. Adhere a 6 inch (150 mm) wide strip of polyethylene sheet over expansion joints with double beads of adhesive each side of joint.
- B. Install boards horizontally on walls.
- C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- D. Place 6 inch (150 mm) wide polyethylene sheet at perimeter of wall openings, from adhesive vapor retarder bed to window and door frames. Tape seal in place to ensure continuity of vapor retarder and air seal.
- E. Tape insulation board joints.

3.3 BOARD INSTALLATION AT CAVITY WALLS

- A. Install board insulation at exterior masonry walls in accordance with manufacturer's printed instructions.
- B. Install boards to fit snugly between wall ties and secured by veneer wall ties and mastic.
- C. Install boards horizontally on walls.
- D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.4 BOARD INSTALLATION OVER LOW SLOPE ROOF DECK

- A. Installation of board insulation over low slope roof deck is specified in Section 07 52 00.
- B. Board Installation Over Roof Deck, General:
 - 1. See applicable roofing specification section for specific board installation requirements.
 - 2. Ensure vapor retarder is clean and dry, continuous, and ready for application of roofing system.
 - 3. Fasten insulation to deck in accordance with roofing manufacturer's written instructions and applicable Factory Mutual requirements.
 - 4. Do not apply more insulation than can be covered with roofing in same day.

3.5 BATT INSTALLATION

- A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
- E. Insulation shall be friction fit between stud and provide full coverage where indicated on drawings.
- F. 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 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.
- G. PROTECTION
 - 1. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION 07 21 00

**SECTION 07 25 00
WEATHER BARRIERS**

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Vapor Retarders: Materials to make exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls water vapor-resistant and air tight.
- B. Air Barriers: Materials that form a system to stop passage of air through exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls.

1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-In-Place Concrete: Vapor retarder under concrete slabs on grade.
- B. Section 07 21 00 - Thermal Insulation: Vapor retarder installed in conjunction with batt insulation.
- C. Section 07 62 00 - Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with weather barriers.
- D. Section 07 90 05 - Joint Sealers: Sealant materials and installation techniques.
- E. Section 09 21 16 - Gypsum Board Assemblies: Water-resistive barrier under exterior cladding.

1.3 DEFINITIONS

- A. Weather Barrier: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.
- B. Air Barrier: Air tight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.
Note: For the purposes of this specification, vapor impermeable air barriers are classified as vapor retarders.

1.4 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2013a.
- B. ASTM E2178 - Standard Test Method for Air Permanence of Building Materials; 2013.
- C. ASTM 2357-11 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies 2011.

1.5 SUBMITTALS

- A. See Section 01 33 00 - Submittals, for submittal procedures.
- B. Product Data: Provide data on material characteristics.
- C. Shop Drawings: Provide drawings of special joint conditions.
- D. Manufacturer's Installation Instructions: Indicate preparation.

1.6 PERFORMANCE REQUIREMENTS

- A. Material Performance: Provide materials which have an air permeance not to exceed 0.004 cubic feet per minute per square foot under a pressure differential of 0.3 in water (1.57 psf) (0.02 L/m² @75 Pa.) when tested in accordance to ASTM E 2178.
- B. Assembly Performance: Provide a continuous air and vapor barrier assembly that has an air leakage not to exceed 0.050 cubic feet per square foot per minute under a pressure differential of 0.3 in water (1.57 psf) (0.20 L/m² @ 75 Pa.) when tested in accordance with ASTM E 2357. Assembly shall perform as a liquid drainage plane flashed to discharge condensation of water penetration to the exterior. Assembly shall accommodate movements of building materials by providing expansion and control joints as required, which accessory air and vapor seal materials at such location, changes in substrate and perimeter conditions.
 - 1. Assembly shall be capable of withstanding combined positive and negative design wind, fan and stack pressures on the envelope without damage or displacement, and shall transfer the load to the structure.
 - 2. Assembly shall not displace adjacent materials under full load.
 - 3. Assembly shall be joined in an airtight and flexible manner to the air barrier material of adjacent assemblies, allowing for the relative movement of assemblies due to thermal and moisture variations and creep, and anticipated seismic movement.
- C. Connections to Adjacent Materials: Provide connections to prevent air leakage and vapor migration at the following locations:
 - 1. Foundation and walls, including penetrations, ties and anchors
 - 2. Walls, windows, curtain walls, storefronts, louvers and doors.
 - 3. Different wall assemblies, and fixed openings within those assemblies.
 - 4. Wall and roof connections and penetrations.
 - 5. Floors over unconditioned space.
 - 6. Walls, floor and roof across construction, control and expansion joints.
 - 7. Seismic and expansion joints.
 - 8. All other leakage pathways in the building envelope.

1.7 QUALITY ASSURANCE

- A. Manufacturer: Obtain primary materials from a single manufacturer regularly engaged in manufacturing air and vapor barrier membranes. Obtain secondary materials from a source acceptable to the primary material manufacturer.
- B. VOC Regulations: Provide products which comply with applicable regulations controlling the use of volatile organic compounds for the specific authority having jurisdiction.
- C. Field Quality Assurance: Implement the ABAA Quality Assurance Program requirements. Cooperate with ABAA inspectors and independent testing and inspection agencies engaged by Owner. Do not cover air and vapor barrier until it has been inspected, tested and accepted.

1.8 MOCK-UP

- A. Build mock-up representative of primary exterior wall assemblies and glazing assemblies including backup wall and typical penetrations. Mock-up shall be approximately 8 feet long by 8 feet high and include the materials proposed for use in the exterior wall assembly. Mock-up shall be suitable for testing as specified in the following paragraph.
- B. Mock-up Test for Air and Water Infiltration: Test mock-up for air and water infiltration in accordance to ASTM E 1186 (air leakage location) or ASTM E 783 (air leakage quantification), and ASTM E 1105 (water penetration). Use smoke tracer to locate sources of air leakage. If deficiencies are found,

repair or modify mock-up and retest until satisfactory results are obtained. Deficiencies include air leakage beyond values specified, uncontrolled water leakage, unsatisfactory workmanship.

- C. Perform the air leakage tests and water penetration test of mock-up prior to installation of cladding and trim but after installation of all fasteners for cladding and trim and after installation of other penetrating elements. For fasteners which would normally only be installed with cladding, install representative fasteners without cladding; intent is to perform testing with all types of penetrations in place.
- D. Mock up Test for Adhesion: Test mock-up of fluid applied and sheet applied materials for adhesion in accordance with ASTM D 4541 using a Type 1 pull tester except that the disk used shall be 100mm in diameter and the membrane shall be cut through to separate the material attached to the disk from the surrounding material. Perform test after curing period recommended by the manufacturer. Record the mode of failure and area which failed, in accordance with ASTM D 4541.

1.9 WARRANTY

- A. Material Warranty: Provide manufacturer's standard product warranty, for a minimum 3 years from date of Substantial Completion.
- B. Installation Warranty: Provide air barrier subcontractor's 2 year warranty from date of Substantial Completion, including all components of the air and vapor barrier assembly against failures including loss of air tight seal, loss of watertight seal, loss of adhesion, loss of cohesion, failure to cure properly.

1.10 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Fluid Applied Air and Vapor Barrier: Fluid applied proprietary materials as specified. Use regular or low-temperature formulation depending on site conditions, within temperature ranges specified by manufacturer. Provide related accessories including primer, seam tape, mastic, fluid and sealant recommended by manufacturer. Subject to compliance with requirements, provide one of the following:
 - 1. BASF Corporation- Wall Systems:
 - a. Fluid Applied Air Barrier Membrane: Enershield-I, Senershield-VB, Finestop-VB.
 - b. Fabric Reinforcement: Sheathing Fabric to be saturated with BASF Fluid Applied Membrane for use at sheathing joints, penetrations and window rough openings.
 - c. Flashing and Transition Membrane: TF Membrane / WS Flash polyester-faced 30 mil self-adhesive membrane or TF Wrap / WS Wrap polyethylene-faced 20-mil self adhesive membrane.
 - d. Water-based Primer for Self-Adhesive Membranes: WS Flashing Primer.
 - e. Mastics: As recommended by manufacturer.
 - 2. Carlisle Coatings & Waterproofing Inc.
 - a. Fluid Applied Air and Vapor Barrier: Fire-Resist Barritech NP, 70 to 80 mils thick (wet).
 - b. Detail Flashing: Fire-Resist 705 FR
 - c. Counterflashing for Metal Wall Flashings: Fire-Resist 705 FR
 - d. Water-Based Primer for Detail Flashing: CCW-702 WB
 - e. Solvent-based Primer for Detail flashing: CCW-702 or CCW-702 LV
 - f. Reinforcing Fabric: DCH Reinforcing Fabric

- g. Glass mat: LiquiFiber-W
- h. Termination Mastic: SURE-SEAL Lap Sealant.
- i. Fill Compound: CCW-201 or CCW-703 V
- 3. Grace Construction Products:
 - a. Fluid Applied Air and Vapor Barrier: Perm-A-Barrier Liquid, 60 mils thick (wet)
 - b. Water-Based Primer for Flashing, Transition Strip and Detail Membrane: Perm-A-Barrier WB Primer
 - c. Solvent-Based Primer for Flashing, Transition Strip and Detail Membrane: Bituthene Primer B-2 and Bituthene Primer B2 LVC.
 - d. Though Wall Flashings or Shelf Angle Flashings: Perm-A-Barrier Wall Flashing.
 - e. Mastics, Adhesives, and Tapes: AS recommended by Grace Construction Products.
 - f. Transition Strip: Perm-A-Barrier Detail Membrane and Perm-A-Barrier Wall Flashing.
 - g. Termination Mastic: Bituthene Liquid Membrane and as recommended by Grace Construction Products.
 - h. Window Flashing and Detail Membrane: Perm-A-Barrier Detail Membrane and Perm-A-Barrier Wall Flashing.
- 4. Henry Company:
 - a. Fluid Applied Air and Vapor Barrier, Low VOC: Air Bloc 32MR, 75 to 115 mils thick (wet)
 - b. Transition Membrane: Blueskin SA and Blueskin SA LT for low-temperature applications.
 - c. Water-Based Primer for Transition Membrane: Aqutec Primer.
 - d. Solvent-Based Primer for Transition Membrane: Blueskin Adhesive.
 - e. Solvent-Based Aerosol Primer for Transition Membrane: Blueskin Spray Prep.
 - f. Counterflashing for Masonry Through-Wall Flashing: Blueskin TWF.
 - g. Mastics, Adhesives and Tapes: Henry 570-05 Polybitume.
- 5. Protective Coatings Technology, Inc.
 - a. Ply-Wall Airlok Flex at 8-12 mils thick (dry)
 - b. Water Based Primer: AS recommended by manufacturer
 - c. Solvent-Based Primer: Ply-Wall Airlok or Airlok Flex as recommended
 - d. Counterflashing for Masonry Thru Wall Flashings: Poly-Wall CrackGuard.
 - e. Mastics, Adhesives and Tapes: AS recommended by manufacturer.
- 6. WR Meadows Inc
 - a. Fluid Applied Air and Vapor Barrier: Air-Shield LMP and Air-Shield LMP All Season (for cold temperature applications), 60 mils (wet), 45 mils (dry).
 - b. Detailing Strips: Air-Shield Self-Adhering Air Barrier
 - c. Water-Based Primer: Mel-Prime WB
 - d. Solvent-Based Primer: Mil-Prime VOC and Mel-Prime NE.
 - e. Counterflashing for Masonry Through-Wall Flashings: Air-Shield Thru-Wall Flashing.
 - f. Mastics, Adhesives and Tapes: Pointing Mastic.

2.2 AUXILIARY MATERIALS

- A. Comply with both air and vapor 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 dampproofing manufacturer or required.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and conditions are ready to accept the work of this section.

- B. Examine substrates, areas and conditions under which air and vapor barrier assemblies will be applied, with Installer present, for compliance with requirements.
 - 1. Surfaces are sound, dry even, and free of oil, grease, dirt, excess mortar or other contaminants.
 - 2. Concrete surfaces are cured and dry, smooth without large voids, spalled areas or shaped protrusions.
 - 3. Masonry joints are flush and completely filled with mortar, and all excess mortar sitting on masonry ties has been removed.
- C. Verify substrate is surface dry. Test for capillary moisture by plastic sheet method according to ASTM D4263 and take suitable measures until substrate passes moisture test. Surface dry is an acceptable substrate condition if acceptable to the manufacturer.
- D. Verify sealants used in sheathing are compatible with membrane proposed for use. Perform field peel-adhesion test on materials to which sealants are adhered.

3.2 PREPARATION

- A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
- B. Substrate Surfaces shall be clean, prepared and treated according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air and vapor barrier application. Mask off adjoining surfaces to prevent overspray and spillage.
- C. Surface Preparation (Masonry): Dust, dirt, old loose or scaling coatings should be removed from the surface before coating. Cracks, joints, penetrations, and splits should be sealed, repaired with four inch wide glass fabric scrim tape embedded in Henry #789, or manufacturer's approved equal. Dusty or porous masonry surfaces should be dampened with water. Highly porous masonry should be primed with Henry #792 Penetrating Asphalt Primer or #788 Non-Fibred Asphalt Emulsion Dampproofing which has been thinned with one gallon water per five gallons of #788, or manufacturers approved equal. Cleaned metal surfaces shall also be primed. Architect must approve the surface preparation and sealing of cracks, joints and other penetrations prior to the application of the dampproofing.
- D. Surface Preparation (Sheathing): Prep joints and penetrations.
- E. Prime Substrate for application of sheet membrane transition strip as recommended by manufacturer as follows:
 - 1. Prime masonry, concrete substrates with conditioning primer.
 - 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 and vapor barrier and at protrusions.
- F. Prime substrate for application of fluid applied air and vapor barrier if recommended by manufacturer based on project conditions and as follows in Installation subsection.

3.3 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Air and Vapor Barrier Installation: Install transition strip materials and fluid applied air and vapor barrier to provide continuity throughout the building envelope. Install materials in accordance with manufacturer's recommendations and as follows, unless manufacturer recommends other procedures in writing based on project conditions or particular requirements of their recommended materials:
- C. Apply under normal working conditions above 45 degrees F and rising. Do not apply when rain is imminent.

- D. Apply with brush or spray equipment. Soft brushes free from stiff bristles should be used and the material applied in even strokes. When spraying, apply in one coat with a 50% overlap of the spray pattern to obtain a uniform and continuous coating, carrying coating in and around joints, grooves, and slots, following reveals and soffits of windows and continuing 12 inches out on adjoining partitions and soffits as instructed by manufacturer.
- E. Ensure continuous coating free of breaks, voids and pinholes.
- F. Thoroughly cover cracks, joints, and corners.
- G. Provide fluid applied air and vapor barrier and transition strips in all exterior cavity walls on concrete masonry units, and on all exterior sheathing including, but not limited to, areas above soffits, doors and windows, and behind stucco and plaster.
- H. Apply primer for transition strips at rate recommended by manufacturer. Allow primer to dry completely before transition strip application. Apply as many coats as necessary for proper adhesion.
- I. Apply primer for fluid applied air and vapor barrier as recommended by fluid applied air and vapor barrier manufacturer. Based on manufacturer's recommendation, no primer may be required for the fluid applied materials.
- J. Apply fluid applied air and vapor barrier using equipment and methods recommended by manufacturer, to achieve a dry film thickness as recommended by the manufacturer.
- K. Apply fluid applied air and vapor barrier and transition strips to shed water naturally without interception by a sheet edge, unless that edge is sealed and permanently flexible termination mastic.
- L. Position subsequent sheets of transition strip applied above so that membrane overlaps the membrane sheet below by a minimum of 2 inches (50 mm), unless greater overlap is recommended by the manufacturer. Roll into place with roller.
- M. Overlap horizontally adjacent pieces of transition strips a minimum of 2 inches (50 mm), unless greater overlap is recommended by manufacturer. Roll seams with roller.
- N. Seal around all penetrations with termination mastic, extruded silicone sealant, membrane counterflashing other procedure in accordance with manufacturer's recommendations.
- O. Connect air and vapor 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 and other intersection conditions and perform sealing of penetrations, using accessory materials and in accordance with the manufacturer's recommendations.
- P. At changes in substrate plane, provide transition material (bead of sealant, mastic, extruded silicone sealant, membrane counterflashing, or other material recommended by manufacturer) under membrane to eliminate all shaped 90 degree inside corners and to make a smooth transition from one plane to the other.
- Q. Provide mechanically fastened non-corrosive metal sheet to span gaps in substrate plane and to make a smooth transition from one plat to the other. Membrane shall be continuously supported by substrate or as recommended by the manufacturer.
- R. At through-wall flashings, provide an additional 6 inch wide strip of manufacturer's recommended membrane or as recommended by manufacturer. Seal exposed top edge of strip with bead of mastic or as recommended by manufacturer.
- S. AT deflection and control joints, provide backup for the membrane to accommodate anticipated movement.
- T. At expansion and seismic joints provide transition to the joint assemblies.
- U. Apply a bead or trowel coat of mastic along membrane seams at reverse lapped seams, rough cuts, and as recommended by the manufacturer.
- V. At end of each working day, seal top edge of the self adhered membrane to substrate with termination mastic.
- W. Do not allow materials to come in contact with chemically incompatible materials.
- X. Do not expose membrane to sunlight longer than as recommended by manufacturer.

- Y. Inspect installation prior to enclosing assembly and re pair punctures, damaged areas and inadequately lapped seams with a patch of membrane lapped as recommended by manufacturer.

3.4 FIELD QUALITY CONTROL

- A. Do not cover installed weather barriers until required inspections have been completed and accepted.
- B. Owner's inspection and Testing / ABAA Audits: Cooperate with Owner's testing agency and ABAA auditors. Allow access to work areas and staging. Notify Owner's testing agency / ABAA auditor in writing of schedule of Work of this Section to allow sufficient time for testing and inspection. Daily inspection and testing may be required.
- C. Twenty days after completion of this portion of the work and at the discretion of the Architect, demonstrate by running water test, the Work of this Section will successfully repels water.
 - 1. Notify Architect at least 72 hours in advance, and conduct the test in the Architect's presence.
 - 2. By means of outrigger or similar acceptable equipment, place the nozzle of a 3/4 inch garden hose at a point approximately 10 feet-0 inches, aiming the nozzle at slight downward angle to direct full stream of water onto wall.
 - 3. Run water onto wall at full available force for not less than four hours.
 - 4. Upon completion of the four hour period, inspect interior surfaces of wall for evidence of moisture penetration.
- D. If evidence of moisture penetration is discovered, apply an additional coat of approved fluid applied air and vapor barrier and/or transition strips to exterior surface, repeating application and testing (at no additional cost to the Owner) until no evidence of moisture penetration is found.

END OF SECTION 07 25 00

SECTION 07 52 00 MODIFIED BITUMINOUS MEMBRANE ROOFING (Rev 01/2011)cb

PART 1 GENERAL

1.01 SECTION INCLUDES:

- A. Preparation of Substrate to Receive Roofing Materials
- B. Base Sheet or Roof Insulation Application to Prepared Substrate
- C. Roof Membrane Application
- D. Roof Flashing Application
- E. Incorporation of Sheet Metal Flashing Components and Roofing Accessories into the Roof System

1.02 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Sheet Metal Flashing and Trim
- B. Sheet Metal Roofing Specialties

1.03 RELATED SECTIONS

- A. Section 06 10 00 - Rough Carpentry
- B. Section 03 52 00 – Lightweight Concrete Roof Insulation
- C. Section 07 62 00 - Sheet Metal Flashing and Trim
- D. Section 07 72 00 - Roof Accessories

1.04 REFERENCE STANDARDS

References in these specifications to standards, test methods and codes, are implied to mean the latest edition of each such standard adopted. The following is an abbreviated list of associations, institutions, and societies which may be used as references throughout this specification section.

ASTM	American Society for Testing and Materials Philadelphia, PA
FM	Factory Mutual Engineering and Research Norwood, MA
NRCA	National Roofing Contractors Association Rosemont, IL
OSHA	Occupational Safety and Health Administration Washington, DC

SMACNA Sheet Metal and Air Conditioning Contractors National Association
Chantilly, VA

UL Underwriters Laboratories
Northbrook, IL

1.05 DESCRIPTION OF WORK

Base Bid

Project Type: New construction

Deck: Slotted metal Slope: Less than 1/8 inch

SUBSTRATE: Vemalite Lightweight Insulating Concrete System by Vermiculite Products, Inc.,
installed over the slotted metal deck. See Specification Section 03 52 00.

Base Sheet: Parabase FS, mechanically attached.

Roof System: Paradiene 20 TG, torch applied;
Paradiene 30 FR TG BW, torch applied.

Flashing System: Veral Aluminum, torch applied.

Supplemental Flashing System: Parapro 123 Flashing System.

Alterante Bid

Project Type: New construction

Deck: Slotted metal Slope: Less than 1/8 inch

SUBSTRATE: ZIC 1:4 Lightweight Insulating Concrete System installed over the slotted metal deck.
See Specification Section 03 52 00.

Base Sheet: Parabase FS, mechanically attached.

Roof System: Paradiene 20 TG, torch applied;
Paradiene 30 FR TG BW, torch applied.

Flashing System: Veral Aluminum, torch applied.

Supplemental Flashing System: Parapro 123 Flashing System.

1.06 SUBMITTALS

All submittals which do not conform to the following requirements will be rejected.

A. Submittals Prior to Contract Award:

1. Letter from the proposed primary roofing manufacturer confirming that the bidder is an acceptable Contractor authorized to install the proposed system.
2. Letter from the primary roofing manufacturer stating that the proposed application will comply with the manufacturer's requirements in order to qualify the project for the specified guarantee.

B. Submittals Prior to Project Close-out:

1. Certificate Of Analysis from the testing laboratory of the primary roofing materials manufacturer, confirming the physical and mechanical properties of the roofing membrane components. Testing shall be in accordance with the parameters published in ASTM D 5147 and ASTM D 7051 and indicate Quality Assurance/Quality Control data as required to meet the specified properties. A separate Certificate Of Analysis for each production run of material shall indicate the following information:
 - a) Material type
 - b) Lot number
 - c) Production date
 - d) Dimensions and Mass (indicate the lowest values recorded during the production run);
 - Roll length
 - Roll width
 - Selvage width
 - Total thickness
 - Thickness at selvage (coating thickness)
 - Weight
 - e) Physical and Mechanical Properties;
 - Low temperature flexibility
 - Peak load
 - Ultimate Elongation
 - Dimensional stability
 - Compound Stability
 - Granule embedment
 - Resistance to thermal shock (foil faced products)
2. Manufacturer's printed recommendations for proper maintenance of the specified roof system including inspection frequencies, penetration addition policies, temporary repairs, and leak call procedures.

1.07 QUALITY ASSURANCE

- A. Acceptable Products: Primary roofing products, including each type of sheet, all manufactured in the United States, shall be supplied by a single manufacturer which has been successfully producing the specified types of primary products for not less than 10 years. The primary roofing products shall have maintained a consistent composition for a minimum of five years.
- B. Product Quality Assurance Program: Primary roofing materials shall be manufactured under a quality management system that is monitored regularly by a third party auditor under the ISO 9001 audit process. A certificate of analysis for reporting/confirming the tested values of the actual material being supplied for the project will be required prior to project close-out.

- C. **Acceptable Contractor:** Contractor shall have a minimum of 2 years experience in successfully installing the same or similar roofing materials and be certified in writing by the roofing materials manufacturer to install the primary roofing products.
- D. **Scope of Work:** The work to be performed under this specification shall include but is not limited to the following: Attend necessary job meetings and furnish competent and full time supervision, experienced roof mechanics, all materials, tools, and equipment necessary to complete, in an acceptable manner, the roof installation in accordance with this specification. Comply with the latest written application instructions of the manufacturer of the primary roofing products. In addition, application practice shall comply with requirements and recommendations contained in the latest edition of the Handbook of Accepted Roofing Knowledge (HARK) as published by the National Roofing Contractor's Association, amended to include the acceptance of a phased roof system installation.
- E. **Local Regulations:** Conform to regulations of public agencies, including any specific requirements of the city and/or state of jurisdiction.
- F. **Manufacturer Requirements:** Ensure that the primary roofing materials manufacturer provides direct trained company personnel to attend necessary job meetings, perform periodic inspections as necessary, and conducts a final inspection upon successful completion of the project.

1.08 PRODUCT DELIVERY STORAGE AND HANDLING

- A. **Delivery:** Deliver materials in the manufacturer's original sealed and labeled containers and in quantities required to allow continuity of application.
- B. **Storage:** Store materials out of direct exposure to the elements on pallets placed over clean, flat and dry surfaces. Storage of pallets over dirt, grass-covered ground or newly placed concrete may result in upward moisture transpiration and contamination of product. Store rolls of roofing on end. For roof-top storage, avoid overloading of deck and building structure. Factory packaging is not intended for job site protection. Slit factory packaging immediately upon arrival at the job site to prevent build-up of condensation and cover materials using a breathable cover such as a canvas. Polyethylene or other non-breathable plastic coverings shall not be used. Store flammable or temperature sensitive materials away from open flame, ignition sources or excessive heat.
- C. **Handling:** Handle all materials in such a manner as to preclude damage and contamination with moisture or foreign matter. Handle rolled goods to prevent damage to edges or ends.
- D. **Damaged Material:** Any materials that are found to be damaged or stored in any manner other than stated above will be automatically rejected, and will require removal and replacement at the Contractor's expense.

1.09 PROJECT/SITE CONDITIONS

- A. **Requirements Prior to Job Start**
 - 1. **Notification:** Give a minimum of 5 days notice to the Owner and manufacturer prior to commencing any work and notify both parties on a daily basis of any change in work schedule.
 - 2. **Permits:** Obtain all permits required by local agencies and pay all fees which may be required for the performance of the work.

3. Safety: Familiarize every member of the application crew with all fire and safety regulations recommended by OSHA, NRCA and other industry or local governmental groups.

B. Environmental Requirements

1. Precipitation: Do not apply roofing materials during precipitation or in the event there is a probability of precipitation during application. Take adequate precautions to ensure that materials, applied roofing, and building interiors are protected from possible moisture damage or contamination.
2. Temperature Restrictions - self-adhesive sheets: The minimum required substrate temperature at point of application is 40°F (4°C). Maintain a minimum roof membrane material temperature above 60° F (16° C). In low temperature conditions, keep materials warm prior to application. Consider using the specified tacky primer, required for vertical applications, in temperatures below 60° F (16° C) to facilitate proper bonding of self-adhered membrane for horizontal applications. The minimum ambient temperature range at the time of tacky primer application is 45°F to 105°F (7°C - 40°C). Suspend application in situations where the self-adhered base ply cannot be kept at temperatures allowing for proper adhesion.

C. Protection Requirements

1. Membrane Protection: Provide protection against staining and mechanical damage for newly applied roofing and adjacent surfaces throughout this project.
2. Torch Safety: Crew members handling torches shall be trained by an Authorized Certified Roofing Torch Applicator (CERTA) Trainer, be certified according to CERTA torch safety guidelines as published by the National Roofing Contractor's Association (NRCA), and follow torch safety practices as required by the contractor's insurance carrier. Designate one person on each crew to perform a daily fire watch. The designated crew member shall watch for fires or smoldering materials on all areas during roof construction activity, and for the minimum period required by CERTA guidelines after roofing material application has been suspended for the day.
3. Limited Access: Prevent access by the public to materials, tools and equipment during the course of the project.
4. Debris Removal: Remove all debris daily from the project site and take to a legal dumping area authorized to receive such materials.
5. Site Condition: Complete, to the owner's satisfaction, all job site clean-up including building interior, exterior and landscaping where affected by the construction.

1.10 GUARANTEE/WARRANTY

- A. Roof System Guarantee: Upon successful completion of the project, and after all post installation procedures have been completed, furnish the Owner with the roof system manufacturer's 20 year labor and materials roof system guarantee. The roof system guarantee shall include both the roofing and flashing membranes, and the specified new lightweight insulating concrete system consisting of aggregate fill, patented-pre-formed polystyrene panels, and base sheet fasteners. All repair or replacement costs covered under the guarantee shall be borne by the roofing membrane manufacturer. The guarantee shall be a term type, without deductibles or limitations on coverage amount, and be

issued at no additional cost to the Owner. Specific items covered under the roof system guarantee include:

1. The actual resistance to heat flow through the roof insulation will be at least 80% of the design thermal resistance, provided that the roofing membrane is free of leaks;
2. Should a roof leak occur, the insulating performance of the roof insulation will be at least 80% of the design thermal resistance within a 2 year period following repair of the leak.
3. The roof insulation will remain in a reroofable condition should the roof membrane require replacement (excluding damage caused by fastener pullout during removal of the old membrane.)
4. The roof insulation material will not cause structural damage to the building as a result of expansion from thermal or chemical action.
 - > Siplast 20 Year Roof System Guarantee

PART 2 PRODUCTS

2.01 ROOFING SYSTEM ASSEMBLY/PRODUCTS

A. Base Sheet

1. Base Sheet: A fiberglass reinforced, asphalt coated sheet with a polyolefin film backing, having a minimum weight of 20 lb/sq. The sheet shall conform to ASTM D 4601, Type II requirements.
 - > Siplast Parabase FS

2.02 DESCRIPTION OF SYSTEMS

- A. Roofing Membrane Assembly: A roof membrane assembly consisting of two plies of a prefabricated, reinforced, homogeneous Styrene-Butadiene-Styrene (SBS) block copolymer modified asphalt membrane, applied over a prepared substrate. Reinforcement mats shall be impregnated/saturated and coated each side with SBS modified bitumen blend and coated one side with a torch grade SBS bitumen blend adhesive layer. The adhesive layer shall be manufactured using a process that embosses the surface with a grooved pattern to provide optimum burn-off of the plastic film and to maximize application rates. The cross sectional area of the sheet material shall contain no oxidized or non-SBS modified bitumen. The roof system shall pass 500 cycles of ASTM D 5849 Resistance to Cyclic Joint Displacement (fatigue) at 14°F (-10°C). Passing results shall show no signs of membrane cracking or interply delamination after 500 cycles. The roof system shall pass 200 cycles of ASTM D 5849 after heat conditioning performed in accordance with ASTM D 5147. 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.
 - > Siplast Paradiene 20 TG/30 FR TG BW torchable roof system
1. Modified Bitumen Base, Stripping, and Flashing Reinforcing Ply
 - a) Thickness (avg): 114 mils (2.9 mm) (ASTM D 5147)

- b) Thickness (min): 110 mils (2.8 mm) (ASTM D 5147)
- c) Weight (min per 100 ft² of coverage): 76 lb (3.7 kg/m²)
- d) Maximum filler content in elastomeric blend: 35% by weight
- e) Low temperature flexibility @ -15° F (-26° C) - PASS (ASTM D 5147)
- f) Peak Load (avg) @ 73°F (23°C): 30 lbf/inch (5.3 kN/m) (ASTM D 5147)
- g) Peak Load (avg) @ 0°F (-18°C): 75 lbf/inch (13.2 kN/m) (ASTM D 5147)
- h) Ultimate Elongation (avg.) @ 73°F (23°C): 50% (ASTM D 5147)
- i) Dimensional Stability (max): 0.1% (ASTM D 5147)
- j) Compound Stability (min): 250°F (121°C) (ASTM D 5147)
- k) Approvals: UL Class listed, FM Approved (products shall bear seals of approval)
- l) Reinforcement: fiberglass mat or other meeting the performance and dimensional stability criteria

> Siplast Paradiene 20 - torchable grade

2. Modified Bitumen Finish Ply

- a) Thickness (avg): 138 mils (3.5 mm) (ASTM D 5147)
- b) Thickness at selvage (coating thickness) (avg): 118 mils (3.0 mm) (ASTM D 5147)
- c) Thickness at selvage (coating thickness) (min): 114 mils (2.9 mm) (ASTM D 5147)
- d) Weight (min per 100 ft² of coverage): 96 lb (4.68 kg/m²)
- e) Maximum filler content in elastomeric blend: 35% by weight
- f) Low temperature flexibility @ -15°F (-26°C): PASS (ASTM D 5147)
- g) Peak Load (avg) @ 73°F (23°C): 30 lbf/inch (5.3 kN/m) (ASTM D 5147)
- h) Peak Load (avg) @ 0°F (-18°C): 75 lbf/inch (13.2 kN/m) (ASTM D 5147)
- i) Ultimate Elongation (avg.) @ 73°F (23°C): 55% (ASTM D 5147)
- j) Dimensional Stability (max): 0.1% (ASTM D 5147)
- k) Compound Stability (min): 250°F (121° C) (ASTM D 5147)
- l) Granule Embedment (max individual loss): 2.0 grams per sample (ASTM D 5147)
- m) Approvals: UL Class listed, FM Approved (products shall bear seals of approval)
- n) Reinforcement: fiberglass mat or other meeting the performance and dimensional stability criteria
- o) Surfacing: ceramic granules specially treated for cool roof applications.

> Siplast Paradiene 30 FR BW - torchable grade

- B. Flashing Membrane Assembly: A flashing membrane assembly consisting of a prefabricated, reinforced, Styrene-Butadiene-Styrene (SBS) block copolymer modified asphalt membrane with a continuous, channel-embossed metal-foil surfacing. The finish ply shall conform to ASTM D 6298 and the following physical and mechanical property requirements.

> Siplast Veral flashing system, aluminum finish

1. Cant Backing Sheet and Flashing Reinforcing Ply

- a) Thickness (avg): 102 mils (2.6 mm) (ASTM D 5147)
- b) Thickness (min): 98 mils (2.5 mm) (ASTM D 5147)
- c) Weight (min per 100 ft² of coverage): 72 lb (3.5 kg/m²)
- d) Maximum filler content in elastomeric blend: 35% by weight
- e) Low temperature flexibility @ -15° F (-26° C) - PASS (ASTM D 5147)
- f) Peak Load (avg) @ 73°F (23°C): 30 lbf/inch (5.3 kN/m) (ASTM D 5147)
- g) Peak Load (avg) @ 0°F (-18°C): 75 lbf/inch (13.2 kN/m) (ASTM D 5147)
- h) Ultimate Elongation (avg.) @ 73°F (23°C): 50% (ASTM D 5147)

- i) Dimensional Stability (max): 0.1% (ASTM D 5147)
- j) Compound Stability (min - sheet): 250°F (121°C) (ASTM D 5147)
- j) Compound Stability (min – adhesive coating): 212°F (100°C) (ASTM D 5147)
- k) Approvals: UL Class listed, FM Approved (products shall bear seals of approval)
- l) Reinforcement: fiberglass mat or other meeting the performance and dimensional stability criteria
- m) Back Surfacing: polyolefin film
 - > Siplast Paradiene 20 SA

2. Metal-Clad Modified Bitumen Flashing Sheet

- a) Thickness (avg): 150 mils (3.8 mm) (ASTM D 5147)
 - b) Thickness (min): 146 mils (3.7 mm) (ASTM D 5147)
 - c) Weight (min per 100 ft² of coverage): 96 lb (4.6 kg/m²)
 - d) Coating Thickness – back surface (min): 40 mils (1 mm) (ASTM D 5147)
 - e) Low temperature flexibility @ 0° F (-18° C): PASS (ASTM D 5147)
 - f) Peak Load (avg) @ 73°F (23°C): 85 lbf/inch (15 kN/m) (ASTM D 5147)
 - g) Peak Load (avg) @ 0°F (-18°C): 180 lbf/inch (31.7 kN/m) (ASTM D 5147)
 - h) Ultimate Elongation (avg) @ 73°F (23°C): 45% (ASTM D 5147)
 - i) Tear-Strength (avg): 120 lbf (0.54 kN) (ASTM D 5147)
 - j) Dimensional Stability (max): 0.2% (ASTM D 5147)
 - k) Compound Stability (min): 225°F (107°C) (ASTM D 5147)
 - l) Cyclic Thermal Shock Stability (maximum): 0.2% (ASTM D 7051)
 - m) Approvals: UL Approved, FM Approved (products shall bear seals of approval)
 - n) Reinforcement: fiberglass scrim mat or other meeting the performance and dimensional stability criteria
 - o) Surfacing: aluminum metal foil
 - > Siplast Veral Aluminum
- C. Catalyzed Acrylic Resin Flashing System: A specialty flashing system consisting of a PMMA-based, fully reinforced membrane installed over a prepared or primed substrate. The flashing system consists of a catalyzed acrylic resin primer, basecoat and topcoat, combined with a non-woven polyester fleece. The use of the specialty flashing system shall be specifically approved in advance by the membrane manufacturer for each application.
- > Parapro 123 Flashing System by Siplast; Irving, TX

2.03 ROOFING ACCESSORIES

A. Roofing Adhesives

- 1. Mastic: An asphalt cutback mastic, reinforced with non-asbestos fibers, used as a base for setting metal flanges conforming to ASTM D 4586 Type II requirements.
 - > Siplast PA-1021 Plastic Cement by Siplast; Irving, TX

B. Primers

- 1. Primer: An asphalt, solvent blend conforming to ASTM D 41 requirements.

- > Siplast PA-1125 Asphalt Primer by Siplast; Irving, TX
- 2. Primer for Self-Adhesive Sheets: A quick drying, low-VOC, water-based, high-tack primer specifically designed to promote adhesion of roofing and waterproofing sheets to approved substrates. Primer shall meet South Coast Air Quality District and Ozone Transport Commission requirements.
 - > Siplast TA-119 Primer by Siplast; Irving, TX
- C. Sealant (horizontal applications): A moisture-curing, self-leveling elastomeric sealant designed for roofing applications. The sealant shall be approved by the roof membrane manufacturer for use in conjunction with the roof membrane materials. Acceptable types are as follows:
 - > Siplast PS-209 Elastomeric Sealant by Siplast; Irving, TX
- D. Sealant (vertical and sloped applications): A moisture-curing, non-slump elastomeric sealant designed for roofing applications. The sealant shall be approved by the roof membrane manufacturer for use in conjunction with the roof membrane materials. Acceptable types are as follows:
 - > Siplast PS-715 NS Elastomeric Sealant by Siplast; Irving, TX
- E. Ceramic Granules: No. 11 grade specification ceramic granules of color scheme matching the granule surfacing of the finish ply.
- F. Perlite Cant Strips: A cant strip composed of expanded volcanic minerals combined with waterproofing binders. The top surface shall be pre-treated with an asphalt based coating. The face of the cant shall have a nominal 4 inch dimension.
- G. Fasteners
 - 1. Base Sheet Fasteners: Base sheet fasteners shall be approved by the manufacturer of the primary roofing products. Acceptable base sheet fasteners for specific substrate types are listed below.
 - a) Lightweight Concrete Substrates
 - A single unit, precision formed, electro zinc coated steel fastener 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 concrete. Fasteners for lightweight concrete shall meet FM Standard 4470 requirements for corrosion resistance.
 - > Zono-tite Fasteners by Siplast; Irving, TX
 - 2. Flashing Reinforcing Sheet Fasteners for Wood/Plywood Substrates to Receive Flashing Coverage: Fasteners shall be approved by the manufacturer of the primary roofing products. Acceptable fasteners for specific substrate types are listed below.
 - a) Wood/Plywood Substrates
 - A 12 gauge, spiral or annular threaded shank, zinc coated steel roofing fastener having a minimum 1 inch head.
 - > Square Cap by Maze Nails; Peru, IL

> Simplex Cap Nail by Simplex Nails, Inc., Americus, GA

H. Walktread: A prefabricated, puncture resistant polyester core reinforced, polymer modified bitumen sheet material topped with a ceramic-coated granule wearing surface.

1. Thickness: 0.217 in (5.5 mm)
2. Weight: 1.8 lb/ft² (8.8 kg/m²)
3. Width: 30 in (76.2 cm)

> Paratread by Siplast; Irving, TX

PART 3 EXECUTION

3.01 PREPARATION

- A. General: Sweep or vacuum all surfaces, removing all loose aggregate and foreign substances prior to commencement of roofing.
- B. Primer for Self-Adhesive Bituminous Membranes: Apply the specified tacky primer by roller or spray in an even film. Refer to the manufacturer's literature for the approved rate of application over various substrate types. Allow the primer to dry until it leaves a slightly sticky surface without transfer when touched.
- C. Asphaltic Primer: Prime metal and concrete and masonry surfaces with a uniform coating of the specified asphalt primer.

3.02 SUBSTRATE PREPARATION

- A. Substrate: Lightweight Insulating Concrete System installed over slotted metal deck. See Specification Section 03 52 00.
- B. Base Sheet Securement to Prepared Substrate: Lay the base sheet over the entire area to be roofed, lapping sides 3 inches and ends 6 inches. Using the specified fasteners, fasten each sheet every 7.5 inches through laps and stagger fasten the remainder of the sheet in 2 rows on nominal 12 inch centers with fasteners in each row on 10 inch centers. Increase the fastening pattern by 70% at the perimeter of the roof and 160% in the corners.

3.03 ROOF MEMBRANE INSTALLATION

- A. Membrane Application: Apply roofing in accordance with roofing system manufacturer's instructions and the following requirements. Application of roofing membrane components shall immediately follow application of base sheet and/or insulation as a continuous operation.
- B. Aesthetic Considerations: Construction of 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 including granules, and exercise care in ensuring that the finished application is acceptable to the Owner.
- C. Bitumen Consistency: Cutting or alterations of bitumen, primer, and sealants will not be permitted.

- D. Roofing Application (Base Bid): 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.
1. Apply all layers of roofing perpendicular to the slope of the deck.
 2. Fully bond the base ply to the prepared substrate, utilizing minimum 3 inch side and end laps. Apply each sheet directly behind the torch applicator. Cut a dog ear angle at the end laps on overlapping selvage edges. Using a clean trowel, apply top pressure to top seal T-laps immediately following sheet application. Stagger end laps a minimum of 3 feet.
 3. Fully bond the finish ply to the base ply, utilizing minimum 3 inch side and end laps. Apply each sheet directly behind the torch applicator. Stagger end laps of the finish ply a minimum 3 feet. Cut a dog ear angle at the end laps on overlapping selvage edges. Using a clean trowel, apply top pressure to top seal T-laps immediately following sheet application. Stagger side laps of the finish ply a minimum 12 inches from side laps in the underlying base ply. Stagger end laps of the finish ply a minimum 3 feet from end laps in the underlying base ply.
 4. 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.
- E. Granule Embedment: Broadcast mineral granules over all bitumen overruns on the finish ply surface, while the bitumen is still hot or the adhesive is soft, to ensure a monolithic surface color.
- F. Flashing Application: Cut the cant backing sheet into 12 inch widths and peel the release film from the back of the sheet. Set the sheet into place over the primed substrate extending 6 inches onto the field of the roof area and 6 inches up the vertical surface utilizing minimum 3 inch laps. Set the non-combustible cant into place dry prior to installation of the roof membrane base ply. Flash 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, prime the base ply surfaces to receive the reinforcing sheet. Fully adhere the reinforcing sheet, utilizing minimum 3 inch side laps onto the primed base ply surface and up the primed wall or curb to the desired flashing height. 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 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 4 inches beyond the toe of the cant onto the prepared surface of the finished roof and up the wall or curb to the desired flashing height. Exert pressure on the flashing sheet during application to ensure complete contact with the vertical/horizontal 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 9 inch centers. (See manufacturer's schematic for visual interpretation).
- G. Catalyzed Acrylic Resin Flashing System: Install the liquid-applied primer and flashing system in accordance with the membrane system manufacturer's printed installer's guidelines and other applicable written recommendations as provided by the manufacturer.
- H. Water Cut-Off: At 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 the resumption of roofing.

3.04 ROOF SYSTEM INTERFACE WITH RELATED COMPONENTS

- A. Roof Moisture Relief Vents - vented lightweight insulating concrete substrates: The installation of the topside vents must be completed daily, immediately following the application of the base ply sheet, and in accordance with the most recent version of the technical bulletin for venting Siplast roof membrane and roof insulation systems. Completely prime the metal flanges and allow to dry prior to installation. After the base ply has been applied, mark the venting designations. Cut a 2 inch diameter core from the roof membrane assembly. Set the vent flange in mastic, centered over the core cut. Strip-in the flange using the stripping-ply material, extending a minimum of 4 inches beyond the edge of the flange. Terminate the finish ply at the flange-throat juncture of the vent. SEE ITEM: SEALANT for finish of this detail.
- B. Walktread: Cut the walktread into maximum 5 foot lengths and allow to relax until flat. 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 5 inch by 5 inch spots in accordance with the pattern as supplied by the walktread manufacturer. Walk-in each sheet after application to ensure proper adhesion. Use a minimum spacing of 2 inches between sheets to allow for proper drainage.
- C. Sealant: Apply a smooth continuous bead of the specified sealant at the exposed finish ply edge transition to metal flashings incorporated into the roof system.

3.05 FIELD QUALITY CONTROL AND INSPECTIONS

- A. Site Condition: Leave all areas around job site free of debris, roofing materials, equipment and related items after completion of job.
- B. Notification Of Completion: Notify the manufacturer by means of manufacturer's printed Notification of Completion form of job completion in order to schedule a final inspection date.
- C. Final Inspection
 - 1. Post-Installation Meeting: Hold a meeting at the completion of the project, attended by all parties that were present at the pre-job conference. A punch list of items required for completion shall be compiled by the Contractor and the manufacturer's representative. Complete, sign, and mail the punch list form to the manufacturer's headquarters.
- D. Issuance Of The Guarantee: Complete all post installation procedures and meet the manufacturer's final endorsement for issuance of the specified guarantee.
- E. No abandoned curbs shall remain on roof. Remove and re-roof over removed curb areas.
- F. Re-paint existing gas line on roof yellow as per CFISD standards.

END OF SECTION

SECTION 07 62 00

ROOFING RELATED SHEET METAL FLASHING AND TRIM

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Fabricated sheet metal items, including flashings, counterflashings, gutters, downspouts, sheet metal roofing, and other items indicated in Schedule.
- B. Reglets and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood nailers.
- B. Section 07 72 00 - Roof Accessories: Roof-mounted units.

1.3 REFERENCE STANDARDS

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels; 2013.
- B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2010.
- C. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2010.
- D. SMACNA (ASMM) - Architectural Sheet Metal Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2012.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.

1.5 SUBMITTALS

- A. See Section 01 33 00 - Submittals, for submittal procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
- C. Samples: Submit two samples 12x12 inch (305x305 mm) in size illustrating metal finish color.

1.6 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA Architectural Sheet Metal Manual and CDA Copper in Architecture Handbook requirements and standard details, except as otherwise indicated.
- B. Maintain one copy of each document on site.
- C. Fabricator and Installer Qualifications: Company specializing in sheet metal work with 5 years of documented experience.

- D. Single Source Responsibility: Fabricator and installer of roof-related flashing and accessories shall be the same as the membrane roof installer.
- E. Comply with governing codes and regulations of authorities having jurisdiction.
- F. ANSI/SPRI ES-1: Fabricate and install sheet metal edge flashings and copings to comply with requirements of ANSI/SPRI ES-1 for 110 MPH wind speed zone and wind resistance loads.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

1.8 WARRANTIES

- A. Manufacturer's Product Warranty:
 - 1. Manufacturer's standard 20 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 limited to:
 - a. Deterioration of finish, such as fading, discoloring, peeling, cracking, corrding, etc.
 - 3. Correction may include repair or replacement of failed product.
- B. Roofing Contractor's Warranty:
 - 1. Contractor shall warrant the sheet metal work and related work to be free from defects in workmanship and materials, and that the metal flashings will be and remain watertight, for a period of five (5) years from date of Substantial Completion.
 - 2. Defects shall include leaking water or bitumen within building or construction, becoming loose from substrate, loose or missing parts and finish failure as defined above.

PART 2 – PRODUCTS

2.1 APPROVED MANUFACTURERS

- A. Manufacturers names within specification are approved for use on the Project providing:
 - 1. Product meets or exceeds 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 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.
- B. SHEET METAL:
 - 1. MBCI, Inc.
 - 2. Petersen Aluminium Corp
 - 3. Vincent Brass and Aluminium Company
 - 4. Berridge Manufacturing Co.
 - 5. WP Hickman Co.

2.2 SHEET 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. Pre-Finished Aluminum: Conforming to Fed Spec QQ-A-250, ASTM B209 (ASTM B209M); minimum 0.04 inch (1 mm) thick; plain finish shop pre-coated with fluoropolymer coating.
 - 1. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system.
 - 2. Finish: Kynar 500
 - 3. Color: From full range of available colors to be selected by Architect.
- C. Sheet Lead:
 - 1. Comply with FS QQ-L-201, Grade B
 - a. Four (4) pound minimum for use at roof drains at soil stacks.
- D. 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 for weather tight installation. (ZAC type).
- 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. Continuous Cleat (coping/ fascia): Minimum 20 gauge, G-90 galvanized, stainless steel or aluminum. Match material of coping/ fascia and provide one gauge heavier.

2.4 ACCESSORIES

- 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. 48 mil minimum, non-reinforced, homogeneous, waterproof, impermeable elastomeric sheeting manufactured by Nervastral, Inc or Lexsuco.
- D. Adhesives: Type recommended by flashing sheet manufacturer seaming and adhesive application of flashing sheet to ensure adhesion and water tightness.
- E. Metal Accessories: Sheet metal clip, 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 suite application and performance.

- F. Sealant:
1. Type A:
 - a. Type: One-part, non-sag, moisture-curing polyurethane sealant.
 - b. Approved Products/Manufacturer: "Chem-Calk 900" manufactured by Bostik Construction Products Division, "Vulkem 921: manufactured by Mameco International Inc., "Drynatrol I" manufactured by Pecora Corporation, "NP 1" manufactured by Sonneborn Building Products, 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 manufacturers:
 - 1) "Chem Calk- 1200" manufactured by Bostik Construction Products Division
 - 2) "795 Silicone" manufactured by Dow Corning Corporation,
 - 3) "895 Silicone" manufactured by Pecora Corporation
 - 4) "Omniseal" manufactured by Sonnebonrn Building Products
 - 5) "Spectrem 2" manufactured by Tremco Inc
 - 6) approved equal
- G. Grout- Pitch Pans.
1. Type: Quick setting, non shrink, non-metallic, high strength formula complying with ASTM C1107.
 2. Approved Manufacturers:
 - a. Sure Grip High Performance Grout manufactured by Dayton Superior Corporation
 - b. Premier Quick-Trim manufactured by L&M Construction Chemicals.
 - c. Masterflow manufactured by Master Builders Inc.
 - d. SonnogROUT 10K manufactured by Sonneborn Building Products
 - e. approved equal
- H. Pitch Pan Filler:
1. Type: Pourable polyurethane sealer, approved by roofing system manufacturer.
 2. Approved Manufacturers:
 - a. Quick Pitch Sealer manufactured by U.S. intec
 - b. SPM Pourable Sealer manufactured by Johns Mansville
 - c. approved equal
- I. Termination Bar:
1. Material: Extruded aluminum bar with flat 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 sixe (6) inches on center.
 3. Approved Manufacturers:
 - a. TB 125 manufactured by TruFast Corp
 - b. approved equal
- J. Splash Blocks:
1. 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 dumps on ground.
- K. Splash Pans: 22 gauge stainless steel, of size and profiles indicated. Use at locations where roof drainage discharges over adjoining, lower roof level (s).

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, receiver and counter flashings in accordance with standards set forth in the NRCA roofing manual and SMACNA.

- B. Fold back edges on concealed side of exposed edge to form hem.
- C. Unless otherwise noted, 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.
- D. Seams:
 - 1. Whenever possible, fabricate non-moving seams in sheet metal with flat-lock seams and end joints.
 - 2. Tin edges to be seamed, from seams and solder.
- E. On Kynar 500 or Hylar 5000 pre-finished metal, surface sand metal flanges prior to applying primers. Prime all metal in contact with bituminous material.
- F. Backpaint all concealed metal surfaces with bituminous paint where expected to be in contact with cementitious materials or dissimilar metals.
- G. Backpaint all concealed metal surfaces with bituminous paint where expected to be in contact with cementitious materials or dissimilar metals.
- H. 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 intersheing hooked flanges, not less than one (1) inch deep filled with mastic sealant concealed within joints.
- I. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- J. Form pieces in longest possible lengths.

2.6 FABRICATED ITEMS

- A. Through-wall Flashings: (minimum ten (10) foot lengths)
 - 1. Through wall Receiver Tray: minimum 24 gauge stainless steel type 316, through wall receivers shall not extend past the face of the exterior veneer more than 3/4 inch.
 - 2. Removable Counterflashings: Minimum 0.04 inch thick pre-finished aluminum formed in maximum ten (10) foot lengths.
- B. Wind Clips: Minimum 24 gauge stainless steel (or match material of removable counterflashing), one (1) inch wide by length to engage counterflashing a minimum of 1/2 inch installed 24" o.c..
- 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 bonnet 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 Fascia Edge: (Ensure all fabrication and installation is ES-1 certified): Refer to Roofing specifications 07 52 00 and 07 52 01 for Metal Fascia Edge material requirements.
 - 1. Minimum 0.040 inch thick pre-finished aluminum formed in maximum ten (10) foot lengths, with six (6) inch wide cover plates of same profile, four (4) inch flange maximum seven (7) inch fascia, 3/4 inch gravel stop. Refer to SMACNA Fig 2-5A
 - 2. Provide expansion slip joints at maximum 20 feet on center.
 - 3. Shop fabricates all interior and exterior corners. Fabricate exterior corners with 18 inch minimum four (4) foot maximum legs. Lap, rivet, and seal prior to delivery to jobsite.
 - 4. Provide mock-up for Architect's approval prior to fabrication.

- 5. Pre-engineered ES-1 certified products shall be submitted to District for prior approval.
- E. Continuous Cleats: continuous strips, same material and profile, minimum one gauge heavier of item which cleats attach or 22 gauge whichever is more stringent. Hot dipped galvanized.
- F. Vent Hoods, Sleeves, Penetration Flashings and Accessories: Minimum 24 gauge stainless steel, or as shown or directed otherwise.
- G. Angle Termination Bar: Aluminum pressure bar 1/8 inch x one (1) inch.
- H. Vent Pipe Flashing: Four (4) pound lead. Provide proper size to fold down inside of pipe a minimum of one (1) inch.
- I.

2.7 GUTTER AND DOWNSPOUT FABRICATION

- A. Gutters: SMACNA Architectural Sheet Metal Manual, Rectangular profile.
- B. Downspouts: Rectangular profile.
- C. Gutters and Downspouts: Size for rainfall intensity determined by a storm occurrence of 1 in 5 years in accordance with SMACNA Architectural Sheet Metal Manual.
- D. Accessories: Profiled to suit gutters and downspouts.
 - 1. Anchorage Devices: In accordance with SMACNA requirements.
 - 2. Expansion Joints: Lap or Butt type per SMACNA, locate every 50 linear feet.
 - 3. Gutter Straps and Supports: minimum 0,040 inch thick pre-finished (match color) aluminum hemmed around 1/8 inch galvanized bent steel bracket.
 - 4. Downspout Strap: Strap type, like metal, match color.
 - 5. Gutter Screen: Stainless steel 1/4 inch diamond wire screen enclosed in a prefinished steel frame.
 - 6. Collect Heads: Minimum 0.040 inch thick pre-finished (match color) aluminum. 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 roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 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. Pre-fabricated 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. Pre-fabricated corners; transitions; changes in direction; elevation and plane; and 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 whenever 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. 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.

- D. Continuous Cleat: AT exposed edges of perimeter edge, fascias, cap flashings, and where required, attach continuous cleat at six (6) inches on center with appropriate fasteners. At a distance of 10 feet from each direction of all corners, install fasteners spaced at three (3) inches on center. Install cleat so fascia extends a minimum of 1 inch below top of exterior wall finish.
- E. Gravel Guard/ Fascia:
1. Install with expansion joints 10 feet o.c., 1/2 inch expansion leeway, with cover plate.
 2. Set in asphaltic mastic and fasten into nailer at 3 inches o.c. staggered.
 3. Buff sand Kynar surface of flange and prime.
 4. Strip in flange with specified stripping plies set in hot bitumen extending 3 inches from outer edge of flange to at least 3 inches inward towards gravel stop. Provide finish stripping ply of modified bitumen base ply in hot bitumen extending 6 inches from the outer edge of the flange and butt base of gravel stop.
- F. Counterflashing:
1. Do not use surface mount counterflashing except as noted in drawings.
 2. Set in through wall with receiver and pring 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:
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 a 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 ground 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:
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 pipes prior to folding lead sleeve.
- I. Gutters / Downspouts:
1. Install gutters 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 (10) feet on center.
 3. Install splash pad or block under discharge port of downspouts (if none exists). Install splash pan over a protection walkway pad for downspouts located at roof level.

END OF SECTION 07 62 00

**SECTION 07 64 00
THRU-WALL FLASHING**

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Combination Flashing, Mortar Deflection and Weep as a complete one step system.

1.2 RELATED REQUIREMENTS

- A. Related Work:
 - 1. Section 04 20 00 - Masonry
 - 2. Section 07 13 00 - Sheet Waterproofing
 - 3. Section 07 25 00 - Weather Barriers

1.3 REFERENCE STANDARDS

- A. ASTM 3273-94 "Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber".
- B. Industry standards:
 - 1. *IBIA Technical Notes on Brick Construction No. 7, Water Penetration Resistance- Design and Detailing*, August 2005.
 - 2. *BIA Technical Notes on Brick Construction No. 28B, Brick Veneer/Steel Stud Walls*, August 2005.

1.4 SUBMITTALS

- A. Product Data: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.
 - 1. Certificates:
 - a. Indicate materials supplied or installed are asbestos free.
 - b. Indicate recycled content: 90% total recycled material; based on 80% Post Industrial Recycled Content and 10% Post Consumer Recycled Content.
 - 2. Performance Attributes:
 - a. Tensile Strength: 31,500 psi min
 - b. Puncture Resistance: >500 pounds average
 - c. When tested as manufactured, product resist growth of mold pursuant to test method ASTM D3273-94.
 - d. Fire Rating: Rated Class B, ASTM E84
- 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.

1.5 QUALITY ASSURANCE

- A. Qualifications:
1. Manufacturer: Provide flashing materials by single manufacturer with not less than twenty five years experience in manufacturing flexible flashing products.
 2. Flashing materials must be able to withstand 300 degrees F temperature without changing the long term performance of the flashing.
 3. All manufacturers of air barriers, insulation and flashing products should provide mutual letters of compatibility for products in combination with each other.

1.6 WARRANTY

- A. Manufacturer shall provide warranty for flexible flashing material for life of the wall. The warranty should begin at Date of Substantial Completion.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Specification: York Multi-Flash SS
- B. Other approved manufacturers:
- a. Illinois Products, Inc.; IPCO Stainless Steel Fabric Flashing
 - b. Prosoco, Inc.; R-Guard SS ThruWall
 - c. STS Coatings, Inc.; Wall Guardian Stainless Steel TWF
 - d. TK Products, Inc.; TK TWF

2.2 MANUFACTURED UNITS

- A. Flashing and Accessories:
1. Flexible flashing:
 2. Characteristics:
 - a. Type: Stainless steel core with polymer fabric laminated to the bottom stainless steel face with non-asphalt adhesive. The top face (exposed side) must not be covered with a polymer fabric.
 - b. Stainless steel: type 304, ASTM A240. Domestically sourced per DFARS 252.225-7008 and/or DFARS 252.225-7009.
 - c. Fabric: polymer fabric; laminated back face (non-exposed side) of stainless steel core.
 - d. Size: Manufacturer's standard width rolls.
 4. Substrate Primer: as instructed by membrane manufacturer.
 5. Termination Bar: 1/8 inch thick by 1 inch minimum wide aluminum, w/pre punched holes and self-tapping screws.

2.3 ACCESSORIES:

- A. Mastik/sealant: Product standard of quality is York Manufacturing, Inc.; UniverSeal US100.
- a. Characteristics:
 - 1) Type: One part 100% solids, solvent-free formulated silyl-terminated

- polyether (STPE), ASTM C920-11, Type S, Grade NS, Class 50.
- B. Outside corner and inside corner material; manufacturer's standard available units using:
 - a. Stainless steel: 26 gauge stainless steel.
 - C. End dam: Product may be folded in line with the flashing material or utilize preformed end dams by manufacturer using:
 - a. Stainless steel: 26 gauge stainless steel
 - D. Splice material: Product standard of quality is York304 SS by York. Manufacturer's standard self-adhered metal material; material matching system material or use Multi-Flash Stainless Steel 6" lap piece and polyether sealant as a splice.
 - E. Termination bar: Product standard of quality is York T-96 termination bar. Manufacturer's standard 1" composite material bar or a 1" 26 gauge stainless steel termination bar with sealant lip.
 - F. Weep vent protection: Product standard of quality is York's Weep Armor. Geotextile drainage fabric at least 12" in height.
 - G. Repair and other materials/accessories: Manufacturer's standard.
 - H. Fasteners: Domestic manufactured fastener types and sizes recommended by flashing manufacturer for intended use.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Locations: Install in exterior walls to divert moisture within walls to exterior surfaces. Install flashing over heads of openings, under sills of openings, around perimeter of building at floor and roof lines, and where indicated on drawings.
- B. Install where indicated, specified, or required in accordance with flashing manufacturer's written instructions and as follows.

3.2 INSTALLATION

- . General:
 - 1. Install where indicated, specified, or required in accord with flashing manufacturer's written instructions and as follows.
 - 2. Extend flashing 6" minimum beyond opening. Fold flashing ends at end of openings or horizontal flashing terminations to form end dam or use pre-manufactured units made of 26 gauge stainless steel.
 - 3. Flashing width: Width required starting flush with outside face of exterior wythe, extending through cavity, rising height required to extend above lintel steel at least 2".
 - 4. Splice end joints by overlapping them 6" and seal with a compatible sealant or metal splice tape.
 - 5. Masonry back up:
 - a. Surface apply after dampproofing installation specified in Dampproofing Section in accord with manufacturer's installation instructions.
 - b. Fasten the top of the flashings to the back up wall with a non-corrosive termination bar and seal the top edge with a compatible sealant or use a termination clamp, which is embedded in the block back up wall.
 - 6. Concrete back up:

- a. Surface apply after dampproofing installation specified in Dampproofing Section in accord with manufacturer's installation instructions.
- b. Fasten the top of the flashings to the back up wall with a non-corrosive termination bar and seal the top edge with a compatible sealant..
7. Stud back up with sheathing:
 - a. Fasten the top of the flashings to the back up wall with a non-corrosive termination bar and seal the top edge with a compatible sealant.
8. Leave ready for certified compatible building felt or air barrier installation lapping flashing top installed in another Section.
9. Lay flashing in continuous bead of sealant on masonry supporting steel.
10. Fold ends of flashing at end of opening to form dam; seal with polyether sealant or use purchased manufacturers preformed end dams.
11. Inside and outside corners: Make in industry accepted manner using corner and splice material or purchase manufactured corners from manufacturer.
13. Cover flashing within a few days of installation to protect it from damage from the different trades, the environment and falling debris. If flashing is left unprotected and it is punctured, torn, or has loose scrim you should contact the manufacturer for repair instructions.

3.01 SCHEDULES

- . Locations:
 1. Exterior door heads.
 2. Window heads and sills.
 3. Storefront heads.
 4. Horizontal control joints.
 5. Changes in veneer materials, vertically.
 6. Other wall openings.
 7. Other locations indicated.

END OF SECTION 07 64 00

SECTION 07 65 00

FLEXIBLE FLASHING STAINLESS STEEL

PART 1 - GENERAL

1.01 SUMMARY

- A. Laminated stainless steel fabric flashing, non-asphaltic.
- B. Related sections:
 - 1. 04 20 00 Unit Masonry
 - 2. 04 72 00 Cast Stone Masonry.
 - 3. 05 50 00 Metal Fabrications
 - 4. 06 10 00 Rough Carpentry.
 - 5. 07 11 10 Dampproofing.
 - 6. 07 62 00 Flashing and Sheet Metal.
 - 7. 07 65 00 Flexible Flashing.

1.02 REFERENCES

- A. Standards of the following as referenced:
 - 1. ASTM
 - 2. Brick Industry Association (BIA)
 - 3. Recycled content & Recyclability
- B. Industry standards:
 - 1. BIA *Technical Notes on Brick Construction No. 7, Water Penetration Resistance- Design and Detailing*, August 2005.
 - 2. BIA *Technical Notes on Brick Construction No. 28B, Brick Veneer/Steel Stud Walls*, August 2005.

1.03 DEFINITIONS

- A. Terms:
 - 1. Cavity wall flashing: Same as flexible flashing.
 - 2. Foundation sill flashing: Same as flexible flashing.
 - 3. Flexible flashing: Water-proof material typically used in cavity wall construction to contain and assist in the proper water drainage that may penetrate wall system veneer. Other materials may be required to constitute the system.
 - 4. Head and sill flashing: Same as flexible flashing.
 - 5. Through-wall flashing:
 - a. Generally considered the same as flexible flashing.
 - b. Rare definition referred to full width cap flashing under copings or wall caps.

1.04 SUBMITTALS

- A. Product data: Indicate material type, composition, thickness, and installation procedures.
- B. Samples: 3" by 5" flashing material.
- C. **Product Quality & Environmental submittals:**
 - 1. **Certificates:**
 - a. Indicate materials supplied or installed are asbestos free.
 - b. Indicate recycled content: 60% total recycled material; based on 60% Post Industrial Recycled Content.
 - 2. **Performance Attributes**
 - a. Tensile strength, 100,000 psi minimum average
 - b. Puncture Resistance, 2,500 pounds average
 - c. When tested as manufactured, product resists growth of mold pursuant to test method ASTM D3273.

- d. Fire Rating: flame spread and smoke generation
 1. Rated Class A, ASTM E84
- f. Certify the use of domestic manufactured stainless steel for flashing.
- g. Certify products contain no silica or asbestos.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: Provide flashing materials by single manufacturer with not less than twenty five years of experience in manufacturing flexible flashing products.
2. Flashing materials must be able to withstand 300° F temperature without changing the long term performance of the flashing.

1.06 WARRANTY

A. Special warranty:

1. Manufacturer: **Warrant flexible flashing material for life of the wall.**
2. Begin warranty at Date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURED UNITS

A. Flexible flashing:

1. Products of manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics, except as modified below, are acceptable for use, subject to compliance with specified requirements. Product standard of quality is York Manufacturing's Multi-Flash SS
 - a. Product standard of quality:
 - a. York Manufacturing, Inc.; Multi-Flash SS
 - b. Illinois Products, Inc.; IPCO Stainless Steel Fabric Flashing
 - c. Prosoco, Inc.; R-Guard SS ThruWall
 - d. STS Coatings, Inc.; Wall Guardian Stainless Steel TWF
 - e. TK Products, Inc.; TK TWF
 - f. Other products that meet the criteria in section 1.04 to 1.06.
2. Characteristics:
 - a. Type: Stainless steel core with polymer fabric laminated to the bottom stainless steel face with non-asphalt adhesive. The top face (exposed side) must not be covered with a polymer fabric.
 - b. Stainless steel: type 304, ASTM A240. Domestically sourced per DFARS 252.225-7008 and/or DFARS 252.225-7009.
 - c. Fabric: polymer fabric; laminated back face (non-exposed side) of stainless steel core.
 - d. Size: Manufacturer's standard width rolls.

2.02 ACCESSORIES:

A. Mastic/sealant: Product standard of quality is York Manufacturing, Inc.; UniverSeal US100.

1. Characteristics:

- a. Type: One part 100% solids, solvent-free formulated silyl-terminated polyether (STPE), ASTM C920-11, Type S, Grade NS, Class 50.

B. Outside corner and inside corner material; manufacturer's standard available units using:

1. Stainless steel: 26 gauge stainless steel.

C. End dam: Product may be folded in line with the flashing material or utilize preformed end dams by manufacturer using:

1. Stainless steel: 26 gauge stainless steel

D. Splice material: Product standard of quality is York304 SS by York. Manufacturer's standard self-adhered metal material; material matching system material or use Multi-Flash Stainless Steel 6" lap piece and polyether sealant as a splice.

- E. Termination bar: Product standard of quality is York T-96 termination bar. Manufacturer's standard 1" composite material bar or a 1" 26 gauge stainless steel termination bar with sealant lip.
- F. Weep vent protection: Product standard of quality is York's Weep Armor. Geotextile drainage fabric at least 12" in height.
- G. Repair and other materials/accessories: Manufacturer's standard.
- H. Fasteners: Domestic manufactured fastener types and sizes recommended by flashing manufacturer for intended use.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. Install where indicated, specified, or required in accord with flashing manufacturer's written instructions and as follows.
2. Extend flashing 6" minimum beyond opening. Fold flashing ends at end of openings or horizontal flashing terminations to form end dam or use pre-manufactured units made of 26 gauge stainless steel.
3. Flashing width: Width required starting flush with outside face of exterior wythe, extending through cavity, rising height required to extend above lintel steel at least 2".
4. Splice end joints by overlapping them 6" and seal with a compatible sealant or metal splice tape.
5. Masonry back up:
 - a. Surface apply after dampproofing installation specified in Dampproofing Section in accord with manufacturer's installation instructions.
 - b. Fasten the top of the flashings to the back up wall with a non-corrosive termination bar and seal the top edge with a compatible sealant or use a termination clamp, which is embedded in the block back up wall.
6. Concrete back up:
 - a. Surface apply after dampproofing installation specified in Dampproofing Section in accord with manufacturer's installation instructions.
 - b. Fasten the top of the flashings to the back up wall with a non-corrosive termination bar and seal the top edge with a compatible sealant..
7. Stud back up with sheathing:
 - a. Fasten the top of the flashings to the back up wall with a non-corrosive termination bar and seal the top edge with a compatible sealant.
8. Leave ready for certified compatible building felt or air barrier installation lapping flashing top installed in another Section.
9. Lay flashing in continuous bead of sealant on masonry supporting steel.
10. Fold ends of flashing at end of opening to form dam; seal with polyether sealant or use purchased manufacturers preformed end dams.
11. Inside and outside corners: Make in industry accepted manner using corner and splice material or purchase manufactured corners from manufacturer.
13. Cover flashing within a few days of installation to protect it from damage from the different trades, the environment and falling debris. If flashing is left unprotected and it is punctured, torn, or has loose scrim you should contact the manufacturer for repair instructions.

3.02 SCHEDULES

A. Locations:

1. Exterior door heads.
2. Window heads and sills.
3. Storefront heads.
4. Horizontal control joints.
5. Changes in veneer materials, vertically.
6. Other wall openings.
7. Other locations indicated.

END OF SECTION 07 65 00

07 65 00-4

SECTION 07 72 00
ROOF ACCESSORIES

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Manufactured curbs, equipment rails, pipe supports and pedestals.
- B. Roof hatches, manual and automatic operation, including smoke vents.

1.2 RELATED REQUIREMENTS

- A. Section 05 31 23 - Steel Roof Deck.
- B. Section 07 52 00- Modified Bituminous Membrane Roofing
- C. Section 07 62 00 - Sheet Metal Flashing and Trim: Roof accessory items fabricated from sheet metal.

1.3 REFERENCE STANDARDS

- A. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2009.
- B. UL (BMD) - Building Materials Directory; current edition.

1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittals, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Maintenance requirements.
 - 5. For smoke hatches, submit evidence of approval by evaluation agency specified.
- C. Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacing.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products under cover and elevated above grade.

PART 2 – PRODUCTS

2.1 MANUFACTURED CURBS

- A. Walls: Galvanized Steel

- B. Wood Nailers: Factory installed
- C. Insulation 1-1/2 inch thick rigid fiberglass board.
- D. Corner Seams: Continuous mitered and welded.

2.2 PIPE SUPPORTS

- A. All pipe supports to be manufactured by PHP.
- D. Installation:
 - 1. Locate as indicated on Drawings at no greater than 6 feet 0 inches o.c.
 - 2. Provide protective traffic pads below each support, tacked in place with approved mastic or adhesive.
 - 3. Install hold down clips if indicated on the drawings or required by codes.

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. 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. Install in accordance with manufacturer's instructions, in manner that maintains roofing weather integrity.

3.4 CLEANING

- A. Clean installed work to like-new condition.

3.5 PROTECTION

- A. Protect installed products until completion of project.

- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 07 72 00

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SECTION 07 81 00
APPLIED FIREPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fireproofing of interior structural steel.
- B. Preparation of fireproofing for application of finish specified elsewhere.
- C. All labor, materials, equipment and services necessary for, and incidental to, the complete and proper installation of sprayed fire resistive materials and related work as shown on the drawings or where specified herein, and in accordance with all applicable requirements of the Contract Documents. The material and installation shall conform to the applicable building code requirements and the requirements of all authorities having jurisdiction.

1.02 RELATED REQUIREMENTS

- A. Section 05 12 00 - Structural Steel Framing.
- B. Section 05 21 00 - Steel Joist Framing.
- C. Section 05 31 00 - Steel Decking.
- D. Section 07 81 20- Firestopping, Penetration Seals
- E. Section 09 21 16 - Gypsum Board Assemblies: Gypsum board fireproofing.

1.03 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2013a.
- B. ASTM E119-12a Standard for Test Methods for Fire Tests of Building Construction and Materials.
- C. ASTM E 136 - 12 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C.
- D. ASTM E605 - Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members; 1993 (Reapproved 2011).
- E. ASTM E736 - Standard Test Method For Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members; 2000 (Reapproved 2011).
- F. ASTM E759 - Standard Test Method for Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members; 1992 (Reapproved 2011).
- G. ASTM E760 - Standard Test Method for Effect of Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members; 1992 (Reapproved 2011).
- H. ASTM E761 - Standard Test Method for Compressive Strength of Sprayed Fire-Resistive Material Applied to Structural Members; 1992 (Reapproved 2011).
- I. ASTM E859 - Standard Test Method for Air Erosion of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members; 1993 (Reapproved 2011).
- J. ASTM E937 - Standard Test Method for Corrosion of Steel by Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members; 1993 (Reapproved 2011).
- K. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2009.
- L. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with placement of ceiling hanger tabs, mechanical component hangers, and electrical components.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittals procedures.
- B. Product Data: Provide data indicating product characteristics.

- C. Test Reports: Reports from reputable independent testing agencies for proposed products, indicating compliance with specified criteria, conducted under conditions similar to those on project, for:
 - 1. Bond Strength.
 - 2. Bond Impact.
 - 3. Compressive Strength.
 - 4. Fire tests using substrate materials similar those on project.
- D. Manufacturer's Certificate: Certify that sprayed-on fireproofing products meet or exceed requirements of contract documents.
- E. Manufacturer's Field Reports: Indicate environmental conditions under which fireproofing materials were installed.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, and:
 - 1. Having minimum 3 years of documented experience.
 - 2. Approved by manufacturer.
- C. Products, execution, and fireproofing thickness shall conform to the required fire-resistance ratings requirements of code authorities having jurisdiction.
- D. Provide certificate of compliance for fireproofing materials to requirements of code authority having jurisdiction indicating approval for use on this Project.

1.07 TESTS AND INSPECTIONS

- A. Architect may require tests and inspections as necessary to verify quality, strength, and thickness of sprayed fireproofing. Laboratory tests of materials of resistance to damage, bond strength, and air erosion will be made in accordance with referenced ASTM standard procedures.
- B. Owner will select Testing Laboratory and Owner will pay for initial tests of Testing Laboratory. Work which fails initial testing shall be replaced with new materials. Retesting shall be at Contractor's expense until test results are satisfactory to Architect.

1.08 PROJECT / SITE CONDITIONS

- A. When the prevailing outdoor temperature at the building is less than 40 degrees F (4 degrees C), a minimum substrate and ambient temperature of 40 degrees F (4 degrees C) shall be maintained prior to, during and for a minimum of 24 hours after application of the spray-applied fireproofing. If necessary for job progress, Contractor shall provide enclosures with heat to maintain temperatures.
- B. Provide ventilation to allow proper drying of spray-applied fireproofing with work in other sections which would interfere with efficient fireproofing application.

1.09 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
 - 1. Include coverage for fireproofing to remain free from cracking, checking, dusting, flaking, spalling, separation, and blistering.
 - 2. Reinstall or repair failures that occur within warranty period.
- C. Provide warranty of 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. Repair or reinstall failures or damaged fireproofing to achieve required fire resistive ratings at no additional expense to Owner.
- D. Defects shall include non-compliance with specifications, loss of fire resistance ratings, cracking, checking, dusting or flaking, spalling or separation from structural substrate and blooming, blistering or peeling.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers named below and their products are approved for use on the project. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the specifications.
- B. Sprayed-On Fireproofing: Concealed Interior Conditions (Low Density):
 - 1. Isolatek International; Product Cafco Blaze-Sheild II- Sealed with Cafco Bond-Seal Topcoat Sealer).
 - 2. Isolatek Internationl: Product (Cafco 300-Wet Mix)
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Sprayed-on Fire Proofing: Non-concealed Interior Conditions and Indirect Weather Conditions (Medium Density):
 - 1. Isolatek International (Cafco Blaze-Shield HP- Dry Mix)
 - 2. Isolatek International (Cafco 400 - Wet Mix)

2.02 FIREPROOFING ASSEMBLIES

- A. Provide assemblies as indicated on the drawings.

2.03 MATERIALS

- A. Fire Resistive Classification: The spray-applied fireproofing material shall have been teste dand reported by Underwriters Laboratories Inc in accordance with the procedures of ASTM E119 and shall be listed in the UL Fire Resistance Directory.
- B. All Spray-applied fire resitive materials be free of all forms of asbestos, including actinolite, amosite, anthophyllite, chrysotile, crocidolite and tremolite. Material manufacturer shall provide certification of such.
- C. Concealed Interior Conditions:
 - 1. Physical Performance Characteristics: Fireproofing material shall meet the following physical performance standards:
 - a. Deflection: When tested in accordance with ASTM E759, the material shall not crack or delaminate when the non-concrete topped galvanized deck to which it is applied is subjected to a one (1) time vertical centerload resulting ina downward deflection of 1/120th of the span.
 - b. Bond Impact: When tested in accordance with ASTM E760, the material shall not crack or delaminate from teh concrete topped galvanized deck to which it is applied.
 - c. Cohesion / Adhesion (Bond Strength): When tested in accordance with ASTM E736, the material applied over uncoated or galvanized steel shall have an average bond strength of 150 psf.
 - d. Air Erosion: When tested in accordance with ASTM E859, the material shall not be subject to losses from the finished application greater than 0.25 grams per square foot.
 - e. Compressive Strength: When tested in accordance with ASTM E761, the material shall not deform more than ten (10) percent when subjected to a crushing force of 750 psf.
 - f. Corrosion Resistance: When tested in accordance with ASTM E937, the material shall not promote corrossion of steel.
 - g. Non-combustibility: When tested in accordance with ASTM E136, the material shall not be combustible.
 - h. Surface Burning Characteristics: When tested in accordance with ASTM E84, the material shall exhibit the following surface burning characteristics:
 - 1) Flame spread: 0
 - 2) Smoke Developed: 0
 - i. Density: When tested in accordance with ASTM E605, the material shall meet the minimum individual and average density values as listed in the appropriate UL design or as requird by the authority having jurisdiction, but in no case shall be less than 15 pcf.
- D. Non-concealed Interior Conditions and Indirect Weather Conditions:

1. Non-concealed spaces shall be defined as non-public spaces not requiring concealment of fireproofed structural members but requiring a higher degree of abuse resistance i.e. parking garages, mechanical rooms, elevator shafts, etc.
2. Physical Performance Characteristics: Fireproofing material shall meet the following physical performance standards:
 - a. Deflection: When tested in accordance with ASTM E759, the material shall not crack or delaminate when the non-concrete topped galvanized deck to which it is applied is subjected to a one (1) time vertical centerload resulting in a downward deflection of 1/120th of the span.
 - b. Bond Impact: When tested in accordance with ASTM E760, the material shall not crack or delaminate from the concrete topped galvanized deck to which it is applied.
 - c. Cohesion / Adhesion (Bond Strength): When tested in accordance with ASTM E736, the material applied over uncoated or galvanized steel shall have an average bond strength of 425 psf.
 - d. Air Erosion: When tested in accordance with ASTM E859, the material shall not be subject to losses from the finished application greater than 0.25 grams per square foot.
 - e. Compressive Strength: When tested in accordance with ASTM E761, the material shall not deform more than ten (10) percent when subjected to a crushing force of 7,300 psf.
 - f. Corrosion Resistance: When tested in accordance with ASTM E937, the material shall not promote corrosion of steel.
 - g. Non-combustibility: When tested in accordance with ASTM E136, the material shall not be combustible.
 - h. Surface Burning Characteristics: When tested in accordance with ASTM E84, the material shall exhibit the following surface burning characteristics:
 - 1) Flame spread: 0
 - 2) Smoke Developed: 0
 - i. Density: When tested in accordance with ASTM E605, the material shall meet the minimum individual and average density values as listed in the appropriate UL design or as required by the authority having jurisdiction, but in no case shall be less than 22 pcf.
- E. Water: Mixing water shall be clean, fresh, and suitable for domestic consumption and free from such amounts of mineral or organic substances as would affect the set of the fireproofing material. Provide water with sufficient pressure and volume to meet the fireproofing application schedule.
- F. Isolatak Cafco Bond Seal Top Coat (for use over Cafco Blaze-Shield II only): Green tinted sealer for identification.

2.04 ACCESSORIES

- A. Primer Adhesive: Of type recommended by fireproofing manufacturer.
- B. Metal Lath: Expanded metal lath; 3.4 lb/sq ft (16 kg/sq m), galvanized finish.

2.05 SOURCE QUALITY CONTROL

- A. Submit evidence that the fireproofing has been tested in accordance with ASTM E19 by UL or other testing agency approved by code authorities having jurisdiction. Include evidence that the fire testing was sponsored by the manufacturer and that the material tested was produced at the manufacturer's facility under the supervision of personnel by said testing agency. Letters documenting classification status are not acceptable evidence of compliance with this Section.

2.06 EXTRA PATCHING MATERIAL

- A. Installer / subcontractor to provide General Contractor with additional materials for patching of previously applied material damaged by other trades after fireproofing installer has completed work and has left site. Provide material equal to one percent of total project quantity.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive fireproofing.
- B. Verify that clips, hangers, supports, sleeves, and other items required to penetrate fireproofing are in place.

- C. Verify that ducts, piping, equipment, or other items that would interfere with application of fireproofing have not been installed.
- D. Verify that voids and cracks in substrate have been filled. Verify that projections have been removed where fireproofing will be exposed to view as a finish material.

3.02 PREPARATION

- A. Perform tests as recommended by fireproofing manufacturer in situations where adhesion of fireproofing to substrate is in question.
- B. Remove incompatible materials that could affect bond by scraping, brushing, scrubbing, or sandblasting.
- C. Prepare substrates to receive fireproofing in strict accordance with instructions of fireproofing manufacturer.
- D. Apply fireproofing manufacturer's recommended bonding agent on primed steel.
- E. Protect surfaces not scheduled for fireproofing and equipment from damage by overspray, fall-out, and dusting.
- F. Close off and seal duct work in areas where fireproofing is being applied.

3.03 APPLICATION

- A. Application of the fireproofing shall not begin until contractor, applicator and fireproofing testing laboratory (inspector) have examined surfaces to receive fireproofing and determined that the surfaces are acceptable to receive the fireproofing material.
- B. All surfaces to receive fire protection shall be free of oil, grease, loose mill scale, dirt, paints/ primers (other than those listed and tested) or other foreign materials which would impair satisfactory bonding to the surface. Any cleaning of surfaces to receive sprayed fire protection shall be the responsibility of the General Contractor or Steel Erector, as outlined in the structural steel or steel deck section.
- C. Clips, hangers, supports, sleeves and other attachments to the substrate shall be placed prior to the application of spray-applied fire resistive materials.
- D. The installation of ducts, piping, conduit or other suspended equipment shall not take place until the application of sprayed fire protection is complete in the area.
- E. The spray-applied fire resistive material shall only be applied to steel deck which has been constructed in accordance with the criteria set forth by the Steel Deck Institute.
- F. On roof deck without a concrete cover, complete all roofing applications and roof mounted equipment installation prior to application of the fireproofing to the underside of roof decking and supporting beams and joists. Prohibit all roof traffic upon commencement of the fireproofing and until the fireproofing material is dry.
- G. Protect permanently exposed walls or floors, or special surfaces which are not scheduled to receive fireproofing.
- H. Equipment, mixing and application shall be in accordance with the manufacturer's written application instructions.
- I. The application of spray-applied fire resistive material shall not commence until certification has been received by the General Contractor that surfaces to receive sprayed fire protection have been inspected by the applicator and are acceptable to receive sprayed fire protection.
- J. All unsuitable substrates must be identified and made known to the General Contractor and corrected prior to the application of the spray-applied fire resistive material.
- K. Fire protection shall not be applied to steel floor decks prior to the completion of concrete work on that deck, if any.
- L. The application of sprayed fire protection to the underside of roof deck shall not commence until the roof is completely installed and tight, all penthouses are complete, all mechanical units have been placed, and all roof traffic has ceased.
- M. Proper temperature and ventilation shall be maintained as specified herein.

- N. Provide masking, drop cloth or other suitable coverings to prevent overspray from coming in contact with surfaces not intended to be sprayed.
- O. Bonding materials (adhesives, catch coats, metal lath, mesh, stud pins, etc) shall be applied in accordance with the appropriate UL fire resistance design and manufacturer's written instructions.
- P. Equipment and application procedures for installation of topcoat sealer material shall conform to the material manufacturer's application instructions.
- Q. Erect appropriate barriers to prevent entry by non-fireproofing workers into the fireproofing spray and mixing areas and other areas exposed to wet fireproofing material.

3.04 FIELD QUALITY CONTROL

- A. Inspect the installed fireproofing after application and curing for integrity, prior to its concealment. Ensure that actual thicknesses, densities, and bond strengths meet requirements for specified ratings and requirements of the Authority Having Jurisdiction.
- B. Re-inspect the installed fireproofing for integrity of fire protection, after installation of subsequent Work.

3.05 INSPECTION AND TESTING

- A. The Owner will select, and pay an independent testing laboratory to randomly sample and verify the thickness and the density of the fireproofing in accordance with one (1) of the following procedures:
 - 1. ASTM E605, Standard Test Method for Thickness and Density of Sprayed Fire-Resistive Materials Applied to Structural Members.
 - 2. AWCI, Standard Practice for the Testing and Inspection of Field Applied Sprayed Fire-Resistive Materials.
 - 3. UBC Standard No. 7-6, Thickness and Density Determination for Sprayed-Applied Fire Protection.

3.06 CLEANING

- A. Remove excess material, overspray, droppings, and debris.
- B. Remove fireproofing from materials and surfaces not required to be fireproofed.

END OF SECTION

SECTION 07 81 20
FIRESTOPPING, PENETRATION, SEALS

CONDITIONS OF THE CONTRACT AND DIVISION 1, AS INDEXED, APPLY TO THIS SECTION.

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Work Included
 - 1. Furnish all materials and labor required for installation of firestops around through - penetrations of pipe, duct, cable, cable tray, conduit, other electrical devices, blank openings and at the periphery of fire-rated walls, floors, partitions and floor/ceiling assemblies.
- B. Related Work
 - 1. Section 03 30 00 - Concrete
 - 2. Section 04 20 00 - Masonry
 - 3. Section 07 90 05 - Joint Sealers
 - 4. Section 09 20 00 - Lath and Plaster
 - 5. Section 09 21 16 - Gypsum Drywall Systems
 - 6. Division 21 thru 28 - Mechanical, Electrical, Plumbing, and related Work

1.2 QUALITY ASSURANCE

- A. Standards
 - 1. ASTM E-814, Standard Method for Fire Tests of Through - Penetration Fire Stops.
 - 2. ASTM E-84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479, Fire Tests of Through-Penetrations Firestops.
 - 4. UL 723, Standard for Test for Surface Burning Characteristics of Building Materials.
 - 5. UL Fire Resistance Directory; Through - Penetration Firestop Systems (XHEZ), and Fill, Void or Cavity Materials (XHHW).
 - 6. NFPA 101 - Life Safety Code
 - 7. NFPA 70 - National Electric Code
- B. Performance
 - 1. Firestop systems shall provide a fire resistance rating at least equal to the hourly resistance rating of the fire-rated barrier.
 - 2. Firestop Systems shall have been tested in accordance with ASTM E-814 or UL 1479 under a minimum positive pressure of 0.01 in. of water.

1.3 DEFINITIONS

- A. Penetration: Any opening of foreign material passing through or into a fire-rated barrier.
- B. Fire-Rated: Have the ability to withstand the effects of a standard fire exposure for a specified time period, as determined by qualified testing.
- C. Fire-Rated Barrier: A floor, wall, partition or floor-ceiling assembly able to withstand a standard fire and hose stream test without failure.

- D. Fire Resistance Rating: The ability of a structure to act as a barrier to the spread of fire and to confine it to the area of origin. Ratings are expressed in hours and apply to beams, columns, floors, roofs, walls and partitions.
- E. Firestopping: A means of sealing openings in fire-rated barriers to preserve or restore the fire resistance rating.
- F. Firestop System: a material, or combination of materials, installed to retain the integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke or gases through penetrations in fire-rated vertical barriers. It should be used in specific locations as follows:
 - 1. Penetrations for the passage of duct, cable, cable tray, conduit, piping and electrical busways and raceways through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor slabs and floor/ceiling assemblies), and vertical service shafts.
 - 2. Openings between floor slabs and curtain walls.
 - 3. Openings between structurally separate sections of walls of floors.
 - 4. Gaps between the top of walls and ceiling or roof assemblies.
 - 5. Vertical service shafts at each floor level.
 - 6. Expansion joints in walls and floors.
 - 7. Openings and penetrations in fire-rated partitions or walls containing fire doors.

1.4 SUBMITTALS

- A. Comply with Section 01 33 00 - Submittals.
- B. Product Data
 - 1. Submit copies of manufacturer's specifications, recommendations, installation instructions, and maintenance data for each type of material required.
 - 2. Submit a copy of UL illustration of each proposed system indicating manufacturer approved modifications.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, grade, and UL label where applicable.
- B. Coordinate delivery with scheduled installation date to allow minimum storage time at site
- C. Store materials in clean, dry, ventilated location. Protect from soiling, abuse, and moisture. Follow manufacturer's instructions.

1.6 PROJECT CONDITIONS

- A. Existing Conditions
 - 1. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
 - 2. Proceed with installation only after penetrations of the substrate and supporting brackets have been installed.
- B. Environmental Requirements
 - 1. Furnish adequate ventilation if using solvent.
 - 2. Furnish forced air ventilation during installation if required by manufacturer.
 - 3. Keep flammable materials away from sparks or flame.
 - 4. Provide masking and drop cloths to prevent contamination of adjacent surfaces by fire stopping materials.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Hilti Construction Chemicals, Inc.
- B. 3M Corporations
- C. Tremco
- D. Metalines, Inc.

2.2 MATERIALS

- A. Firestopping materials / constructions shall constitute one or more of the following products or equal by other listed manufacturers.
 - 1. Hilti CP601S Firestop Sealant: An adhesive, one-part, silicone-based, elastomeric sealant.
 - 2. Hilti FS ONE Intumescent Wrap: An Aluminum foil-backed intumescent strip for plastic or insulate pipe.
 - 3. Damming Materials: Hilti CF 128 Adhesive Filling and Sealing Foam or fire-tested designs.
- B. Firestopping materials shall be asbestos-free, emit no toxic or combustible fumes and be capable of maintaining an effective barrier against flame, smoke, gas, and water in compliance with previously referenced standards.
- C. Firestopping materials /systems shall be flexible to allow for normal movement of building structure and penetrating item(s) without affecting the adhesion or integrity of the system.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Prepare substrate surfaces to ensure proper and adequate structural support for the specified UL Rated Firestop System. Install fire-rated partitions /floors with void to receive firestop system.
- B. Clean surfaces from all foreign materials i.e., loose debris, dirt, oil, grease, wax and/or oil caulking before sealant is applied.
- C. Field measure and verify dimensions as required.
- D. Protect adjacent areas or surfaces from damage as a result of the work of this Section.

3.2 APPLICATION

- A. Installation of fire stopping materials shall be in exact accordance with the manufacturer's latest published instructions.
- B. Installation shall be in accordance with the appropriate UL Building Materials Directory Assembly or with the appropriate Warnock Hersey International Listing.
- C. Seal holes or voids made by penetrating items to ensure an effective fire and smoke barrier.
- D. Seal all intersections and all penetrations of floors, ceilings, walls, and columns.
- E. Seal around all cutouts for lights, cabinets pipes, and plumbing, HVAC ducts, electrical boxes, etc.

3.3 FIELD QUALITY CONTROL

- A. Examine finished penetrations to ensure proper installation before concealing or enclosing any areas of work.
- B. Keep areas of work accessible until inspection by applicable code authorities, and Architect.
- C. Manufacturer's Field Service: Inspect to verify and confirm that systems installation is in strict conformance with manufacturer's and UL requirements. Report to Architect.
- D. Correct unacceptable work and provide further inspection to verify compliance with requirements.

3.4 CLEANING

- A. Immediately remove all spots, smears, stains, residues, adhesives, etc., from the work of this Section and or upon adjacent areas or surfaces which result from the work of this Section.
- B. Upon the completion of the work of this Section, dispose of (away from site) all debris, trash containers, residue, remnants and scraps which result from the work of this Section.
- C. Cleaning to be free of volatile solvents. Leave work area in a clean and satisfactory condition.

END OF SECTION 07 81 20

SECTION 07 90 05
JOINT SEALERS

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Sealants and joint backing.
- B. Precompressed foam sealers.
- C. Hollow gaskets.

1.2 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 07 81 20 - Firestopping, Penetration Seals
- C. Section 08 45 00 – Translucent Wall and Roof Assemblies
- D. Section 08 80 00 - Glazing: Glazing sealants and accessories.
- E. Section 09 21 16 - Gypsum Board Assemblies: Acoustic sealant.
- F. Section 09 30 00 - Tiling: Sealant used as tile grout.

1.3 REFERENCE STANDARDS

- A. ASTM C793-05 (2010) Standard Test Method for Effects of Laboratory Accelerated Weathering on Elastomeric Joint Sealants.
- B. ASTM C794-10 Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
- C. ASTM C834 - Standard Specification for Latex Sealants; 2010.
- D. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2012.
- E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.
- F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2013.
- G. ASTM D1667 - Standard Specification for Flexible Cellular Materials--Poly(Vinyl Chloride) Foam (Closed-Cell); 2005 (Reapproved 2011).
- H. Federal Specifications TT-S-00227E.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with other sections referencing this section.

1.5 SUBMITTALS

- A. See Section 01 33 00 - Submittals, for submittal procedures.
- B. Product Data: Provide data indicating sealant chemical characteristics.
- C. Samples: Submit two samples, 12x12 inch (300x300 mm) in size illustrating sealant colors for selection.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years documented experience and approved by manufacturer.

1.7 MOCK-UP

- A. Provide mock-up of sealant joints in conjunction with window under provisions of Section 01 40 00.
- B. Construct mock-up with specified sealant types and with other components noted.
- C. Locate where directed.
- D. Mock-up may remain as part of the Work.

1.8 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.9 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Gunnable and Pourable Sealants:
 - 1. BASF Construction Chemicals-Building Systems: www.buildingsystems.basf.com.
 - 2. Dow Corning Corporation: www.dowcorning.com.
 - 3. Pecora Corporation: www.pecora.com.
 - 4. Tremco Global Sealants: www.tremcosealants.com.
 - 5. W.R. Meadows, Inc: www.wrmeadows.com.
 - 6. Sonneborne/ChemRex, www.sonneborn.com
- B. Preformed Compressible Foam Sealers:
 - 1. EMSEAL Joint Systems, Ltd: www.emseal.com.
 - 2. Sandell Manufacturing Company, Inc: www.sandellmfg.com.
 - 3. Dayton Superior Corporation: www.daytonsuperior.com.
 - 4. Tremco Global Sealants: www.tremcosealants.com.
 - 5. Sonneborne/ChemRex www.sonneborn.com

2.2 SEALANTS

- A. Sealants and Primers - General: Provide products having volatile organic compound (VOC) content as specified in Section 01 61 16.
- B. Caulking of Exposed non-working interior locations at all hollow metal frames and abutting surfaces at ceiling, wall angles and all other locations for finished appearance:
 - 1. Basis of Design: Tremco "Acrylic Latex 834"
- C. Exterior concrete joints, including drives, paving, sidewalks, play surfaces and other flatwork:
 - 1. Basis of Design: Tremco "THC 900/901"

- D. Exterior Highly active joints in walls, masonry or concrete fences:
 - 1. Basis of Design: Tremco "Dymeric"
- E. Exterior Joints around windows, glazing, entrances, soffit joints and other general sealant areas:
 - 1. Basis of Design: Tremco "Mono"
- F. Interior Expansion Contraction or Control Joints where movement is to be accommodated:
 - 1. Basis of Design: Tremco "Mono"
- G. Primer, Cleaners, Top Coats: Use only materials listed as suitable in resistance to staining, compatibility and durability before proceeding.
- H. Back-up Filler: Closed cell or open cell, non-gassing filler as recommended by sealant manufacturer.
- I. Type ___ - Acoustical Sealant for Concealed Locations:

2.3 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify that joint backing and release tapes are compatible with sealant.

3.2 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean and prime joints in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Protect elements surrounding the work of this section from damage or disfigurement.
- E. Exposed Concrete Floor Joints: Test joint filler in inconspicuous area of floor slab. Verify specified product does not stain or discolor slab.

3.3 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Perform acoustical sealant application work in accordance with ASTM C919.
- D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- E. Install bond breaker where joint backing is not used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- G. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- H. Tool joints concave using slicking materials recommended by manufacturer. The tooling procedure shall press sealant against the sides of the groove. No materials shall be left "feathered" out or smeared on the abutting material. If necessary, protect adjacent surfaces with tape. Completed joints shall have a uniform professional appearance. Use an anti-tack compound on sealant that does not setup fast enough to avoid dust collection.

- I. Precompressed Foam Sealant: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch (3 to 6 mm) below adjoining surface.
- J. Compression Gaskets: Avoid joints except at ends, corners, and intersections; seal all joints with adhesive; install with face 1/8 to 1/4 inch (3 to 6 mm) below adjoining surface.
- K. Concrete Floor Joint Filler: Install concrete floor joint filler per manufacturer's written instructions. After floor joint filler is fully cured, shave joint filler flush with top of concrete slab.
- L. Sealant Back up: provide back-up filler where groove depth is too great to fill with sealant. Review joint design with Architect.
- M. Compressible Filler: Seal vertical expansion joints with fillers. Provide compressible filler twice the width of the joint and with a depth of one and one-half times the compressed width. Lap ends a minimum of 2 inches.
- N. Seal ends together in such a manner to allow natural drainage. Install filler by compressing material and sliding into joint. Align filler on one face of the joint before it expands to the full joint width.

3.4 CLEANING

- A. Clean adjacent soiled surfaces.

3.5 PROTECTION

- A. Protect sealants until cured.

END OF SECTION 07 90 05

SECTION 07 95 13
EXPANSION JOINT COVER ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Expansion joint assemblies for floor, wall, ceiling and soffit surfaces.

1.02 RELATED REQUIREMENTS

- A. Section 03 10 00 - Concrete Forming and Accessories: Placement of joint assembly frames in formwork.
- B. Section 03 30 00 - Cast-in-Place Concrete: Expansion and contraction joints in exterior concrete joints.
- C. Section 04 20 00 - Unit Masonry: Placement of joint assembly frames in masonry.
- D. Section 05 50 00 - Metal Fabrications: Custom fabricated steel expansion and control joint devices.
- E. Section 07 62 00 - Sheet Metal Flashing and Trim: Roof control joints.
- F. Section 07 90 05 - Joint Sealers: Expansion and control joint finishing utilizing a sealant and bond breaker.

1.03 REFERENCE STANDARDS

- A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2013.
- B. ASTM B308/B308M - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles; 2010.
- C. ASTM B455 - Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Extruded Shapes; 2010.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide joint assembly profiles, profile dimensions, anchorage devices, available colors and finish.
- C. Shop Drawings: Indicate joint and splice locations, miters, layout of the work, affected adjacent construction, anchorage locations, and misc. accessories.
- D. Samples: Submit two samples 12 inch (300 mm) long, illustrating profile, dimension, color, and finish selected.
- E. Manufacturer's Installation Instructions: Indicate rough-in sizes; provide templates for cast-in or placed frames or anchors; required tolerances for item placement.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Expansion Joint Cover Assemblies:
 - 1. Construction Specialties, Inc: www.c-sgroup.com.
 - 2. Basis of Design: Inpro: www.inprocorp.com.
 - 3. MM Systems Corp: www.mmsystemscorp.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 EXPANSION JOINT COVER ASSEMBLY APPLICATIONS

- A. Interior Floor Joints Subject to Thermal Movement:
 - 1. Products:
 - a. Inpro Corp: Series 110 for 3" or less. Series 222 for above 3"..
 - b. At Fire Rated Separation: use with Inpro 990.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Interior Wall/Ceiling Joints Subject to Thermal Movement:
 - 1. Products:
 - a. Inpro; 112/101 Series (for 5/8 inch gwb): www.inprocorp.com.

- b. At Fire Rated Separation: use with Inpro 990.
- c. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Interior Fire-Rated Wall/Ceiling Joints: N/A
- D. Exterior Wall Joints Subject to Thermal Movement:
 - 1. Products:
 - a. Inpro; 1250 Series Seal (precompressed foam): www.inprocorp.com.
 - b. At Fire Rated Separation: use with Inpro 990.
- E. Exterior Roof to Roof Joint:
 - 1. Products: Inpro Series 691 Vertical curb Mount with 900 FB Fire Blanket at Fire Separation Wall.

2.03 EXPANSION JOINT COVER ASSEMBLIES

- A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.
 - 1. Joint Dimensions and Configurations: As indicated on drawings.
 - 2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
 - 3. Joint Movement Capability: If not indicated, provide minimum plus/minus 25 percent joint movement capability.
 - 4. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
 - 5. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.
- B. Floor Joint Covers: Coordinate with indicated floor coverings.
- C. Covers In Fire Rated Assemblies: Provide cover assembly having fire rating equivalent to that of assembly into which it is installed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.

3.02 PREPARATION

- A. Provide anchoring devices for installation and embedding under Section 03 10 00.
 - 1. Provide templates and rough-in measurements.

3.03 INSTALLATION

- A. Install components and accessories in accordance with manufacturer's instructions.
- B. Align work plumb and level, flush with adjacent surfaces.
- C. Rigidly anchor to substrate to prevent misalignment.

3.04 PROTECTION

- A. Do not permit traffic over unprotected floor joint surfaces.

END OF SECTION

SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Non-fire-rated steel doors and frames.
- B. Steel frames for wood doors.
- C. Fire-rated steel doors and frames.
- D. Thermally insulated steel doors.
- E. Sound-rated steel doors and frames.
- F. Steel glazing frames.

1.2 RELATED REQUIREMENTS

- A. Section 08 71 00 - Door Hardware.
- B. Section 08 80 00 - Glazing: Glass for doors and borrowed lites.
- C. Section 09 90 00 - Painting and Coating: Field painting.

1.3 REFERENCE STANDARDS

- A. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.
- B. ANSI A250.8 - SDI-100 Recommended Specifications for Standard Steel Doors and Frames; 2003 (R2008).
- C. ANSI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 1998 (R2011).
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- E. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- F. ASTM E413 - Classification for Rating Sound Insulation; 2010.
- G. BHMA A156.115 - Hardware Preparation in Steel Doors and Steel Frames; 2006.
- H. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers; 2007.
- I. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2013.
- J. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.
- K. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 33 00 – Submittals for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced grade standard.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.
- B. Maintain at the project site a copy of all reference standards dealing with installation.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store in accordance with NAAMM HMMA 840.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Steel Doors and Frames:
 - 1. American Door Products (Pearland Industries) www.pearlandindustries.com
 - 2. Assa Abloy Ceco, www.assaabloydss.com.
 - 3. Curries, or Fleming:
 - 4. Amweld
 - 5. Steelcraft, an Allegion brand; www.allegion.com/us.
 - 6. Republic Doors and Frames; www.republicdoor.com
 - 7. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 DOORS AND FRAMES

- A. Requirements for All Doors and Frames:
 - 1. Accessibility: Comply with ANSI/ICC A117.1.
 - 2. Door Top Closures: Flush with top of faces and edges.
 - 3. Door Edge Profile: Beveled on both edges.
 - 4. Door Texture: Smooth faces.
 - 5. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
 - 6. Hardware Preparation: In accordance with BHMA A156.115, with reinforcement welded in place, in addition to other requirements specified in door grade standard.
 - 7. Galvanizing for Units in Wet Areas: All components hot-dipped zinc-iron alloy-coated (galvannealed), manufacturer's standard coating thickness.
 - 8. Finish: Factory primed, for field finishing.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with all the specified requirements for each type; for instance, an exterior

door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

- C. 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 items is started.
- D. Jamb Extensions: Provide structural extensions at jambs as shown or required. Extensions are required for vertical members not otherwise adequately braced at top. Extension shall be C3 x 4.1 channel extending 12 inches into frame and welded. Weld to structure or provide 2'x2'x1/4" steel angle headers installed in structure above to form rigid assembly.

2.3 STEEL DOORS

- A. Doors shall be custom made, of types and sizes shown on approved shop drawings, and shall be fully welded seamless construction with no visible seams or joints on faces or vertical edges. Minimum door thickness shall be 1 3/4 inches, unless specifically noted or shown differently.
- B. Doors shall be strong, rigid and neat in appearance, free from warp and buckle. Corner bends shall be true and straight and of minimum radius for gauge of metal used. Provide 22 gauge steel stiffeners spaced max six (6) inches o.c. and extending full height of door. Fill interior with foamed in place urethane.
- C. 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.
- D. 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 welded 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.
- E. Edge Profile shall be provided on both vertical edges of door as follows:
 - 1. Single acting swing doors- beveled 1/8 inch in 2 inch.
- F. Hardware Reinforcements:
 - 1. Doors shall be mortised, reinforced, drilled and tapped at factory for fully templated hardware in accordance with the approved hardware schedule provided by Section 08 71 00 Finish Hardware. 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 and Pivot Reinforcing: 7 gauge
 - b. Reinforcements for lock face, flush bolts, concealed holders, concealed or surface mounted closers: 12 gauge
- G. Glass moldings and stops: Loose stops shall be not less than 18 gauge steel, with butt corner joints, secured to frame opening by countersunk screws. Snap-on attachments will not be acceptable.
- H. Gauges:
 - 1. Exterior Doors: 16 gauge galvanized (zinc coated)
 - 2. Interior Doors: 16 gauge
- I. Edge Clearances:
 - 1. Between door and frame at head and jambs: 1/8 inch
 - 2. At door sills with no threshold, 5/8 to 3/4 inch above finished floor
 - 3. At door sill with threshold, as required to suite threshold.
 - 4. Between meeting edges of double doors: 1/8 inch.
- J. Interior Doors, Fire-Rated:
 - 1. Grade: ANSI A250.8 Level 2, physical performance Level B, Model 2, seamless.
 - 2. Fire Rating: As indicated on Door and Frame Schedule, tested in accordance with UL 10C ("positive pressure").

- a. Provide units listed and labeled by UL.
 - b. Attach fire rating label to each fire rated unit.
- K. Interior Doors, Sound-Rated:
1. Grade: ANSI A250.8 Level 2, physical performance Level B, Model 2, seamless.
 2. STC Rating of Assembled Door, Frame, and Seals: 52, calculated in accordance with ASTM E413, tested in accordance with ASTM E90.
 3. Sound Seals: Integral, concealed in door or frame.

2.4 STEEL FRAMES

- A. General:
1. Finish: Same as for door.
 2. Frames shall be custom made, welded units with integral trim of sizes and shapes shown on approved shop drawings.
 3. 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.
 4. Jamb depths, trim, profile and backbends shall be to fit wall thickness as indicated. Shop drawings shall reflect conditions appropriately.
 5. Corner joints shall have contact edges closed tight, with trim faces mitered and continuously welded, and stops butted. The use of gussets shall be not be permitted.
 6. Minimum depth of stops shall be 5/8 inch.
 7. 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.
 8. Hardware Reinforcement:
 - a. Frames shall be mortised, reinforced, drilled and tapped at factory for fully templated mortised hardware in accordance with approved hardware schedule by Section 08 71 00 Finish Hardware. Where surface-mounted hardware is to be applied, frames shall have reinforcing plates only.
 - b. Minimum thickness of hardware reinforcement plates shall be as follows:
 - 1) Hinge and pivot reinforcements (1-1/4" x 10" minimum size): 7 gauge
 - 2) Strike reinforcement: 12 gauge
 - 3) Flush bolt reinforcement: 12 gauge
 - 4) Closer reinforcement: 12 gauge
 - 5) Reinforcements for surface-mounted hardware, hold-open arms, and surface panic devices: 12 gauge.
 9. Floor anchors shall be securely welded inside each jamb, with holes for floor anchorage.
 10. Jamb Anchors:
 - a. Frames for installation on 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'-6" height - 3 anchors
 - 2) Frames from 7'-6" to 8'-0" height- 4 anchors.
 - 3) Frames over 8'-0" height- 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'-6" height - 4 anchors
 - 2) Frames from 7'-6" to 8'-0" height- 5 anchors.
 - 3) Frames over 8'-0" height- four anchors plus 1 additional anchor for each 2 feet, or fraction thereof over 8 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.

11. Dust cover boxes of not less than 26 gauge steel shall be provided at all mortised hardware items.
 12. Frames shall be provided with steel spreader temporarily attached to bottoms of both jambs for bracing during shipping and handling.
 13. Loose glazing stops shall be of cold rolled steel, not less than 18 gauge thickness, butted at corner joints and secured to the frame with countersunk cadmium or zin-plated screws. Loose stops at exterior frames shall be placed on the exterior side of the frames unless otherwise shown.
- B. Exterior Door Frames: Face welded, seamless with joints filled.
1. Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
 2. Weather-stripping: Separate, see Section 08 71 00.
- C. Interior Door Frames, Non-Fire-Rated: Fully welded type.
1. Metal thickness shall be not less than 16 gauge for frames openings 4 feet x 0 inches or less in width, and not less than 14 gauge for openings over 4 feet x 0 inches in width.
- D. Interior Door Frames, Fire-Rated: Fully welded type.
1. Fire Rating: Same as door, labeled.
- E. Sound-Rated Door Frames: Fully welded type.
- F. Frames for Interior Glazing or Borrowed Lights: Construction and face dimensions to match door frames, and as indicated on drawings.

2.5 ACCESSORY MATERIALS

- A. Louvers: Roll formed steel with overlapping frame; finish same as door components; factory-installed.
1. In Fire-Rated Doors: UL-listed fusible link louver, same rating as door.
 2. Style: Sight proof inverted V blade.
 3. Fasteners: Concealed fasteners.
- B. Glazing: As specified in Section 08 80 00, factory installed.
- C. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.
- D. Temporary Frame Spreaders: Provide for all factory- or shop-assembled frames.

2.6 FINISH MATERIALS

- A. Primer: Rust-inhibiting, complying with ANSI A250.10, baked on.
- B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.

3.2 PREPARATION

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

- B. Coat inside of other frames with bituminous coating to a thickness of 1/16 inch (1.5 mm).
- C. Separate dissimilar metals, protect against galvanic action.

3.3 INSTALLATION

- A. Install in accordance with the requirements of the specified door grade standard and NAAMM HMMA 840.
- B. In addition, install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Coordinate installation of hardware.
- E. Coordinate installation of glazing.

3.4 TOLERANCES

- A. Maximum Diagonal Distortion: 1/16 in (1.5 mm) measured with straight edge, corner to corner.

3.5 ADJUSTING

- A. Adjust for smooth and balanced door movement. Sand smooth all rusted and damaged areas of prime coat and apply touch up with compatible air-drying primer.
- B. Adjust sound control doors so that seals are fully engaged when door is closed.

END OF SECTION 08 11 13

SECTION 08 14 16
FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flush wood doors; flush configuration; fire rated, non-rated, and acoustical.
- B. Transom panels.

1.02 RELATED REQUIREMENTS

- A. Section 06 20 00 - Finish Carpentry.
- 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 21 16 - Gypsum Board Assemblies: Bullet-resistant sheathing and wallboard for bullet-resistant partitions and walls.

1.03 REFERENCE STANDARDS

- A. AWI (QCP) - Quality Certification Program, www.awiqcp.org; current edition at www.awiqcp.org.
- B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2009.
- C. ICC (IBC) - International Building Code; 2012.
- D. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
- E. NEMA LD 3 - High-Pressure Decorative Laminates; National Electrical Manufacturers Association; 2005.
- F. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2013.
- G. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association; 2012.
- H. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.
- I. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- J. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- K. WDMA I.S.1-A - Architectural Wood Flush Doors; Window and Door Manufacturers Association; 2011.

1.04 SUBMITTALS

- A. See Section 01 33 00 – Submittals for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
- D. Specimen warranty.
- E. Samples: Submit two samples of door construction, 12x12 inch (305x305 mm) in size cut from top corner of door.
- F. Samples: Submit two samples of door veneer, 12x12 inch (305x305 mm) in size illustrating wood grain, stain color, and sheen.
- G. Warranty, executed in Owner's name,

1.05 QUALITY ASSURANCE

- A. Quality Certification: Provide AWI Quality Certification Program inspection report and quality certification of completed work.
 - 1. Provide labels or certificates indicating that the work complies with requirements of AWS Grade or Grades specified.

2. Prior to delivery to the site provide shop drawings with certification labels.
 3. Provide labels on each product when required by certification program.
 4. Upon completion of installation provide certificate certifying that the installation and products meet the specified requirements.
 5. Arrange and pay for inspections required for certification.
 6. Replace, repair, or rework all work for which certification is refused.
- B. Installed Fire Rated Door and Transom Panel Assembly: Conform to NFPA 80 for fire rated class as indicated.
1. Provide UL approved 5" deep structural composite lumber top rail reinforcement suitable to hold surface mounted closers with 1-1/2" x No. 12 fully threaded wood screws without the use of through-bolted fasteners.
 2. For door assemblies exceeding sizes of tested assemblies, provide manufacturer's certificate stating that doors conform to all standard construction requirements of tested and labeled fire door assemblies except for size.
 3. At stairwell enclosures, provide doors which have a temperature rise rating of not more than 450 degrees F (232 deg C) maximum in 30 minutes of fire exposure.
 4. Provide fire-rated doors and fire retardant stiles matching face veneer that are labeled and listed for kinds of applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals.
 - 5.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging. Inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

1.07 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for the life of the installation agreeing to repair or replace defective doors which have warped (bow, cup or twist) more than 1/4" in a 42" x 84" section, delaminated, or which show telegraphing of construction below in face veneers exceeding 0.01" in a 3" span, or do not conform to tolerance limitations or referenced quality standards. The guarantee includes refinishing of defective doors.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. High Pressure Decorative Laminate Faced Doors:
 1. Marlite, Inc.
 2. VT Industries, Inc: www.vtindustries.com.
 3. Weyerhaeuer.

2.02 DOORS AND PANELS

- A. All Doors: See drawings for locations and additional requirements.
 1. Quality Level: Premium Grade, in accordance with AWI/AWMAC/WI Architectural Woodwork Standards.
 2. High Pressure Decorative Laminate Faced Doors: 3-ply AWI PC-HPDL-3 unless otherwise indicated, bonded 32 lb per cubic foot particle core, bonded 1 3/8" stile and 1-1/8" min rails abrasively planed as an assembly prior to laminating, factory machine and fit. Structural lumber cores are required at doors with more than 40 percent of door core removed due to light or vent cutouts or door with exit devices.
- B. Interior Doors: 1-3/4 inches (44 mm) thick unless otherwise indicated; flush construction.
 1. Provide solid core doors at all locations.

2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with International Building Code ("positive pressure"); UL or WH (ITS) labeled without any visible seals when door is open, with a 20 minute rated core minimum.
 - a. In addition to meeting the above requirements the doors shall receive the appropriate fire rated label (45, 60, or 90 min), shall contain an asbestos free incombustible mineral core, positive pressure category A and shall contain 7-inch top-rail blocking, in doors indicated to have closers, 5-inch bottom rail blocking, in doors indicating armor plates and 5-inch mid rail and corner blocking in doors indicated to have exit devices.
 3. High pressure decorative laminate finish where indicated on drawings.
- C. Transom Panels: Same construction and finish as door; same performance rating as door.
- D. Lite Kits – Basis of Design: Preferred product is National Guard Products Low Profile Lite Kit; L-FRA 100.
1. Color to be selected by Architect during submittal.
 2. Standard lite kit opening measures 6” x 27” unless code requires otherwise.

2.03 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated above.
- B. Fire Rated Doors: Mineral core, Type FD, plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.
- C. Sound Retardant Doors: Equivalent to Type PC construction with core as required to achieve rating specified; plies and faces as indicated above. All classroom doors shall be rated minimum STC of 50.

2.04 DOOR FACINGS

- A. High Pressure Decorative Laminate Facing for Fire Doors: NEMA LD 3, SGF; color as selected; textured, low gloss finish.
- B. High Pressure Decorative Laminate Facing for Non-Fire-Rated Doors: NEMA LD 3, HGS; color as selected by architect from full range of available colors or as indicated in drawings; textured, low gloss finish.
- C. Facing Adhesive: Type 1, hot pressed.

2.05 ACCESSORIES

- A. Glazing should be factory applied and should be compatible with positive pressure requirements. Glass lite framing shall be painted to match door.
- B. Glazing Stops: Rolled steel channel shape, butted corners; prepared for countersink style tamper proof screws.
- C. The top, bottom and cut surface of openings should be sealed at the factory with two coats of varnish. Vertical door edges shall be factory painted to match door face. Factory shall supply matching paint and edges shall be touched-up in field.
- D. Astragals for Non-Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge.
- E. Astragals for Fire Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge, specifically for double doors.

2.06 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
- C. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements, dimensions shop drawings, DHI A115-W series standards, and hardware templates. Coordinate with hardware mortises in metal frames.
- D. Factory machine astragals and formed-steel edges for hardware pairs of fire-rated doors.

- E. Provide concealed wiring harness and standardized Molex plug connectors on both ends to accommodate up to twelve wires to doors receiving electrified hardware. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the through wire transfer hardware or wiring harness.
- F. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- G. Provide edge clearances in accordance with the quality standard specified.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
 - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
- B. Coordinate work with door opening construction, and door and frame hardware installation.
- C. 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.
- D. Verify that frames comply with indicated requirements for type, size, location and swing characteristics and that the frames are installed plumb, level and parallel.
- E. 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.
- F. Protect doors from damage and replace doors that are damaged. Verify that tops and bottoms of door have been sealed prior to installation as required for warranty.
- G. Do not remove or paint over labels on labeled doors.
- H. Coordinate installation of doors with installation of frames and hardware.
- I. Coordinate installation of glazing.

END OF SECTION

SECTION 08 33 23
OVERHEAD COILING DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Overhead coiling doors and shutters, operating hardware, non-fire-rated and exterior, manual operation.

1.2 RELATED REQUIREMENTS

- A. Section 08 71 00 - Door Hardware: Cylinder cores and keys.
- B. Section 09 90 00 - Painting and Coating: Field paint finish.

1.3 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2012.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2013.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.
- C. Samples: Submit two slats, 12x12 inch (300x300 mm) in size illustrating shape, color and finish texture.
- D. Maintenance Data: Indicate lubrication requirements and frequency and periodic adjustments required.

1.5 QUALITY ASSURANCE

- A. Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.6 WARRANTY

- A. Counter Shutter Warranty: Provide Two (2) Year Warranty signed by the manufacturer and installer agreeing to repair or replace work which has failed as a result of defects in materials or workmanship. Upon notification within the warranty period, such defects shall be repaired at no cost to the owner.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Overhead Coiling Doors:
 - 1. Basis of Design: The Cookson Company; Product Temp-Master Insulated Rolling Doors.: www.cooksondoor.com.
 - 2. Wayne-Dalton, a Division of Overhead Door Corporation: www.wayne-dalton.com.
- B. Overhead Coiling Doors at Serving Line:

1. Basis of Design: The Cookson Company; Screenguard perforated slat overhead coiling door with aluminum finishes, clear anodized, and all aluminum trim in clear anodized. Include extruded aluminum bottom bar and closure plate.
 2. Cornell and Clopay only for equal product substitution if available.
- C. Coiling Security Counter Shutters:
1. Basis of design: Coiling security counter shutters shall be model CS3000-HK-G as manufactured by McKeon Door Company, distributed by Griesbeck Architectural Products, Houston, TX. nathan@griesbeck.com
 2. Cookson, Inc. www.cookson.com
 3. North American Rolling Door Inc
 4. Overhead Door Corporation; www.overheaddoor.com
 5. Atlas Door Corporation; www.atlasoverhead.com

2.2 COILING DOORS

- A. Exterior Coiling Doors at CTE Welding and HVAC: Steel slat curtain.
1. Capable of withstanding positive and negative wind loads of 20 psf (940 Pa), without undue deflection or damage to components.
 2. Sandwich slat construction with insulated core of rigid type insulation; insulation (u-) value: 0.50 BTU/hr sq ft deg F (2.84 W/sq m deg K)
 3. Finish: SpectraShield® Coating System (Color Selected by Architect):
 4. Guides: Angles; galvanized steel.
 5. Hood Enclosure: Manufacturer's standard; primed steel.
 6. Motor Operated. Doors designed for jackshaft motor operation.
 - a. Motor HP rating: ½ HP
 - b. Electrical requirements: 115 volt single phase
 - c. Duty Cycle: 30 cycles/hour
 - d. Control wiring: 24 volt control with provisions for connection to safety edge to reverse. Provide keyed momentary contact “open-close-stop”
 7. Mounting: Within framed opening.
 8. Safety: Chain operated doors shall be designed so that the door immediately stops upward or downward travel and is maintained in a stationary position when the hand chain is released by user.
 9. Weatherstripping:
 - a. Bottom Bar:
 - i. Manually Operated Doors: Replaceable, bulb-style, compressible EDPM gasket extending into guides
 - b. Guides: Replaceable vinyl strip on guides sealing against both sides of curtain
 - c. Lintel Seal: Double brush seal with EPDM sandwiched between the two brush seals at door header to impede air flow.
 - d. Hood: Neoprene/rayon baffle to impede air flow above coil
 10. Locking:
 - a. Masterkeyable cylinder operable from both sides of bottom bar, options for all types of operation.
 - b. Refer to Door Hardware schedule.
- B. Exterior Coiling Doors at Storage building: Steel slat curtain.
1. Capable of withstanding positive and negative wind loads of 20 psf (940 Pa), without undue deflection or damage to components.
 2. Sandwich slat construction with insulated core of rigid type insulation; insulation (u-) value: 0.50 BTU/hr sq ft deg F (2.84 W/sq m deg K)
 3. Finish: SpectraShield® Coating System (Color Selected by Architect):
SpectraShield Ultra – Ultra Powder Coat to be applied as a protective top coat over SpectraShield finish. Top coat is a polyester based structured wear resistant clear powder coat of 2.5-3.5 mils cured

- film thickness. ASTM D-3363 pencil hardness: 2H or better. Tested per ASTM B117. Base coating of SpectraShield color as selected by Architect from manufacturer's color range, more than 180 colors.
4. Guides: Angles; galvanized steel.
 5. Hood Enclosure: Manufacturer's standard with matching finish.
 6. Manual ControlGard Chain Hoist: Provide chain hoist operator with endless steel chain, chain pocket wheel and guard, geared reduction unit, and chain keeper secured to guide. Chain hoist to include integral brake mechanism that will immediately stop upward or downward travel and maintain the door in a stationary position when the hand chain is released by the user
 7. Mounting: Within framed opening.
 8. Safety: Chain operated doors shall be designed so that the door immediately stops upward or downward travel and is maintained in a stationary position when the hand chain is released by user.
 9. Weatherstripping:
 1. Bottom Bar:
 - a. Manually Operated Doors: Replaceable, bulb-style, compressible EDPM gasket extending into guides
 2. Guides: Replaceable vinyl strip on guides sealing against both sides of curtain
 3. Lintel Seal: Double brush seal with EPDM sandwiched between the two brush seals at door header to impede air flow.
 4. Hood: Neoprene/rayon baffle to impede air flow above coil
 10. Locking:
 1. Masterkeyable cylinder operable from both sides of bottom bar, options for all types of operation.
 - a. Refer to Door Hardware schedule.
- B. Coiling Security Counter Shutters:
1. Curtain: Shall be assembled of interlocking galvanized steel slats, cold rolled. Slats shall have endlocks locking each end of alternate slats to act as a wearing surface, and maintain slat alignment. Curtain shall be 22 gauge minimum.
 - a. Slats: Shall be of a cross section not less than 1¼" wide by ½" deep.
 2. Bottom Bar: Shall consist of a single steel angle not less than 1½" x 1½" formed to fit slats. Provide slide locks with hasps on both jambs to allow for locking.
 3. Guides: Each guide assembly shall be fabricated of a minimum 1/8" steel angles and channels formed to a box type configuration
 4. Mounting Brackets: Fabricated of hot rolled 1/8" steel plate minimum, brackets shall be provided to house ends of the counterbalance barrel assembly.
 5. Hood: Shall be provided to entirely enclose curtain and counterbalance barrel assembly. Hood shall be fabricated 22 gauge galvanized steel and designed to match brackets. Top and bottom shall be bent and reinforced for stiffness.
 6. Counterbalance Assembly: Counter shutter shall be counterbalanced by means of adjustable steel helical torsion springs attached to shaft enclosed in pipe with required mounting blocks or rings for attachment of curtain. Grease sealed bearings or self-lubricating graphite bearings shall be attached to the spring barrel which shall be fabricated of hot formed structural quality carbon steel seamless pipe.
 7. Hand Crank Operator: Counter shutter shall be provided with a compact reduction geared unit designed as an integral part of the assembly. The hand crank mechanism shall not require more than 35 pounds of operational force to move the counter shutter in either the open or close position.
 8. Finish: After completion of fabrication, clean all metal surfaces to remove dirt and chemically treat to provide for paint adhesion. Curtain assembly is to receive a prime coat finish of .2 mils of epoxy primer and .8 mils of polyester paint in a McKeon Sterling Gray finish.
- C. Overhead **Curtain at Lockers:**
1. **Configuration: Standard curtain** configuration
 2. **Slats: Aluminum:** No. 5F, minimum 0.050 inch (1.270 mm) aluminum.
 3. **Finish: Aluminum:** Clear or as selected by the Architect.
 4. **Endlocks:** Alternate slats each secured with two ¼" (6.35 mm) rivets. Fabricate interlocking sections with high strength nylon

- a. **Nylon:** Required up to 21'-5" width (DBG - Distance Between Guides)
5. **Bottom Bar**
 - a. **Configuration: Aluminum Angle:** Two 2x2x1/8" minimum (50x50x3.2mm) aluminum angle
 - b. **Finish: Aluminum:** Clear anodized or as selected by the Architect.
6. **Guides:**
 - a. **Fabrication:** Minimum 3/16 inch (4.76 mm) aluminum angles. Top of inner and outer guide angles to be flared outwards to form bellmouth for smooth entry of curtain into guides. Provide removable guide stoppers to prevent over travel of curtain and bottom bar. Top 16 1/2" (419.10 mm) of coil side guide angles to be removable for ease of curtain installation and as needed for future curtain service.
 - b. **Configuration: Standard** guide configuration
 - c. **Finish: Aluminum:** Clear anodized or as selected by the Architect.
7. **Counterbalance Shaft Assembly:**
 - a. **Barrel:** Steel pipe capable of supporting curtain load with maximum deflection of 0.03 inches per foot (2.5 mm per meter) of width
 - b. **Spring Balance:** Oil-tempered, heat-treated steel helical torsion spring assembly designed for proper balance of door to ensure that maximum effort to operate will not exceed 25 lbs (110 N). Provide wheel for applying and adjusting spring torque
8. **Brackets:**

Fabricate from minimum 3/16 inch (5 mm) steel plate with permanently lubricated ball or roller bearings at rotating support points to support counterbalance shaft assembly and form end closures

 - a. **Finish: AtmoShield Powder Coat (Color Selected by Architect):**
 - 1) Zirconium pre-treatment followed by baked-on polyester powder coat, Platinum minimum 2.5 mils (0.065 mm) cured film thickness; ASTM D-3363 pencil hardness: H or better
9. **Hood:**

Minimum 24 gauge aluminum with reinforced top and bottom edges. Provide minimum 1/4 inch (6.35 mm) steel intermediate support brackets.

 1. Finish:
 - a. **Aluminum** Clear anodized

2.3 OPERATION at Motorized Overhead doors:

A. Motor Operation:

1. **VSH Standard Series Operator – 1/2 horsepower UL listed gear head motor**
 - a. The operator is to include a totally enclosed non ventilated (TENV) gear head motor, reversing magnetic controller in NEMA 1 enclosure, spur gearbox for drive reduction, and an electric brake.
 - b. The controller shall include UL listed thermal overload protection, rotary limit switches, safety edge circuit and transformer with 24 volt control secondary, and delay on reverse.
 - c. All components of the motor controller are to be pre-wired to a terminal block using color coding of the wires to facilitate troubleshooting.
 - d. The operator must not extend above or below the door coil when mounted front-of-coil.
 - e. Rated for a maximum of 20 cycles per hour
 - f. Supply motor with the following configuration:
 - i. Standard configurations:
 1. 120 Volts, 1-phase, 60 Hertz
 - g. Operator shall be equipped with an emergency manual chain hoist assembly that safely cuts operator power when engaged. A disconnect chain shall not be required to engage or release the manual chain hoist.
 - h. Operator to be supplied with 72" minimum of #50 roller chain.

- i. The electrical contractor shall mount the control station(s) and supply the appropriate disconnect switch, all conduit and wiring per the motor operator wiring instructions.

B. Control Stations:

1. NEMA 1 Interior Flush Mounted Key Control with Stop Button and Best Cylinder

A. Safety Devices:

1. **NEMA 4X photo eye sensors** consisting of a transmitter and receiver that are to be mounted within 6" (152.4 mm) of the floor, projecting an IR beam across the entire width of the door. Interruption of beam before door fully closes shall cause door to immediately stop downward travel and reverse direction to the fully opened position. Electrical contractor to provide low voltage wiring from the transmitter and receiver to the door operator.

1.1 ACCESSORIES

- A. **Strap brake safety system:** engages guide mounted engagement teeth to effectively stop the door in the event of strap failure.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that opening sizes, tolerances and conditions are acceptable.

3.2 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- E. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07 90 05.
- F. Install perimeter trim, closures, and hardware as specified.

3.3 TOLERANCES

- A. Maintain dimensional tolerances and alignment with adjacent work.
- B. Maximum Variation From Plumb: 1/16 inch (1.5 mm).
- C. Maximum Variation From Level: 1/16 inch (1.5 mm).
- D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft (3 mm per 3 m) straight edge.

3.04 ADJUSTING

- A. Adjust operating assemblies for smooth and noiseless operation.

3.05 CLEANING

- A. Clean installed components.

- B. Remove labels and visible markings.

END OF SECTION 08 33 23

SECTION 08 34 73
SOUND CONTROL DOOR ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Sound-control doors including the following:
 - 1. Integrated sound control door assemblies.

1.2 RELATED SECTIONS

- A. Section 08 71 00 – Door Hardware.

1.3 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI 115.1: Specifications for Steel Door and Frame Preparation for Hardware.
- B. ASTM International (ASTM):
 - 1. ASTM A1008/A 1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
 - 2. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - 3. ASTM E 413 - Classification for Rating Sound Transmission.
- C. Code of Federal Regulations (CFR):
 - 1. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials.
- D. HMMA 840: Installation and Storage of Hollow Metal Doors and Frames.
- E. WDMA Industry Standard I.S. 1-A-21
- F. AWI Standards, Current Edition
- G. International Organization for Standardization (ISO): ISO 9001 Quality management systems - Requirements.
- H. National Fire Protection Association (NFPA): NFPA 80 - Standard For Fire Doors and Other Opening Protectives.
- I. Underwriter's Laboratory (UL):
 - 1. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies.

1.4 SUBMITTALS

- A. Shop Drawings: Submit a schedule of items to be provided under this Section along with shop drawings in sufficient detail to show fabrication, installation, anchorage and interface of the work of this section with the work of adjacent trades.
- B. Acoustical Certification: Provide certification that the door construction utilized has been tested at an independent laboratory in accordance with ASTM E90, and that the STC rating determined in accordance with ASTM E413, is not less than that specified in Part 2 of this Section. The laboratory

referenced in the certification must be qualified under the National Voluntary Accreditation Program (NVLAP) of the U.S. Bureau of Standards. Certification must reference laboratory name, test report number, and date of test; substitution of test data not in accordance with ASTM E90 and E413 will not be acceptable.

- C. Finish Samples: Provide one (1) veneer cut and finish sample for each type used on the project.
- D. Secondary Requirements: Fire Resistance, certify that assemblies have been tested in accordance with Standard for Safety UL10C for positive pressure requirements of labeled fire doors and frames, and meet the applicable requirements of NFPA 80. When positive pressure fire ratings are required, Category B frame mounted intumescent shall be used.
- E. Submit under provisions of Section 01 30 00 - Administrative Requirements.
- F. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Provide test results by certified independent testing laboratory indicating compliance with performance requirements.
- G. Closeout Submittals:
 - 1. Operation and Maintenance Data: For adjusting, repairing and replacing components and accessories.
 - 2. Warranty: Submit manufacturer's warranty.
 - 3. As-Built Drawings: For completed work.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum 5 years' experience in design and manufacturing of similar products on projects of similar size, scope and complexity, and with the production capacity to meet the construction and installation schedule.
- B. Installer Qualifications: ESTA-certified and experienced in installation of the work of this section and acceptable to the manufacturer and in the regular employ of the manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original unopened containers with manufacturer's labels attached. Do not deliver material until spaces to receive them are clean, dry, and ready for their installation. Ship to jobsite only after roughing-in, painting and other finishing work has been completed, installation areas are ready to accept work.
- B. Handle and install materials to avoid damage.

1.7 WARRANTY

- A. Special Warranty for Sound Control Doors: Manufacturer's written warranty indicating manufacturer's intent to repair or replace components of sound-control door assemblies that fail in materials or workmanship within 5 years from date of Substantial Completion. Failures are defined to include, but are not limited to, the following:
 - 1. Fracturing or breaking of unit components including doors and hardware resulting from normal use other than vandalism.
 - 2. Warping or deterioration of components not resulting from leaks, flooding, or other uncontrolled moisture or humidity.
 - 3. Failure of acoustical gaskets and seals.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer:
 - 1. Overly Door Company, Greensburg, PA 15601. Tel 800-979-7300, Fax 724-830-2871.
 - 2. Krieger Specialty Products, Pico Rivera, CA 90660. Tel 562-695-0645
- B. Requests for substitutions shall be considered in accordance with provisions of Section 01 60 00 - Product Requirements.
 - 1. Manufacturers seeking approval shall submit the following:
 - a. Product data, including third-party certified acoustical data and proposed graphic/drawing layout for this project.
 - b. Project references: Minimum of 5 installations not less than 3 years old, of comparable size, scope and complexity of this project, complete with owner contact information.
 - c. Sample warranty.
 - 2. Submit substitution request not less than required days prior to bid date.
 - 3. Approval shall be indicated by issuance of written Addendum.
 - 4. Approved manufacturers shall meet separate requirements of Submittals Article.
 - 5. Manufacturers' products that are either listed as pre-approved in these Specifications or who have been granted approval as an alternate must still demonstrate all of the material performance and operational characteristics required by this Section.

2.2 INTEGRATED SOUND CONTROL DOOR ASSEMBLIES

- A. Basis of Design: Sound Retardant wood swinging door system as manufactured by Overly Door Company. Model No. 4511251 Solid door with 99 sq in window.
- B. Performance Requirements: Provide sound-control door assemblies identical to assemblies tested by an independent testing agency per ASTM E 90 with the specified minimum certified STC rating per ASTM E 413 for the configurations indicated.
 - 1. Acoustical performance shall meet manufacturer's published data for transmission loss based on door type specified.
- C. Compliance for Fire-Rated Sound-Control Door and Frame Assemblies:
 - 1. NFPA 80 compliant, listed and labeled by a testing and inspection agency acceptable to authorities having jurisdiction.
 - 2. Test at equalized pressure per UL 10C.
- D. Safety Glass Compliance: Products must comply with testing requirements in 16 CFR 1201 for Category II materials.
- E. Compliance with Accessibility Requirements:
 - 1. Americans with Disabilities Act/Architectural Barriers Act (ADA/ABA).
 - 2. Accessibility Guidelines for Buildings and Facilities (ADAAG).
 - 3. ANSI A117.1.
- F. Sound-Control Door Assemblies: Provide sound-control door assemblies consisting of acoustically engineered door and frame combination with engineered sound seals.

1. Designation in schedule on Drawings: Sound Doors.
 2. Door Configuration: As scheduled on Drawings.
 3. Door Leaf Size: As scheduled on Drawings.
 4. Glazing Lite Size, per Door: 99 sq in (639 sq cm).
 5. Fire Rating: As scheduled on Drawings.
 6. Assembly Sound Transmission Class (STC): 52 minimum.
- G. Door Hardware: Provide manufacturer's standard acoustical seals, threshold, and hinges required to achieve sound control performance requirements specified.
- H. Other Door Hardware: Refer to requirements of Section 08 71 53 - Door Hardware.
- I. Fasteners: Refer to Section 06 10 00 - Rough Carpentry.

2.2 FABRICATION

- A. Materials: Frames for Sound Retardant Wood Swinging Doors to be constructed from formed sheet steel or structural shapes and bars. Sheet steel shall be commercial quality, level, cold rolled steel conforming to ASTM A1008 or hot rolled, pickled and oiled steel conforming to ASTM A1011. Steel shapes shall comply with ASTM A36 and steel bars with ASTM A108, Grade 1018.
- B. Door Design: Sound Retardant Wood Swinging Doors shall be a minimum 1-3/4" thickness construction with sizes as indicated on Architect approved shop drawings. No visible seams shall be permitted on door faces. Internal sound retardant core and perimeter door edge construction to be manufacturer's standard for the specified model. No lead or asbestos shall be permitted in door construction to achieve STC performance. Face veneer species cut and color to be as selected from manufacturer's full range of available colors and patterns. No lead or asbestos shall be permitted in door construction to achieve performance requirements. **Match existing Plastic Laminate Clad door.**
- C. Frame Design: Sound Retardant Metal Frames shall be 14 gauge minimum welded units with integral trim and shipped with temporary spreader. Knock-down frames are not acceptable. After installation, field splices required because of shipping limitations must be field welded by certified welders per manufacturer's instructions and in accordance with AWS D1.1/D1.3.
- D. Cam Lift Hinges: When required to achieve STC, manufacturer to furnish laboratory test data certifying hinges have been cycled a minimum of 1,000,000 while supporting a minimum door weight of 350 pounds.
- E. Hardware Reinforcements: Factory mortise, reinforce, drill and tap frames for all mortise hardware as required by hardware manufacturer's template. Factory mortise and reinforce doors for all mortise hardware. Provide necessary reinforcement plates as required for surface mounted hardware; all drilling and tapping to be done in field by installer. Provide dust cover boxes on all frame mortises.
- F. Anchors: Provide suitable anchors to properly install frames in partition types shown on Architects drawings.
- G. Frame Painting and Cleaning: After fabrication of frames, all tool marks and surface imperfections shall be removed and exposed faces of all welded joints dressed smooth. Chemically treat all surfaces to insure maximum paint adhesion and coat with a water-based rust-inhibitive primer.
- H. Door Finishing: Factory finishing of Sound Retardant Wood Swinging Doors shall be done in accordance with AWI Quality Standards. Factory finishing to be water-base stain and ultraviolet (UV) cured polyurethane sealer to comply with EPA Title 5 guidelines for Volatile Organic Compound (VOC) emissions limitations. Finish must meet or exceed performance standards of AWI TR#6 catalyzed polyurethane.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine installation areas and mounting surfaces with Installer present, for compliance with manufacturer's installation tolerances including required clearances, floor level, location of blocking and anchoring reinforcements, and other existing conditions that may affect installation or performance.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Proceed with installation only after correction of unsatisfactory conditions.

3.2 Site Storage and Protection of Materials

- A. Receipt: Upon receipt of product, all materials shall be thoroughly inspected and all discrepancies, deficiencies and/or damages shall be immediately reported to the supplier in writing
- B. Frame Storage: Store all frames on planks or dunnage in a dry location in a vertical position, spaced by blocking to permit air circulation between units. Cover all material or store in a controlled area to protect from damage.
- C. Door Storage: Do not deliver or install doors until spaces are enclosed, weather tight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between 60 and 90 degrees F and relative humidity between 25 and 55 percent during remainder of construction.

3.3 PREPARATION

- A. Clean surfaces thoroughly prior to installation. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.4 INSTALLATION - GENERAL

- A. Clean exposed surfaces. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Prior to installation, secure the services of a qualified representative of the manufacturer to visit the job site and instruct the contractor's personnel in proper installation and adjustment of the assemblies or secure services of manufacturer's factory trained and authorized installer to perform installation of assemblies.
- C. Install work of this Section in strict accordance with approved shop drawings and manufacturer's recommended installation instructions. Field finishing of wood doors, when required, shall be done with manufacturer's recommended finishing guidelines for the particular face veneer species supplied.
- D. Upon installation, secure the services of a qualified representative of the manufacturer to visit the jobsite and inspect the complete installation of the door and frame assemblies, test all components thru a minimum of ten (10) cycles of operation and direct installer in correcting any non-conforming items found.
- E. Distortion: Upon installation, doors shall be allowed to acclimate through a full cycle of seasons, for a period not to exceed one (1) year, after which distortion shall be checked in accordance with NWWDA 1.S 1-A.

3.5 INSTALLATION OF SOUND-CONTROL DOORS

- A. Prior to installation, adjust sound-control door frames to within tolerances recommended by manufacturer.
- B. Prepare doors and frames to accept field-applied door hardware specified in other sections according to door manufacturer specifications.
- C. Install units plumb, square, in proper alignment and secured to opening, within manufacturer's recommended tolerances. Comply with manufacturer's installation instructions and approved submittals.
 - 1. Masonry and Concrete Walls: Where indicated, fill space between frames and adjacent wall construction with mortar or grout. Where required, pump frames full after installation; plug and fill grout access holes.
- D. Install hardware uniformly and precisely, using supplied shims. Apply sealant to threshold and both sides of frame cross member under threshold. Allow for final adjustment of hardware following installation.
- E. Adjust units and hardware so doors operate smoothly without warp or bind and close with uniform frame alignment and seal compression.
- F. Comply with NFPA 80 for fire-rated openings.

3.6 CLEANING AND PROTECTION

- A. Repair or replace defective work as directed by Architect upon inspection.
- B. Clean surfaces. Touch up marred finishes, or replace damaged components that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by manufacturer.
- C. Protect installed products from damage, abuse, dust, dirt, stain, or paint until completion of project. Do not permit use during construction.

3.7 FIELD TESTING

- A. Secure the services of a qualified Independent Testing agency to test door and frame installations selected by Owner/Architect in accordance with ASTM E336. Installed product shall perform no less than five (5) [FSTC] [NIC] rating points below the specified STC rating. Any installations which fail to meet these criteria shall be examined, re-worked and re-tested until compliance is obtained.

END OF SECTION

SECTION 08 51 00 - ALUMINUM GLAZED SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Aluminum windows for exterior and interior locations.
 - 2. Aluminum doors and glazed systems.
 - 3. Accessories necessary for a complete installation.

1.2 WINDOW PERFORMANCE REQUIREMENTS

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
 - 1. Window Certification: AAMA certified with label attached to each window.
- B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440:
 - 1. Minimum Performance Class: AW.
 - 2. Minimum Performance Grade: 40.
- C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.35 Btu/sq. ft. x h x degrees F (2.0 W/sq. m x K).
- D. Solar Heat Gain Coefficient (SHGC): NFRC 200 maximum whole window SHGC of 0.30.
- E. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 45.
- F. Thermal Movements: Provide aluminum windows, including anchorage, 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 joint sealants, 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: 120 degrees F (67 degrees C) ambient; 180 degrees F (100 degrees C) material surfaces.
- G. Sound Transmission Class (STC): Rated for not less than 30 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.
- H. Outside-Inside Transmission Class (OITC): Rated for not less than 26 OITC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 1332.

1.3 SUBMITTALS

- A. Product Data: Technical data for each type of product, including construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.
- B. Shop Drawings: Submit plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

- C. Product Test Reports: For each type of aluminum window, for tests performed by a qualified testing agency.
- D. Field quality control reports.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Energy Code: Provide window units compliant with the IECC with Texas amendments,
 - 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).
- B. Manufacturer Qualifications: Manufacturer having minimum 5 years documented experience who is capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting the performance by test reports and calculations.
- C. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.
- D. Source Limitations: Obtain aluminum windows from single source from single manufacturer.
- E. Preinstallation Conference: Conduct conference at site.

1.5 WARRANTY

- A. Manufacturer's Warranty: Written warranty signed by Manufacturer in which manufacturer agrees to repair or replace aluminum windows 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 excessive deflection, water leakage, condensation, and air infiltration.
 - c. Faulty operation of movable sash and hardware.
 - d. Deterioration of materials and finishes beyond normal weathering.
 - e. Failure of insulating glass.
 - 2. Warranty Period:
 - a. Window System: 2 years from date of Substantial Completion.
 - b. Glazing Units: 10 years from date of Substantial Completion.
 - c. Aluminum Finish: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Manufacturers: Subject to compliance with requirements, provide exterior window products by one of the following:
 - 1. EFCO Corporation.
 - 2. Kawneer Company, Inc, www.kawneer.com.
 - 3. Atlas Architectural Metals
 - 4. TRACO.
 - 5. Vistawall.
 - 6. ARCH Aluminium & Glass, Amarlite

- B. Manufacturers: Subject to compliance with requirements, provide interior aluminum glazed products by one of the following:
1. Frameworks- Type 1 Series
 2. Modulex Interior Products
 3. Avalon International Avalon Eagle Series
 4. American Door Products Versatrac System 400R
- C. Operating Types: Provide fixed window units, storefront and interior systems in locations indicated on Drawings:
- D. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.
1. Thermally Improved Construction: Fabricate frames, sashes, and muntin's with an integral, concealed, low conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal to metal contact.
- E. Entrance Door Systems: Manufacture's standard glazed entrance doors for manual swing operation.
1. Door Construction: 2-inch (50.8-mm) overall thickness, with minimum 0.188-inch- (4.8-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: **As indicated in drawings.**
 3. Glass: Refer to drawing and specification section 088000 Glazing
 4. Glazing Stops and Gaskets: Beveled or Square, snap-on, extruded aluminum stops and preformed gaskets.
 5. Finish: Match existing storefront framing finish.
 6. Entrance Door Hardware: Refer to specification section 087100 Door
 7. Hardware. Entrance Door Systems: manufacturer's standard glazed entrance doors for manual swing operation with Owner's standard core.
- F. Glass: Comply with Section 088000 for insulated impact resistant glazing; clear laminated insulated glass, impact resistant glazing and others ASTM C 1036, Type 1, Class 1, q3, Kind: Fully tempered.
- G. Windborne Debris Impact Resistant Insulating Glass: ASTM E 2190, factory assembled sealed glass unit units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
1. Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary sealants.
 2. Spacer: Aluminum with black, color anodic finish.
 3. Desiccant: Molecular sieve or silica gel, or a blend of both.
 4. Overall Unit Thickness: 1 inch (25 mm).
 5. Minimum Thickness of Each Glass Lite: 6 mm.
 6. Outdoor Lite: Low E tinted float glass, impact resistant laminated glass.
 7. Interspace Content: Air.
 8. Indoor Lite: Fully tempered float glass.
- H. Glazing System: Factory glazing system that produces weathertight seal. Refer to Section 088000 for insulated glass.
- I. Hardware: Fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or corrosion resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.
1. Exposed Hardware Color and Finish: Selected by Architect.
 2. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

- a. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

J. Accessories

1. Subsills: Thermally broken, extruded aluminum subsills in configurations indicated on Drawings.
2. Interior Trim: Extruded aluminum profiles in sizes and configurations indicated on Drawings.
3. Receptor System: Two piece, snap together, thermally broken, extruded aluminum receptor system that anchors windows in place.
4. Snap on glass stops shall be beveled type- square stops are to be fastened (door window stops).

2.2 FABRICATION

- A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
- B. Glaze aluminum windows in the factory.
- C. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
- D. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.
- E. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

2.3 FINISH REQUIREMENTS

- A. Comply with NAAMM *Metal Finishes Manual* 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 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.
- D. Aluminum Finish: Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 1. To match existing building aluminum finishes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the work.
- B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.
- C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.

- D. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.
- C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.
- E. Protect exterior glass from breakage immediately upon installation. Do not apply markers to substrates of glass. Remove non-permanent labels and clean surfaces. Wash glass on both faces not more than 4 days prior to date scheduled for inspections indicated to establish date of substantial completion in each are of project. Wash glass by method recommended by glass manufacturer.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
 - 1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.
- B. Testing Services: Testing and inspecting of installed windows shall take place as follows:
 - 1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed in general conformance with ASTM E783 for air leakage and ASTM E1105 for water infiltration testing.
 - 2. Air Infiltration Testing:
 - a. Test Pressure: That required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance class indicated.
 - b. Allowable Air-Leakage Rate: **1.5** times the applicable AAMA/WDMA/CSA 101/I.S.2/A440 rate for product type and performance class rounded down to one decimal place.
 - 3. Water Resistance Testing:
 - a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.
 - b. Allowable Water Infiltration: No water penetration.
 - 4. Testing Extent: **Three** windows of each type as selected by Architect and a qualified independent testing and inspecting agency. Windows shall be tested after perimeter sealants have cured.
 - 5. Test Reports: Prepared according to AAMA 502.
- C. Windows will be considered defective if they do not pass tests and inspections. Retest failed unit plus one additional unit with similar installation conditions.
- D. Prepare test and inspection reports.

3.4 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.
- B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
 - 1. Keep protective films and coverings in place until final cleaning.
- C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

- END OF SECTION -

**SECTION 087100
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. Cylinders specified for doors in other sections.
- C. Related Sections:
1. Division 08 Section "Door Hardware Schedule".
 2. Division 08 Section "Hollow Metal Doors and Frames".
 3. Division 08 Section "Interior Aluminum Doors and Frames".
 4. Division 08 Section "Plastic Laminate Faced Wood Doors".
- 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. 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 installer of Windstorm assemblies.
- 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 Submittals.

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 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 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.

- 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 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 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. Lifetime for mortise locks and latches.
 - 2. Five years for exit hardware.
 - 3. Ten years for electric latch retraction exit motors

4. Twenty-five years for manual surface door closer bodies.
5. Two years for electromechanical door hardware.
6. Lifetime for SN200 readers.

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.

1.9 OWNER STOCK – See Attic Stock at the end of Hardware Schedule.

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:
- C. 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.
- D. 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 as specified in the Door Hardware Sets.
 1. Quantity: Provide the following hinge quantity, unless otherwise indicated:
 - 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.

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 where indicated in the Hardware Sets or on Drawings:
 - 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. Acceptable Manufacturers:
 - a. Hager Companies (HA).
 - b. McKinney Products (MK).
 - c. Stanley Hardware (ST).
- B. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 certified continuous geared hinge. with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.
1. Acceptable Manufacturers:
 - a. McKinney Products (MK).
 - b. Pemko Manufacturing (PE).
 - c. Stanley Hardware (ST).

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. Acceptable Manufacturers:

- a. Pemko Manufacturing (PE) – EL-CEPT Series.
 - b. Securitron (SU) - EL-CEPT Series.
 - c. Stanley Hardware (ST) EPT-12C 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 (MK) - Electrical Connecting Kit: QC-R001.
 - b. McKinney Products (MK) - Connector Hand Tool: QC-R003.

2.4 DOOR OPERATING TRIM

- A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.
1. Manual flush bolts to be furnished with top rod of sufficient length to allow bolt location approximately six feet from the floor.
 2. Furnish dust proof strikes for bottom bolts.
 3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
 4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
 5. Acceptable Manufacturers:
 - a. Ives (IV).
 - b. Rockwood Manufacturing (RO).
 - c. Trimco (TC).
- B. Door Push Plates and Pulls: ANS/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. Acceptable Manufacturers:

- a. Ives (IV).
- b. Rockwood Manufacturing (RO).
- c. Trimco (TC).

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.
- B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
 1. Acceptable Manufacturers:
 - a. Stanley Best (BE).
 - b. Sargent Cylinder Housings
 - c. No Substitution.
- C. 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.
- 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: Key locks to Owner's existing system.
- E. Key Quantity: Provide the following minimum number of keys:
 1. Change Keys per Cylinder: Two (2)
 2. Twenty construction cores
 3. 50 Key Blanks – Best "A" Keyway
- F. Construction Keying: Provide temporary keyed construction cores. Green Best Cores No Substitution . All Best temporary cores to be returned to the district at the end of the project.
- 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. Provide a new cabinet to all new construction projects. Use Lund 1205-B as a basis of design.

1. Acceptable Manufacturers:

- a. Lund Equipment (LU).
- b. MMF Industries (MM).
- c. Telkee (TK).

2.6 MECHANICAL LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.

1. Acceptable Manufacturers

- a. Sargent Manufacturing (SA) 8200 Series – No substitutions
- b. Sargent Manufacturing (SA) 10X Series - No substitutions
1) Use at student restrooms or as directed by Cy Fair ISD

2.7 AUXILIARY LOCKS

A. Tubular Deadlocks: Deadlocks to be products of the same source manufacturer and keyway as other specified locksets.

1. Acceptable Manufacturers:

- a. Marks (MX) - 130 Series.
- b. Sargent Manufacturing (SA) – 480 Series.

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. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Auxiliary Deadlocks: BHMA A156.5.
3. 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. 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.
6. Rail Sizing: Provide exit device rails factory sized for proper door width application.
7. Through Bolt Installation: For exit devices and trim as indicated (TB) in Door Hardware Sets.
8. Provide Less Dogging (LD) at all exit devices.
9. Add 31- Prefix to all exit devices being provided at two inch aluminum doors.
10. No self-tapping screws allowed.

- 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. Acceptable 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. Acceptable Manufacturers:
 - a. Stanley Precision (PR) - 822 Series.
 - b. No Substitution.

2.10 INTEGRATED WIEGAND OUTPUT ACCESS CONTROL EXIT DEVICES

- A. Wiegand Output Integrated Card Reader Exit Hardware: Wiegand output ANSI 156.3 Grade 1 rim, mortise, and vertical rod exit device hardware with integrated proximity card reader, 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 compatible access control systems. Inside push bar (request-to-exit) signaling and door position (open/closed status) monitoring (via separately connected DPS).
 2. Reader supports either HID 125 kHz proximity (up to 39 bits, including Corporate 1000) or 13.56 MHz (2K-32K) iClass® credentials.
 3. 12VDC external power supply required for reader, with optional 24VDC operation available with iClass® reader (125 kHz reader is always 12VDC). 24VDC required for solenoid operated exit trim (12VDC if applicable). 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. Acceptable Manufacturers:
 - a. Sargent Manufacturing (SA) - SN – 56-SN20080 Series Exits. x SPAR04867
 - b. Sargent Manufacturing (SA) - SN – SN2008200 Series Locks.
 - c. 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, and through-bolt and security type fasteners as required for proper installation.
 8. Through Bolt Installation: All door closers are to be installed with (TB) through bolting as indicated in Door Hardware Sets.
 9. No self-tapping screws allowed.
- 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. Acceptable Manufacturers:
 - a. Sargent Manufacturing (SA) – TB 351 Series.

2.12 SURFACE MOUNTED CLOSER HOLDERS

- A. Electromagnetic Door Holders: Certified ANSI A156.15 electromagnetic door holder/releases with a minimum 20 to 40 pounds holding power and single coil construction able to accommodate 12VDC, 24VAC, 24VDC and 120VAC. Coils to be independently wound, employing an integral fuse and armatures to include a positive release button.
1. Acceptable Manufacturers:
 - a. LCN Door Closers (LC) - SEM7800 Series.
 - b. Rixson (RF) - 980/990 Series.
 - c. Sargent Manufacturing (SA) - 1560 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. 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.
4. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
5. Acceptable Manufacturers:
 - a. Ives (IV).
 - b. Rockwood Manufacturing (RO).
 - c. Trimco (TC).

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. Acceptable Manufacturers:

- a. Ives (IV).
- b. Rockwood Manufacturing (RO).
- c. Trimco (TC).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.6, Grade 1 certified overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Acceptable Manufacturers:

- a. Do not use overhead stops/holders

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 UBC 7-2, Fire Tests of Door Assemblies.

D. No Replaceable Seal Strips allowed: Provide only those units where they can be screw applied..

E. Acceptable Manufacturers:

1. National Guard Products (NG).
2. Pemko Manufacturing (PE).
3. Reese Enterprises, Inc. (RE).

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. Acceptable Manufacturers:

- a. Provided by Security

- B. Switching Power Supplies: Provide UL listed or recognized filtered and regulated power supplies. Provide single, dual, or multi-voltage units as shown in the hardware sets. Units must be expandable up to eight Class 2 power limited outputs. Units must include the capability to incorporate a battery backup option with integral battery charging capability in addition to operating the DC load in event of line voltage failure. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.

1. Acceptable Manufacturers:

- a. Provided by Security

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.

3.3 INSTALLATION

- A. 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.
- B. 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.
- C. Integrated Wiegand access control products are required to be installed through current members of the ASSA ABLOY "Certified Integrator" (CI) program.
- D. 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.

- E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- F. 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.
- G. No self-tapping screws allowed.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.5 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.
- B. Final Adjustment: Installer shall return and make final adjustment of all hardware once all air conditioning test and balance is complete. Final adjustment shall be made while air conditioner system is operating. Coordinate with General Contractor and Owner.

3.6 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.

3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

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.

A. Manufacturer's Abbreviations:

1. MK - McKinney
2. OT - OTHER
3. PE - Pemko
4. RO - Rockwood
5. PR - Precision
6. MX - Marks
7. SA - Sargent
8. AD - Adams Rite
9. BE - Best Access Systems
10. HS – HES
11. SU – Securitron
12. KD – Keedex
13. LO – Locinox

****At existing doors / frames, all conditions must be field verified prior to order.**

At aluminum frames, gasket is by frame manufacturer.

****Add 2891APK gasketing to all exterior hollow metal doors.**

****Confirm loop or EPT at all existing openings requiring access control.**

Hardware Sets based on plans dated 08-13-2024

10/14/2024 hardware revised per 75% review meeting.

11/11/2024 hardware revised per 95% review meeting.

Set: 1.0

Doors: 1070-2, 1500-1

Description: Add Reader

1	SN200 Reader	52 6027 (Exit / Lock)	26D	SA
1	Balance of hardware	Existing to remain		OT

Set: 1.1

Doors: 1500A-2
 Description: 2N Station - rail

68-1375	Mounting Rail Insert		SA
1 Balance of hardware	Existing to remain		OT
2N Station	2N Station		OT

Set: 2.0

Doors: 1070-3, 1130-1
 Description: Add Reader - 68-1375 Rail - Pivots

2 Pivots	New - by Storefront Supplier		OT
1 68-1375	Mounting Rail Insert		SA
1 SN200 Reader	52 6027 (Exit / Lock)	26D	SA
1 Balance of hardware	Existing to remain		OT

Notes: Remove cylinder dogging on exiting rail with 68-1375 mounting rail insert.

Set: 3.0

Doors: 1850-1
 Description: Add Reader - 68-1375 Rail Insert - 2 - Threshold

2 68-1375	Mounting Rail Insert		SA
1 Threshold	2005AT MSES25SS X Opening Width		PE
1 SN200 Reader	52 6027 (Exit / Lock)	26D	SA
1 Balance of hardware	Existing to remain		OT

Notes: Remove cylinder dogging on rail with 68-1375 mounting rail insert

Set: 4.0

Doors: 1535-2, 1575-3
 Description: Add Reader - Rail Insert

1 68-1375	Mounting Rail Insert		SA
1 SN200 Reader	52 6027 (Exit / Lock)	26D	SA
1 Balance of hardware	Existing to remain		OT

Notes: Remove cylinder dogging on exiting rail with 68-1375 mounting rail insert.
 *Replace HID reader on wall with SN200 reader.

Set: 5.0

Doors: 1800-1
 Description: Add Reader - 68-1375 Rail Insert - 2

2 68-1375	Mounting Rail Insert		SA
1 SN200 Reader	52 6027 (Exit / Lock)	26D	SA
1 Balance of hardware	Existing to remain		OT

Notes: Remove cylinder dogging on rail with 68-1375 mounting rail insert

Set: 6.0

Doors: 2515-3

Description: Add 68-1375 Rail Insert - 1

1	68-0549	Rail Inserts		SA
1	Balance of hardware	Existing to remain		OT

Notes: Remove cylinder dogging on rail with 68-1375 mounting rail insert

Set: 7.0

Doors: 1125-2, 1125-3

Description: Add 68-1375 Rail Insert - 2

1	68-1375	Mounting Rail Insert		SA
1	Rim Exit SPAR NC-E11 - Dogging	19 TB 43 70 8504 Less Pull	US32D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	Balance of hardware	Existing to remain		OT

Notes: Remove cylinder dogging on rail with 68-1375 mounting rail insert

Set: 8.0

Doors: 1006-1, 1100-1, 1125-1, 1174-1, 1225-1, 1225-2, 1225-3, 1225-4, 1373-2, 1575-1, 1575-2, 1575-4

Description: Add 68-1375 Rail Insert - SN200 8500 - EPT

1	Electric Power Transfer	EL-CEPT	630	SU
1	Rim Exit xSPAR04867/NC-E11/NC-E35		19 LD TB 43 70 56-	
	SN200-8504	US32D	SA	
1	68-1375	Mounting Rail Insert		SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	ElectroLynx Harness	QC-C1500P		MK
1	ElectroLynx Harness	QC-C***P (length as req'd)		MK
1	Door Position Switch	By Security.		OT
1	Power Supply	Provided by security		SU
1	Balance of hardware	Existing to remain		OT

Notes: Remove cylinder dogging on existing rail with 68-1375 mounting rail insert. Reuse existing trim.

Set: 8.1

Doors: 1000-1, 1000-2

Description: Add SN200 Narrow Exit - 862, EPT

1	Electric Power Transfer	EL-CEPT	630	SU
1	Rim Exit xSPAR04867/NC-E11/NC-E35+-		19 TB 43 70 56-SN200-	
	8504 862	US32D	SA	
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE

1	Door Stop	462	US2C	RO
1	ElectroLynx Harness	QC-C1500P		MK
2	ElectroLynx Harness	QC-C***P (length as req'd)		MK
1	Power Supply	Provided by security		SU
1	Balance of hardware	Existing to remain		OT

Notes: 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.
 Verify use of EPT vs Door Loop.

Set: 8.2

Doors: 1500A-1, 1502-1

Description: Add SN200 Narrow Exit - 862, EPT

1	Electric Power Transfer	EL-CEPT	630	SU
1	Rim Exit xSPAR04867/NC-E11/NC-E35		19 LD TB 43 70 56-	
	SN200-8504 Less Trim	US32D	SA	
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	Door Stop	462	US2C	RO
1	ElectroLynx Harness	QC-C1500P		MK
2	ElectroLynx Harness	QC-C***P (length as req'd)		MK
1	Power Supply	Provided by security		SU
1	Balance of hardware	Existing to remain		OT

Notes: 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.
 Verify use of EPT vs Door Loop.

Set: 9.0

Doors: 1008-1

Description: Add 2 ea - 68-1375 Rail Insert - SN200 Reader Only

2	68-1375	Mounting Rail Insert		SA
2	Door Position Switch	By Security.		OT
1	SN200 Reader	52 6027 (Exit / Lock)	26D	SA
1	Balance of hardware	Existing to remain		OT

Notes: Remove cylinder dogging on rail with 68-1375 mounting rail insert. Replace existing reader with SN200

Set: 10.0

Doors: 1125-4

Description: Add 1 ea - 68-1375 Rail Insert - SN200 Reader Only

1	68-1375	Mounting Rail Insert		SA
2	Door Position Switch	By Security.		OT
1	SN200 Reader	52 6027 (Exit / Lock)	26D	SA

1 Balance of hardware Existing to remain OT

Notes: Remove cylinder dogging on exiting rail with 68-1375 mounting rail insert. Replace existing HID reader with SN200

Set: 11.0

Doors: 1104-2, 1104-3, 1109-1, 1109-2, 1113-1, 1119-1, 1119-2, 1607-1, 1608-1, 1609-1, 1610-1, 1611-1, 1612-1, 1613-1, 1663-1, 1665-1, 1667-1, 1713-2, 1803-1, 1809-1, 1810-1, 1830-1, 1836-1, 1845-1, 1873-3, 1874-2, 1881-3, 1909-1, 2122-1, 2135-1, 2137-1, 2515-1

Description: Add Exit Device-8816- HO Closers

1 Rim Exit Sec CR x SPAR#NC-E11	19 LD 43 49 70 8816 ETL	US32D	SA
2 Interchangeable Core	I/CK-7	626	BE
2 Const. Core	7190224	Green	BE
1 Surface Closer	TB 351 PSH	EN	SA
1 Door Stop	481H	US26D	RO
1 Balance of hardware	Existing to remain		OT

Notes: Provide hold open closers at classrooms unless fire rated. No hold open on rated doors.

Set: 12.0

Doors: 1037-1, 1038-1, 1171-1, 1173-1, 1175-1, 1178-1, 2108-1, 2110-1, 2114-1, 2116-1, 2209-1, 2210-1, 2211-1, 2212-1, 2213-1, 2214-1, 2215-1, 2216-1, 2309-1, 2310-1, 2311-1, 2312-1, 2313-1, 2315-1, 2316-1, 2318-1, 2405-1, 2407-1, 2416-1, 2418-1, 2606-1, 2608-1, 2612-1, 2613-1, 2705-1, 2707-1, 2709-1, 2711-1, 2714-1, 2716-1, 2718-1, 2720-1, 2806-1, 2807-1, 2808-1, 2809-1, 2811-1, 2812-1, 2813-1, 2814-1, 2906-1, 2910-1, 2916-1, 2917-1

Description: Add Exit Device-8816- HO Closers - Thru bolts

1 Rim Exit Sec CR x SPAR#NC-E11	19 LD 43 49 70 8816 ETL	US32D	SA
2 Interchangeable Core	I/CK-7	626	BE
2 Const. Core	7190224	Green	BE
1 Sex Nut & Bolt Kit	SNB134-38	689	NO
1 Surface Closer	TB 351 PSH	EN	SA
1 Door Stop	481H	US26D	RO
1 Balance of hardware	Existing to remain		OT

Notes: Provide hold open closers at classrooms unless fire rated. No hold open on rated doors.

**TB Kit to be used to fill existing pull preps.

Set: 13.0

Doors: 1171-2, 1173-2, 1175-2, 1178-2

Description: Add Exit Device-8804- HO Closers - Thru bolts

1 Rim Exit NL SPAR#NC-E11	LD TB 19 43 70 8804 ETL	US32D	SA
1 Interchangeable Core	I/CK-7	626	BE
1 Const. Core	7190224	Green	BE
1 Sex Nut & Bolt Kit	SNB134-38	689	NO
1 Surface Closer	TB 351 PSH	EN	SA
1 Door Stop	481H	US26D	RO

1 Balance of hardware Existing to remain OT

Notes: Provide hold open closers at classrooms unless fire rated. No hold open on rated doors.
**TB Kit to be used to fill existing pull preps.

Set: 14.0

Doors: 1047-1, 1047-2, 2500-1

Description: Add Exit Device-8816/8804- HO Closers - Thru bolts

1	Rim Exit Sec CR x SPAR#NC-E11	LD 19 LD 43 49 70 8816 ETL	US32D	SA
1	Rim Exit NL SPAR#NC-E11	LD TB 19 43 70 8804 ETL	US32D	SA
3	Interchangeable Core	I/CK-7	626	BE
3	Const. Core	7190224	Green	BE
2	Sex Nut & Bolt Kit	SNB134-38	689	NO
2	Surface Closer	TB 351 PSH	EN	SA
2	Door Stop	481H	US26D	RO
1	Balance of hardware	Existing to remain		OT

Notes: Provide hold open closers at classrooms unless fire rated. No hold open on rated doors.
**TB Kit to be used to fill existing pull preps.

Set: 15.0

Doors: 1255-1, 1809-2, 1873-1, 1874-1, 1881-2, 1938-1, 2122-2, 2135-2, 2137-2

Description: Add Exit Device-8804- HO Closers

1	Rim Exit NL SPAR#NC-E11	LD TB 19 43 70 8804 ETL	US32D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	Surface Closer	TB 351 PSH	EN	SA
1	Door Stop	481H	US26D	RO
1	Balance of hardware	Existing to remain		OT

Notes: Provide hold open closers at classrooms unless fire rated. No hold open on rated doors.

Set: 15.1

Doors: 1810-2, 1830-2

Description: New Exit Device-8804- STC - Confirm hinge

1	Continuous Hinge	CFM HD1 x Dr. Ht.		PE
1	Rim Exit SPAR NC-E11 STC	LD TB 19 TB 31 43 70 8804 ETL	US32D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	Parallel Hold Open Arm	25-PSH	EN	SA
1	Door Stop	462	US2C	RO
1	Gasketing, Threshold, Door Bottom	By the STC door manufacturer		OT
1	Balance of hardware	Existing to remain		OT

Notes: Confirm hinge type required to meet desired STC Rating. Existing frame - coordinate with new hardware. Hold open closers will not normally work with cam lift hinges - confirm hinge type prior to

hardware purchase.

Set: 16.0

Doors: 1990-3

Description: Add Exit Device-8816- HO Closers - repair

1	Rim Exit Sec CR x SPAR#NC-E11	19 LD 43 49 70 8816 ETL	US32D	SA
2	Interchangeable Core	I/CK-7	626	BE
2	Const. Core	7190224	Green	BE
1	Surface Closer	TB 351 PSH	EN	SA
1	Door Stop	481H	US26D	RO
1	Balance of hardware	Existing to remain		OT

Notes: Provide hold open closers at classrooms unless fire rated. No hold open on rated doors. Contractor to paint and bondo any existing holes.

Set: 17.0

Doors: 3101-1, 3101-2

Description: Add SN200 Narrow Exit 8504 x 8510, Loop

1	Rim Exit xSPAR04867/NC-E11/NC-E35	19 LD TB 43 70 56-		
	SN200-8504	US32D	SA	
1	Rim Exit SPAR NC-E11	LD 19 TB 43 8510 EO	US32D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	ElectroLynx Harness	QC-C1500P		MK
2	ElectroLynx Harness	QC-C***P (length as req'd)		MK
1	Door Loop	DL-2		AK
1	Power Supply	Provided by security		SU
1	Balance of hardware	Existing to remain		OT

Notes: 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. Verify use of EPT vs Door Loop.

Set: 18.0

Doors: 1025-1

Description: Add SN200 Exit, Loop, Rail Insert - Threshold

1	Rim Exit x SPAR04867/NC-E11	19 LD TB 43 70 56-SN200-8804	US32D	SA
2	68-1375	Mounting Rail Insert		SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	Threshold	2005AT MSES25SS X Opening Width		PE
1	ElectroLynx Harness	QC-C1500P		MK
2	ElectroLynx Harness	QC-C***P (length as req'd)		MK
1	Door Loop	DL-2		AK
1	Power Supply	Provided by security		SU

1 Balance of hardware Existing to remain OT

Notes: 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. Reuse existing Trim

Verify use of EPT vs Door Loop.

Set: 19.0

Doors: 1140-1, 1140-2, 1165-2, 1724-2

Description: Add SN200 Exit, Loop, Rail Insert

1 Rim Exit x SPAR04867/NC-E11	19 LD TB 43 70 56-SN200-8804	US32D	SA
1 68-0549	Rail Inserts		SA
1 Interchangeable Core	I/CK-7	626	BE
1 Const. Core	7190224	Green	BE
1 Threshold	2005AT MSES25SS X Opening Width		PE
1 ElectroLynx Harness	QC-C1500P		MK
2 ElectroLynx Harness	QC-C***P (length as req'd)		MK
1 Door Loop	DL-2		AK
1 Power Supply	Provided by security		SU
1 Balance of hardware	Existing to remain		OT

Notes: 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. Reuse existing Trim. Remove cylinder dogging on exiting rail with 68-1375 mounting rail insert

Verify use of EPT vs Door Loop.

Set: 20.0

Doors: 1702-2, 1704-2, 1718-2, 1722-2, 1909-2, 1909-9, 1990-1

Description: Add SN200 Exit, Loop

1 Rim Exit x SPAR04867/NC-E11	19 LD TB 43 70 56-SN200-8804	US32D	SA
1 Interchangeable Core	I/CK-7	626	BE
1 Const. Core	7190224	Green	BE
1 ElectroLynx Harness	QC-C1500P		MK
2 ElectroLynx Harness	QC-C***P (length as req'd)		MK
1 Door Loop	DL-2		AK
1 Power Supply	Provided by security		SU
1 Balance of hardware	Existing to remain		OT

Notes: 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. Reuse existing Trim. Remove cylinder dogging on exiting rail with 68-1375 mounting rail insert

Verify use of EPT vs Door Loop.

Set: 21.0

Doors: 1500B-1, 1800-2

Description: Add SN200 Lock, Loop

1	SN200 Mort Lock	70 SN200-82271 OL	US26D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	ElectroLynx Harness	QC-C1500P		MK
2	ElectroLynx Harness	QC-C***P (length as req'd)		MK
1	Door Loop	DL-2		AK
1	Power Supply	Provided by security		SU
1	Balance of hardware	Existing to remain		OT

Notes: 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. Reuse existing Trim. Remove cylinder dogging on exiting rail with 68-1375 mounting rail insert
Verify use of EPT vs Door Loop.

Set: 22.0

Doors: 1933-1

Description: Add 2N Exit, Loop

1	Rim Exit - 2N SPAR#04867/NC-E11	LD 19 TB 43 56 70 8804 Less Pull	US32D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	ElectroLynx Harness	QC-C1500P		MK
1	ElectroLynx Harness	QC-C***P (length as req'd)		MK
1	Door Loop	DL-2		AK
1	Power Supply	Provided by security		SU
1	Balance of hardware	Existing to remain		OT

Notes: 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. Card reader by security. Reuse existing Trim.
Verify use of EPT vs Door Loop.

Set: 23.0

Doors: 1750-1, 1750-4

Description: Pair Add Rated Exit Devices-8816 x 8804

1	Rim Exit Rated Sec CR x SPAR#NC-E11		12 LD 19 43 49 70 8816	
	ETL	US32D		SA
1	Rim Exit SPAR NC-E11	12 LD 19 TB 43 70 8804 ETL	US32D	SA
3	Interchangeable Core	I/CK-7	626	BE
3	Const. Core	7190224	Green	BE
2	Door Stop	481H	US26D	RO
1	Balance of hardware	Existing to remain		OT

Set: 24.0

Doors: 1102-1, 1102-2, 1102-3, 1102-4, 1102-5, 1102-6, 1102-7, 1120-1, 1120-2, 1147-1

Description: Pair Add Exit Devices-8804 x 8810 x HO Closer - SNB

1	Rim Exit EO x SPAR#NC-E11	19 LD TB 43 8810	US32D	SA
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1	Rim Exit NL SPAR#NC-E11	LD 19 TB 43 70 8804 Less Pull	US32D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
2	Sex Nut & Bolt Kit	SNB134-38	689	NO
2	Surface Closer	TB 351 PSH	EN	SA
2	Door Stop	481H	US26D	RO
1	Balance of hardware	Existing to remain		OT

Notes: Reuse existing trim.

Set: 25.0

Doors: 1045-1, 1105-2, 1114-3, 1308-1, 1413-1, 3014-1

Description: Existing - Add 8204

1	Storeroom/Closet Lock	70 8204 LL	US26D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	Door Stop	481H	US26D	RO
1	Balance of hardware	Existing to remain		OT

Set: 26.0

Doors: 1156-1, 1159-1, 1162-1, 1163-1, 1164-1, 1166-1, 1168-1, 1169-1, 1170-1, 1206-1, 1212-3, 1214-1, 1260-1, 1264-3, 1305-1, 1306-1, 1309-1, 1311-1, 1369-1, 1371-1, 1705-1, 1717-2, 1867-1

Description: Existing - Add 8204 - HO Closer

1	Storeroom/Closet Lock	70 8204 LL	US26D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	Door Closer w/ HO	TB 351 H (inswing)/ PSH (outswing) As Req	EN	SA
1	Door Stop	481H	US26D	RO
1	Balance of hardware	Existing to remain		OT

Set: 27.0

Doors: 1030-1, 1034-1, 1048-1, 1049-1, 1103-1, 1156-2, 1159-2, 1162-2, 1163-2, 1164-2, 1166-2, 1168-2, 1169-2, 1170-2, 1206-2, 1212-2, 1214-2, 1255-2, 1260-3, 1264-2, 1301-1, 1305-2, 1306-2, 1309-2, 1311-2, 1369-2, 1371-2, 1374-1, 1375-1, 1534-1, 1556-1, 1558-1, 1560-1, 1562-1, 1602-1, 1604-1, 1605-1, 1657-1, 1658-1, 1659-1, 1662-1, 1664-1, 1666-1, 1704-1, 1705-2, 1711-1, 1717-1, 1718-1, 1854-1, 1860-1, 1867-2, 1900-1, 1902-1, 1924-1, 1932-1, 1938-2, 2006-1, 2008-1, 2010-1, 2012-1, 2014-1, 2016-1, 2018-1, 2109-1, 2111-1, 2113-1, 2307-1, 2402-1, 2410-1, 2411-1, 2417-1, 2519-1, 2520-1, 2702-1, 2904-1, 2911-1, 2915-1, 3004-1, 3006-1, 3008-1, 3010-1, 3012-1

Description: Existing - Add 8238 - HO Closer

1	Classroom Security Intruder Lock SA	V01 EMB 70 8238 VN1L 90-3/8" Collar	US26D	
2	Interchangeable Core	I/CK-7	626	BE
2	Const. Core	7190224	Green	BE
1	Door Closer w/ HO	TB 351 H (inswing)/ PSH (outswing) As Req	EN	SA
1	Door Stop	481H	US26D	RO
1	Balance of hardware	Existing to remain		OT

Set: 28.0

Doors: 1355-1, 1378-1, 2414-1

Description: Existing - Add 8238

1 Classroom Security Intruder Lock SA	V01 EMB 70 8238 VN1L 90-3/8" Collar		US26D
2 Interchangeable Core	I/CK-7	626	BE
2 Const. Core	7190224	Green	BE
1 Door Stop	481H	US26D	RO
1 Balance of hardware	Existing to remain		OT

Set: 29.0

Doors: 1036-1, 1054-1, 1056-1, 1056-2, 1057-1, 1105-1, 1105-3, 1114-1, 1114-2, 1157-1, 1158-1, 1357-1, 1511-2, 1704-3, 1705-3, 1710-1, 1711-2, 1713-1, 1714-1, 1716-1, 1722-1, 1750-3, 1752-1, 1772-1, 1811-1, 1812-1, 1817-1, 1818-1, 1819-1, 1820-1, 1821-1, 1822-1, 1823-1, 1824-1, 1832-1, 1837-1, 1839-1, 1840-1, 1841-1, 1842-1, 1843-1, 1854-2, 1854-3, 1856-1, 1859-1, 1862-1, 1865-1, 1866-1, 1870-1, 1886-1, 1902-2, 1913-1, 1927-1, 1927-2, 1928-1, 1977-1, 1993-1, 2507-1, 2508-1, 2511-1, 2511-2, 2704-1, 2706-1, 2708-1, 2710-1, 2908-1, 2912-1, 3012-2, 3103-1

Description: Existing - No Work

1 All hardware	Existing to remain		OT
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Set: 30.0

Doors: 1020-1, 1380-1, 1381-1, 1382-1, 1401-1, 1404-1, 1407-1, 1409-1, 1410-1, 1411-1, 1412-1, 1415-1, 1416-1, 1418-1, 1419-1, 1420-1, 1421-1, 1422-1, 1423-1, 1424-1, 1426-1, 1501-1, 1501-2, 1503-1, 1504-1, 1506-1, 1506-2, 1508-1, 1508-2, 1509-1, 1510-1, 1510-2, 1511-1, 1513-1, 1513-2, 1521-1, 1522-1, 1523-1, 1524-1, 1525-1, 1527-1, 1528-1, 1529-1, 1530-1, 1533-1, 1533-2, 1982-1

Description: Existing - Add 8205

1 Office/Entry Lock	70 8205 LL	US26D	SA
1 Interchangeable Core	I/CK-7	626	BE
1 Const. Core	7190224	Green	BE
1 Door Stop	481H	US26D	RO
1 Balance of hardware	Existing to remain		OT

Set: 31.0

Doors: 1512-1, 1514-1, 1514-2

Description: Existing - Add 8205/ Indicator

1 Office/Entry Lock	V01 EMB 70 8205 VN1L	US26D	SA
1 Interchangeable Core	I/CK-7	626	BE
1 Const. Core	7190224	Green	BE
1 Door Stop	481H	US26D	RO
1 Balance of hardware	Existing to remain		OT

Set: 32.0

Doors: 1033-1, 1359-1, 1720-1, 1985-1, 1991-1

Description: Existing - No Work

1 All hardware Existing to remain OT

Set: 33.0

Doors: 1365-1, 1367-1, 1376-1
Description: Existing - No Work

1 All hardware Existing to remain OT

Set: 34.0

Doors: 1827-1
Description: Existing Pr- Add HO Closer

2 Surface Closer	TB 351 PSH	EN	SA
2 Door Stop	481H	US26D	RO
1 Balance of hardware	Existing to remain		OT

Set: 35.0

Doors: 4000B-1, 4010-2
Description: **Sgl Ext - ASF - Exit -SN200 - Closer w/Stop Arm- Access Control

1 Continuous Hinge	CFM SLF-HD1 PT x Dr. Ht.		PE
1 Electric Power Transfer	EL-CEPT	630	SU
1 Rim Exit xSPAR04867/NC-E11/NC-E35+-		19 TB 43 70 56-SN200-	
8504 862	US32D		SA
1 Interchangeable Core	I/CK-7	626	BE
1 Const. Core	7190224	Green	BE
1 Kit	581-1/ 581-2 as required	EN	SA
1 Surface Closer	TB 351 PS	EN	SA
1 Sweep IDF/MDF/Alum	18061CNB x Dr. Width		PE
1 Threshold	2005AT MSES25SS X Opening Width		PE
1 Perimeter Seal	By door mfr		OT
1 ElectroLynx Harness	QC-C1500P		MK
2 ElectroLynx Harness	QC-C***P (length as req'd)		MK
1 Door Position Switch	By Security.		OT
1 Power Supply	Provided by security		SU

Notes: Operation: Doors normally closed and locked. Valid card at the card reader retracts the latch on the active leaf for entry. Free egress at all times. Door status monitored. Confirm specified hardware is compatible with aluminum door manufacturer.

Set: 36.0

Doors: 1768A-1
Description: **Pr Ext - ASF - Exit Device- SN200/DT - KR Mullion - Closer w/Stop Arm -Access Control

1 Continuous Hinge	CFM SLF-HD1 x Dr. Ht.		PE
1 Continuous Hinge	CFM SLF-HD1 PT x Dr. Ht.		PE

1	Electric Power Transfer	EL-CEPT	630	SU
1	Mullion	KR822 (FLK as req)	600	PR
2	Stabilizer	ST989	Dull Black	PR
1	Spacer	MCS822	689	PR
1	Rim Exit xSPAR04867/NC-E11/NC-E35+- 8504 862	US32D	19 TB 43 70 56-SN200- SA	
1	Rim Exit SPAR NC-E11	LD 19 TB 43 8510 862	US32D	SA
2	Interchangeable Core	I/CK-7	626	BE
1	Rim Cylinder	70 34 X #90 - 1/2	US32D	SA
1	Const. Core	7190224	Green	BE
2	Kit	581-1/ 581-2 as required	EN	SA
2	Surface Closer	TB 351 PS	EN	SA
2	Sweep IDF/MDF/Alum	18061CNB x Dr. Width		PE
1	Threshold	2005AT MSES25SS X Opening Width		PE
1	Perimeter Seal	By door mfgr		OT
1	ElectroLynx Harness	QC-C1500P		MK
2	ElectroLynx Harness	QC-C***P (length as req'd)		MK
2	Door Position Switch	By Security.		OT
1	Power Supply	Provided by security		SU

Notes: Operation: Doors normally closed and locked. Valid card at the card reader retracts the latch on the active leaf for entry. Free egress at all times. Door status monitored. Confirm specified hardware is compatible with aluminum door manufacturer.

Set: 36.1

Doors: 4000D-1

Description: **Pr Ext - ASF - Exit Device- 2N/DT - KR Mullion - Closer w/Stop Arm -Access Control

1	Continuous Hinge	CFM SLF-HD1 x Dr. Ht.		PE
1	Continuous Hinge	CFM SLF-HD1 PT x Dr. Ht.		PE
1	Electric Power Transfer	EL-CEPT	630	SU
1	Mullion	KR822 (FLK as req)	600	PR
2	Stabilizer	ST989	Dull Black	PR
1	Spacer	MCS822	689	PR
1	Rim Exit SPAR NC-E11	LD 19 TB 43 8510 862	US32D	SA
1	Rim Exit 2N xSPAR04867/NC-E11	LD 19 TB 43 56 70 8504 862	US32D	SA
2	Interchangeable Core	I/CK-7	626	BE
1	Rim Cylinder	70 34 X #90 - 1/2	US32D	SA
1	Const. Core	7190224	Green	BE
2	Kit	581-1/ 581-2 as required	EN	SA
2	Surface Closer	TB 351 PS	EN	SA
2	Sweep IDF/MDF/Alum	18061CNB x Dr. Width		PE
1	Threshold	2005AT MSES25SS X Opening Width		PE
1	Perimeter Seal	By door mfgr		OT
1	ElectroLynx Harness	QC-C1500P		MK
1	ElectroLynx Harness	QC-C***P (length as req'd)		MK
2	Door Position Switch	By Security.		OT
1	Power Supply	Provided by security		SU

Notes: Operation: Doors normally closed and locked. Valid card at the card reader retracts the latch on the active leaf for entry. Free egress at all times. Door status monitored. Confirm specified hardware is compatible with aluminum door manufacturer.

Set: 37.0

Doors: 1047C-1, 1047D-1, 1904-1, 4025-2

Description: **Sgl - ExT -HM - Exit- SN200 - Closer /Stop- Access Control

1	Continuous Hinge	CFM HD1 PT x Dr. Ht.		PE
1	Electric Power Transfer	EL-CEPT	630	SU
1	Rim Exit x SPAR04867/NC-E11	19 LD TB 43 70 56-SN200-8804	US32D	SA
1	Vandal Resistant Trim	826	US32D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	Surface Closer	TB 351 PS	EN	SA
1	Gasketing	2891APK (head & jambs)		PE
1	Rain Guard	346C x Frame Width		PE
1	Sweep	345ANB x Dr. Width		PE
1	Threshold	2005AT MSES25SS X Opening Width		PE
1	ElectroLynx Harness	QC-C1500P		MK
2	ElectroLynx Harness	QC-C***P (length as req'd)		MK
1	Door Position Switch	By Security.		OT
1	Power Supply	Provided by security		SU

Notes: 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.

Set: 37.1

Doors: 4017-2

Description: **Sgl - ExT -HM - Exit- 2N - Closer /Stop- Access Control

1	Continuous Hinge	CFM HD1 PT x Dr. Ht.		PE
1	Electric Power Transfer	EL-CEPT	630	SU
1	Rim Exit x SPAR04867/NC-E11	19 LD TB 43 70 56-SN200-8804	US32D	SA
1	Vandal Resistant Trim	826	US32D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	Surface Closer	TB 351 PS	EN	SA
1	Gasketing	2891APK (head & jambs)		PE
1	Rain Guard	346C x Frame Width		PE
1	Sweep	345ANB x Dr. Width		PE
1	Threshold	2005AT MSES25SS X Opening Width		PE
1	ElectroLynx Harness	QC-C1500P		MK
1	ElectroLynx Harness	QC-C***P (length as req'd)		MK
1	Door Position Switch	By Security.		OT
1	Power Supply	Provided by security		SU

Notes: 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.

Set: 38.0

Doors: 1986-2

Description: **Pr Ext - EX FR - 2N Lock - Closer w/HO -DPS- Peep

1	Continuous Hinge	CFM HD1 x Dr. Ht.		PE
1	Continuous Hinge	CFM HD1 PT x Dr. Ht.		PE
1	Surface Bolt	580-12 @ top only	US26D	RO
1	Fail Secure Lock	RX 70 8271 LL	US32D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
2	Kit	581-1/ 581-2 as required	EN	SA
2	Surface Closer	TB 351 PSH	EN	SA
2	Armor Plate	K1050 36" CSK BEV	US32D	RO
1	Astragal Set (2)	18061CNB x Dr. Ht		PE
1	Gasketing	2891APK (head & jambs)		PE
1	Rain Guard	346C x Frame Width		PE
2	Sweep	345ANB x Dr. Width		PE
1	Threshold	2005AT MSES25SS X Opening Width		PE
1	ElectroLynx Harness	QC-C1500P		MK
1	ElectroLynx Harness	QC-C***P (length as req'd)		MK
2	Door Position Switch	By Security.		OT
1	Power Supply	Provided by security		SU
2	Viewer	622 x door thickness	DCRM	RO

Notes: Door is normally closed and secure. Presentation of valid credential allows entry by trim. Upon loss of power, door will remain secure. Free egress at all times. Card reader is by security.

Set: 38.1

Doors: 1986-1

Description: Pr 8204 - 580 FB -Armor - HO Closer

2	Continuous Hinge	CFM HD1 x Dr. Ht.		PE
1	Surface Bolt	580-12 @ top only	US26D	RO
1	Storeroom/Closet Lock	70 8204 LL	US26D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
2	Door Closer w/ HO	TB 351 H (inswing)/ PSH (outswing) As Req	EN	SA
2	Armor Plate	K1050 36" CSK BEV	US32D	RO
2	Door Stop	481H	US26D	RO

Set: 39.0

Doors: 4011-1, 4025-4

Description: **Sgl - Ext- Mech/Storage/Fire Riser - Closer w/Stop Arm

1	Continuous Hinge	CFM HD1 x Dr. Ht.		PE
1	Storeroom/Closet Lock	70 8204 LL	US26D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	Surface Closer	TB 351 PS	EN	SA
1	Gasketing	2891APK (head & jambs)		PE
1	Rain Guard	346C x Frame Width		PE
1	Sweep	345ANB x Dr. Width		PE
1	Threshold	2005AT MSES25SS X Opening Width		PE
1	Door Position Switch	By Security.		OT

Set: 39.1

Doors: 1500B-2

Description: **Sgl Int - ASF - Exit -SN200 - Closer w/Stop Arm- Access Control

1	Continuous Hinge	CFM SLF-HD1 PT x Dr. Ht.		PE
1	Electric Power Transfer	EL-CEPT	630	SU
1	Rim Exit xSPAR04867/NC-E11/NC-E35+- 8504 862	US32D	19 TB 43 70 56-SN200- SA	
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	Kit	581-1/ 581-2 as required	EN	SA
1	Surface Closer	TB 351 PS	EN	SA
1	Perimeter Seal	By door mfr		OT
1	ElectroLynx Harness	QC-C1500P		MK
2	ElectroLynx Harness	QC-C***P (length as req'd)		MK
1	Door Position Switch	By Security.		OT
1	Power Supply	Provided by security		SU

Notes: Operation: Doors normally closed and locked. Valid card at the card reader retracts the latch on the active leaf for entry. Free egress at all times. Door status monitored. Confirm specified hardware is compatible with aluminum door manufacturer.

Set: 40.0

Doors: 4010-1

Description: **Sgl Typ - Security Classroom - Closer - HO

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Classroom Security Intruder Lock SA	V01 EMB 70 8238 VN1L 90-3/8" Collar		US26D
2	Interchangeable Core	I/CK-7	626	BE
2	Const. Core	7190224	Green	BE
1	Door Closer w/ HO	TB 351 H (inswing)/ PSH (outswing) As Req	EN	SA
1	Kit	581-1/ 581-2 as required	EN	SA
1	Door Stop	481	US26D	RO
3	Silencer	608		RO

Notes: Provide hold open closers at classrooms.

Set: 41.0

Doors: 4000D-2

Description: **Pr Int -Vest Exit Device- NL x NL - Mullion - Closer

2	Continuous Hinge	CFM HD1 x Dr. Ht.		PE	
2	Stabilizer	ST989	Dull Black		PR
1	Spacer	MCS822	689		PR
1	Mullion	822 (FL as req)	600		PR
2	Rim Exit SPAR NC-E11	LD 19 TB 43 70 8804 ETL	US32D		SA
3	Interchangeable Core	I/CK-7	626		BE
1	Rim Cylinder	70 34 X #90 - 1/2	US32D		SA
3	Const. Core	7190224	Green		BE
2	Surface Closer	TB 351 PS	EN		SA
2	Silencer	608			RO

Set: 42.0

Doors: 1762-1

Description: **Sgl Ext - Storeroom/Mech- Closer/Stop

1	Continuous Hinge	CFM HD1 x Dr. Ht.		PE	
1	Storeroom/Closet Lock	70 8204 LL	US26D		SA
1	Interchangeable Core	I/CK-7	626		BE
1	Const. Core	7190224	Green		BE
1	Surface Closer	TB 351 PS	EN		SA
1	Gasketing	2891APK (head & jambs)			PE
1	Rain Guard	346C x Frame Width			PE
1	Sweep	345ANB x Dr. Width			PE
1	Threshold	2005AT MSES25SS X Opening Width			PE
1	Door Position Switch	By Security.			OT

Notes: Closer on active leaf.

Set: 43.0

Doors: 1950-1

Description: **Pr Ext - Storeroom/Mech-(Classroom Lock) Closer/HO - Armor

2	Continuous Hinge	CFM HD1 x Dr. Ht.		PE	
1	Surface Bolt	580-12 @ top only	US26D		RO
1	Classroom Lock	70 8237 LL	US26D		SA
1	Interchangeable Core	I/CK-7	626		BE
1	Const. Core	7190224	Green		BE
2	Surface Closer	TB 351 PS	EN		SA
2	Armor Plate	K1050 36" CSK BEV	US32D		RO
1	Astragal Set (2)	18061CNB x Dr. Ht			PE
1	Gasketing	2891APK (head & jambs)			PE
2	Sweep	345ANB x Dr. Width			PE

1 Threshold 2005AT MSES25SS X Opening Width PE

Set: 44.0

Doors: 1894-1, 1895-1, 4006-1

Description: **Sgl - Exit Device-Security CL - Closer - STC

3 Hinges	By the STC door manufacturer		OT
1 Rim Exit STC Sec CR x SPAR#NC-E11		LD 19 31 43 49 70 8816	
ETL	US32D	SA	
2 Interchangeable Core	I/CK-7	626	BE
2 Const. Core	7190224	Green	BE
1 Door Closer	TB 351 O/P9 (type as required)	EN	SA
1 Door Stop	462	US2C	RO
1 Gasket, threshold, door bottom	By the STC door manufacturer		OT

Notes: Door hardware is specified for design intent. Confirm hardware compatibility and design meets the door manufacturer's approved assembly testing for the STC level indicated.

Set: 45.0

Doors: 4013-1, 4017-1, 4025-1

Description: Sgl - Exit Device-Security CL - Closer / HO

3 Hinge (heavy weight)	T4A3786	US26D	MK
1 Rim Exit Sec CR x SPAR#NC-E11	19 LD 43 49 70 8816 ETL	US32D	SA
2 Interchangeable Core	I/CK-7	626	BE
2 Const. Core	7190224	Green	BE
1 Surface Closer	TB 351 PSH	EN	SA
1 Door Stop	481H	US26D	RO
1 Gasketing	2891APK (head & jambs)		PE

Set: 46.0

Doors: 4013-2

Description: Sgl - Exit Device-NL - Closer / HO - Classroom

3 Hinge (heavy weight)	T4A3786	US26D	MK
1 Rim Exit NL SPAR#NC-E11	LD TB 19 43 70 8804 ETL	US32D	SA
1 Interchangeable Core	I/CK-7	626	BE
1 Const. Core	7190224	Green	BE
1 Surface Closer	TB 351 PSH	EN	SA
1 Door Stop	481H	US26D	RO
1 Gasketing	2891APK (head & jambs)		PE

Set: 47.0

Doors: 1965-2

Description: No Work

1 All hardware Existing to remain OT

Set: 48.0

Doors: [1827B-1](#)
Description: No Work

1 All hardware Existing to remain OT

Set: 49.0

Doors: [4001-1](#)
Description: **Pr - Int Classroom Sec CL x NL -Closer - STC

6 Hinges	By the STC door manufacturer		OT
1 Mullion	KR822 (FLK as req)	600	PR
2 Stabilizer	ST989	Dull Black	PR
1 Spacer	MCS822	689	PR
1 Rim Exit SPAR NC-E11 STC	LD TB 19 TB 31 43 70 8804 ETL	US32D	SA
1 Rim Exit STC Sec CR x SPAR#NC-E11		LD 19 31 43 49 70 8816	
ETL		US32D	SA
4 Interchangeable Core	I/CK-7	626	BE
1 Mullion Cylinder	70 34 x 1KB-3	US32D	SA
4 Const. Core	7190224	Green	BE
2 Door Closer	TB 351 O/P9 (type as required)	EN	SA
2 Door Stop	481H	US26D	RO
1 Gasket, threshold, door bottom	By the STC door manufacturer		OT

Notes:

Door hardware is specified for design intent. Confirm hardware compatibility and design meets the door manufacturer's approved assembly testing for the STC level indicated.

Set: 50.0

Doors: [1120-3](#)
Description: **Pr - EX FR - Int Classroom 8804/8810 MSL -Closer

2 Continuous Hinge	CFM HD1 x Dr. Ht.		PE
1 Mullion	KR822 (FLK as req)	600	PR
2 Stabilizer	ST989	Dull Black	PR
1 Spacer	MCS822	689	PR
1 Rim Exit-Dog SPAR NC-E11	19 TB 43 70 8804 MSL	US32D	SA
1 Rim Exit SPAR NC-E11	LD 19 TB 43 8810 MAL	US32D	SA
3 Interchangeable Core	I/CK-7	626	BE
1 Mullion Cylinder	70 34 x 1KB-3	US32D	SA
3 Const. Core	7190224	Green	BE
2 Surface Closer	TB 351 PSH	EN	SA
2 Door Stop	481H	US26D	RO
2 Silencer	608		RO

Notes: Keep dogging

Set: 51.0

Doors: [4002-1](#)

Description: **Pr - Push/Pull - Closer HO - STC

6 Hinges	By the STC door manufacturer		OT	
2 Push Plate	70E	US32D	RO	
2 Pull Plate	111x70C	US32D	RO	
2 Door Closer w/ HO	TB 351 H (inswing)/ PSH (outswing) As Req		EN	SA
2 Door Stop	462	US2C	RO	
1 Gasketing, Threshold, Door Bottom	By the STC door manufacturer		OT	

Notes: Door hardware is specified for design intent. Confirm hardware compatibility and design meets the door manufacturer's approved assembly testing for the STC level indicated.

Set: 52.0

Doors: 1838-1, 1892-1, 4007-1, 4008-1, 4012-1, 4014-1

Description: **Sgl - Storeroom

3 Hinge, Full Mortise	TA2714	US26D	MK	
1 Storeroom/Closet Lock	70 8204 LL	US26D	SA	
1 Interchangeable Core	I/CK-7	626	BE	
1 Const. Core	7190224	Green	BE	
1 Door Stop	481H	US26D	RO	
3 Silencer	608		RO	

Set: 52.1

Doors: 4004-1

Description: **Sgl - Storeroom - Seals

3 Hinge (heavy weight)	T4A3786	US26D	MK	
1 Storeroom/Closet Lock	70 8204 LL	US26D	SA	
1 Interchangeable Core	I/CK-7	626	BE	
1 Const. Core	7190224	Green	BE	
1 Door Stop	481H	US26D	RO	
1 Gasketing	2891APK (head & jambs)		PE	

Set: 53.0

Doors: 4000-1, 4015-1

Description: **Sgl - Storeroom - Closer - Gasket - Sweep MDF/IDF

3 Hinge, Full Mortise	TA2714	US26D	MK	
1 Storeroom/Closet Lock	70 8204 LL	US26D	SA	
1 Interchangeable Core	I/CK-7	626	BE	
1 Const. Core	7190224	Green	BE	
1 Door Closer	TB 351 O/P9 (type as required)		EN	SA
1 Door Stop	481H	US26D	RO	
1 Gasketing	2891APK (head & jambs)		PE	
1 Sweep	345ANB x Dr. Width		PE	
3 Silencer	608		RO	

Set: 54.0

Doors: 1128-1

Description: No Work

1 All hardware	Existing to remain		OT
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Notes: Closer on active leaf.

Set: 55.0

Doors: 1768-1

Description: **Pr - Storeroom Lock - Rated

6 Hinge, Full Mortise	TA2714	US26D	MK
2 Flush Bolt	555 12" / 72" AFF	US26D	RO
1 Dust Proof Strike	570	US26D	RO
1 Storeroom/Closet Lock	70 8204 LL	US26D	SA
1 Interchangeable Core	I/CK-7	626	BE
1 Const. Core	7190224	Green	BE
1 Door Closer	TB 351 O/P9 (type as required)	EN	SA
2 Door Stop	481H	US26D	RO
1 Astragal Set (2)	18061CNB x Dr. Ht		PE
1 Gasketing	2891APK (head & jambs)		PE

Notes: Closer on active leaf.

Set: 56.0

Doors: 1848-1, 4016-1

Description: **Pr - Storeroom - Floor Stop - Mechanical - No Closer

6 Hinge, Full Mortise	TA2714	US26D	MK
1 Surface Bolt	580-12 @ top only	US26D	RO
1 Storeroom/Closet Lock	70 8204 LL	US26D	SA
1 Interchangeable Core	I/CK-7	626	BE
1 Const. Core	7190224	Green	BE
2 Door Stop	481H	US26D	RO
2 Silencer	608		RO

Set: 57.0

Doors: 4018-1

Description: **Sgl - Office, Conf, Work, Sat Admin Offices, Lounge, Nurse - No Closer

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Classroom Lock	70 8237 LL	US26D	SA
1 Interchangeable Core	I/CK-7	626	BE
1 Const. Core	7190224	Green	BE
1 Door Stop	481H	US26D	RO
1 Silencer	608		RO

Set: 57.1

Doors: 1500C-1

Description: **Sgl - ASF Office (Storeroom function)

1	Continuous Hinge	CFM HD1 x Dr. Ht.		PE
1	Storeroom/Closet Lock	70 8204 LL	US26D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	Kit	581-1/ 581-2 as required	EN	SA
1	Surface Closer	TB 351 PS	EN	SA
1	Door Stop	481H	US26D	RO
1	Perimeter Seal	By door mfr		OT

Set: 58.0

Doors: 1927-3

Description: **Sgl - Classroom - 8238 - HO

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Classroom Security Intruder Lock SA	V01 EMB 70 8238 VN1L 90-3/8" Collar		US26D
2	Interchangeable Core	I/CK-7	626	BE
2	Const. Core	7190224	Green	BE
1	Door Closer w/ HO	TB 351 H (inswing)/ PSH (outswing) As Req	EN	SA
1	Door Stop	481H	US26D	RO
3	Silencer	608		RO

Set: 58.1

Doors: 4019-1

Description: **Sgl - Classroom - 8237 - HO

3	Hinge, Full Mortise	TA2714	US26D	MK
	Classroom Lock	70 8237 LL	US26D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	Door Closer w/ HO	TB 351 H (inswing)/ PSH (outswing) As Req	EN	SA
1	Door Stop	481H	US26D	RO
3	Silencer	608		RO

Set: 59.0

Doors: 1890-1, 1891-1, 1893-1, 4003-1, 4005-1

Description: **Sgl - 8237 - STC

3	Hinges	By the STC door manufacturer		OT
1	Classroom Lock	31 70 8237 LNL	US26D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	Door Stop	462	US2C	RO
1	Gasket, threshold, door bottom	By the STC door manufacturer		OT

Notes:

Door hardware is specified for design intent. Confirm hardware compatibility and design meets the door manufacturer's approved assembly testing for the STC level indicated.

Set: 60.0

Doors: 4002-2

Description: Sgl - Push Pull - Closer - HO

3	Hinge (heavy weight)	T4A3786	US26D	MK	
1	Push Plate	70E	US32D	RO	
1	Pull Plate	111x70C	US32D	RO	
1	Door Closer w/ HO	TB 351 H (inswing)/ PSH (outswing) As Req	EN	SA	
1	Door Stop	481H	US26D	RO	
3	Silencer	608		RO	

Set: 61.0

Doors: 1124A-1, 1127A-1, 1852-1, 1853-1, 4021-1, 4022-1

Description: **Sgl - Multi Occ RR - Classroom Cyl - Closer

4	Hinge, Full Mortise	TA2714	US26D	MK	
1	Classroom Lock	70 10XG37 LL	US26D	SA	
1	Interchangeable Core	I/CK-7	626	BE	
1	Const. Core	7190224	Green	BE	
1	Door Closer w/ HO	TB 351 H (inswing)/ PSH (outswing) As Req	EN	SA	
1	Door Stop	481H	US26D	RO	
3	Silencer	608		RO	

Set: 62.0

Doors: 1018-1, 1361-1, 1377-1, 1878-1

Description: **Sgl - Typ / 8265 Privacy - Closer - HO

3	Hinge, Full Mortise	TA2714	US26D	MK	
1	Privacy Lock	V20 8265 VN1L	US26D	SA	
1	Door Closer w/ HO	TB 351 H (inswing)/ PSH (outswing) As Req	EN	SA	
1	Door Stop	481H	US26D	RO	
1	Silencer	608		RO	

Set: 62.1

Doors: 2203-1, 2303-1, 2502-1, 2503-1, 2517-1, 2518-1

Description: **Sgl - Typ / 8250 Privacy - Closer - HO

3	Hinge, Full Mortise	TA2714	US26D	MK	
1	Hotel Guest Lock Lock	V20 LC 8250 VN1L	US26D	SA	
1	Interchangeable Core	I/CK-7	626	BE	
1	Const. Core	7190224	Green	BE	
1	Mortise Cylinder for Hotel Lock	1E-7G4 C208 RP3	626	BE	
1	Door Closer w/ HO	TB 351 H (inswing)/ PSH (outswing) As Req	EN	SA	
1	Door Stop	481H	US26D	RO	
1	Silencer	608		RO	

Set: 63.0

Doors: 1126-2, 1426-2, 1530-2, 1760-1, 1760-2, 1904-2, 1904-3, 1909-3, 1909-4, 1909-5, 1909-6, 1909-7, 1909-8, 1933-2, C101-1, C102-2, C108-2, C108-3

Description: **OH Coiling Doors - No Work

1 All hardware Existing to remain OT

Set: 64.0

Doors: 4017-3, 4025-3

Description: **OH Coiling Doors - No hardware

1 All hardware By the door manufacturer OT

Set: 65.0

Doors: 1006-2, 1006-3, 1008-2, 1008-3, 1016-1, 1022-1, 1031-1, 1032-1, 1035-1, 1039-1, 1041-1, 1042-1, 1043-1, 1044-1, 1046-1, 1047A-1, 1047B-1, 1050-1, 1055-1, 1058-1, 1061-1, 1062-1, 1062-2, 1063-1, 1070-1, 1100-2, 1104-1, 1106-1, 1110-1, 1111-1, 1112-1, 1115-1, 1117-1, 1118A-1, 1118A-2, 1121-1, 1122-1, 1123-1, 1124-1, 1126-1, 1127-1, 1129-1, 1141-1, 1141B-1, 1142-1, 1145-1, 1146-1, 1148-1, 1152-1, 1153-1, 1154-1, 1155-1, 1165-1, 1166-3, 1167-1, 1167-2, 1170-3, 1171-3, 1172-1, 1173-3, 1175-3, 1176-1, 1176-2, 1179-1, 1204-1, 1206-3, 1207-1, 1208-1, 1208-2, 1208-3, 1210-1, 1212-1, 1214-3, 1252-1, 1253-1, 1254-1, 1255-3, 1256-1, 1257-1, 1258-1, 1260-2, 1264-1, 1303-1, 1304-1, 1305-3, 1306-3, 1307-1, 1309-3, 1310-1, 1311-3, 1353-1, 1363-1, 1369-3, 1371-3, 1372-1, 1373-1, 1378-2, 1379-1, 1383-1, 1384-1, 1402-1, 1403-1, 1405-1, 1406-1, 1408-1, 1427-1, 1500-2, 1515-1, 1516-1, 1517-1, 1518-1, 1519-1, 1520-1, 1532-1, 1535-1, 1536-1, 1554-1, 1603-1, 1606-1, 1614-1, 1654-1, 1656-1, 1660-1, 1661-1, 1668-1, 1670-1, 1702-1, 1703-1, 1706-1, 1707-1, 1708-1, 1712-1, 1715-1, 1724-1, 1726-1, 1750-2, 1754-1, 1756-1, 1763-1, 1765-1, 1766-1, 1767-1, 1769-1, 1770-1, 1773-1, 1773-2, 1774-1, 1776-1, 1805-1, 1813-1, 1814-1, 1815-1, 1816-1, 1826-1, 1831-1, 1833-1, 1834-1, 1835-1, 1844-1, 1846-1, 1851-1, 1858-1, 1861-1, 1864-1, 1868-1, 1871-1, 1876-1, 1880-1, 1882-1, 1883-1, 1884-1, 1901-1, 1903-1, 1905-1, 1907-1, 1908-1, 1910-1, 1910B-1, 1911-1, 1912-1, 1914-1, 1915-1, 1916-1, 1917-1, 1918-1, 1925-1, 1926-1, 1929-1, 1930-1, 1931-1, 1939-1, 1940-1, 1953-1, 1955-1, 1956-1, 1958-1, 1960-1, 1962-1, 1965-1, 1966-1, 1968-1, 1968-2, 1968-3, 1968-4, 1969-1, 1972-1, 1975-1, 1975-2, 1975-3, 1975-4, 1975-5, 1975-6, 1975-7, 1976-1, 1978-1, 1979-1, 1983-1, 1984-1, 1990-2, 1992-1, 1995-1, 1995-2, 2001A-1, 2002-1, 2004-1, 2020-1, 2022-1, 2024-1, 2030-1, 2101-1, 2103-1, 2105-1, 2106-1, 2107-1, 2112-1, 2112-2, 2112A-1, 2112B-1, 2117-1, 2118-1, 2121-1, 2121-2, 2121-3, 2136-1, 2136-2, 2136-3, 2204-1, 2206-1, 2207-1, 2208-1, 2305-1, 2308-1, 2314-1, 2314-2, 2314B-1, 2403-1, 2406-1, 2408-1, 2409-1, 2413-1, 2419-1, 2420-1, 2504-1, 2505-1, 2506-1, 2509-1, 2510-1, 2510-2, 2512-1, 2512-2, 2515-2, 2516-1, 2521-1, 2522-1, 2604-1, 2609-1, 2610-1, 2610-2, 2611-1, 2703-1, 2712-1, 2765-1, 2801-1, 2803-1, 2804-1, 2805-1, 2810-1, 2902-1, 2905-1, 2907-1, 2909-1, 2913-1, 2914-1, 2918-1, 2919-1, 3016-1, 3018-1, 3020-1, 3022-1, 3024-1, 3026-1, 3102-1, 3104-1, 3105-1, 3106-1, 3106-2, 3107-1, 3108-1, 3109-1, 3209-1, 3210-1, 3211-1, BB100-1, BB200-1, C111-1, FB100-1, FB200-1, SB100-1, SB200-1

Description: No Work

1 All hardware Existing to remain OT

Set: 66.0

Doors: Attic

Description: **Attic Stock - EVERY CAMPUS

1	Hydraulic Gate Closer & Hinge	MAMMOTH-180-HD	9005	OT
5	Quick Fix Bolts	MAMMOTH-P00006000		OT
5	Mullion Lock	98-2520		SA
5	Mullion Lock	98-2518		SA
5	Classroom Security Intruder Lock SA	V01 EMB 70 8238 VN1L 90-3/8" Collar		US26D
5	130KB	Thumbturn Kit	26D	SA
50	Interchangeable Core	I/CK-7	626	BE
50	Key Blanks	Best "A" Keyway		BE
12	Regular Hold Open Arm	25-H	EN	SA
12	Parallel Hold Open Arm	25-PSH	EN	SA
4	Electromagnetic Holder	994M 24VAC	689	RF
5	994M Magnetic Parts	Door Armature 994510M	689	RF
5	994M Magnetic Parts	Screw & Backplate 998300	689	RF
5	994M Magnetic Parts	Swivel Armature 900-3	689	RF
5	994M Magnetic Parts	Magnet Assembly 998369-3V	689	RF
5	994M Magnetic Parts	Wall Cover 998315M	689	RF
4	SN200 Reader	52 6027 (Exit / Lock)	26D	SA

Notes: All attic stock ships direct to
Director of Technical Services
Cy Fair ISD Lockshop
11430 Perry Road
Houston, Texas 77064
All attic stock to ship directly to Cy Fair.
DO NOT ship to jobsite.

Set: 67.0

Doors: 2029-1, C101-2, C102-1, C103-1, C104-1, C105-1, C106-1, C107-1, C108-1, C108-4, C109-1,
S1000-1, S1000-2

Description: Not Found

1	Door	Not found		OT
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END OF SECTION 087100

SECTION 08 80 00
GLAZING

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Glass.
- B. Glazing compounds and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 06 20 00 – Finish Carpentry: Cabinets with requirements for glass shelves.
- B. Section 07 25 00 - Weather Barriers.
- C. Section 07 90 05 - Joint Sealers: Sealant and back-up material.
- D. Section 08 11 13 - Hollow Metal Doors and Frames: Glazed doors and borrowed lites.
- E. Section 08 14 16 - Flush Wood Doors: Glazed lites in doors.
- F. Section 08 43 13 - Aluminum-Framed Storefronts: Glazing furnished by storefront manufacturer.
- G. Section 08 44 13 - Glazed Aluminum Curtain Walls: Glazing furnished by wall manufacturer.
- H. Section 08 45 00 - Translucent Wall and Roof Assemblies.

1.3 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.
- B. ASTM C509- 06 (2011) Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Material
- C. ASTM C1036 - Standard Specification for Flat Glass; 2011e1.
- D. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2013.
- E. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2012a.
- F. GANA (GM) - GANA Glazing Manual; Glass Association of North America; 2009.
- G. GANA (SM) - GANA Sealant Manual; Glass Association of North America; 2008.
- H. ICC (IBC) - International Building Code; 2012.
- I. ANSI Z97.2 2010 For Safety Glazing Materials Used in Building- Safety Performance Specifications and Methods of Test.

1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittals, for submittal procedures.
- B. Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.
- C. Samples: Submit two samples 12x12 inch (305x305 mm) in size of glass and plastic units, showing coloration and design.
- D. Samples: Submit 6 inch (152 mm) long bead of glazing sealant, color as selected from full range of colors.

- E. Certificates: Certify that products meet or exceed specified requirements.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA Glazing Manual and GANA Sealant Manual for glazing installation methods.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

1.6 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Sealed Insulating Glass Units: Provide a ten (10) year warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.
- C. Laminated Glass: Provide a five (5) year warranty to include coverage for delamination, including replacement of failed units.

PART 2 PRODUCTS

2.1 GLAZING TYPES

- A. Type IG-1 - Sealed Insulating Glass Units: Exterior Vision glazing, low-E.
 - 1. Application(s): All exterior glazing unless otherwise indicated.
 - 2. Between-lite space filled with argon.
 - 3. Thermal Resistance (U-Value):.29 or better, nominal.
 - 4. Total Solar Heat Gain Coefficient: 0.24 or better, nominal.
 - 5. Total Visible Light Transmittance: 35 percent, minimum.
 - 6. Basis of Design: PPG Solarban R-100 (2) + Clear Low E-Glass to match existing.
 - 7. Outboard Lite: Heat-strengthened float glass, 2- 1/4 inch (6 mm) thick, minimum.
 - a. Tint: To match existing.
 - b. Coating: To Match Existing.
 - 8. Inboard Lite: Heat-strengthened float glass, 1/4 inch (6 mm) thick.
 - a. Tint: Clear.
 - 9. Total Thickness: 1 inch (25 mm).
 - 10. Tempered as required per code.
- B. Type IG-2 - Sealed Insulating Glass Units: Spandrel glazing.
 - 1. Basis of Design: Oldcastle Inc to match existing building.
 - 2. Outboard Lite: Annealed float glass, 2- 1/4 inch (6 mm) thick, minimum.
 - a. Tint: to match existing.
 - b. Coating: Same as on vision units, on #2 surface.
 - 3. Inboard Lite: Heat-strengthened float glass, 1/4 inch (6 mm) thick.
 - a. Tint: to match existing.
 - 4. Total Thickness: 1 inch (25 mm).
 - 5. Tempered as required by code.
- C. Type IG-3 - Sealed Insulating Glass Units: Safety glazing:
 - 1. Applications: Provide this type of glazing in the following locations:

- a. Glazed lites in exterior doors.
 - b. Glazed sidelights and panels next to doors.
 - c. Other locations required by applicable federal, state, and local codes and regulations.
 - d. Other locations indicated on the drawings.
 - e. Safety glazing shall be permanently marked on each individual glass lite with certification label of manufacturer acceptable to authorities having jurisdiction.
 - f. Shall conform to ANSI Z97.1, Safety Performance Specification, and ANSI Z97.1 Safety Glass Code and IBC 2406.1 as applicable.
2. Type: Same as other vision glazing except use fully tempered float glass for both outboard and inboard lites.
- D. Type S-1 - Single Vision Glazing:
1. Applications: All interior glazing unless otherwise indicated.
 2. Type: Heat-strengthened float glass.
 3. Tint: Clear.
 4. Thickness: 1/4 inch (6 mm).
- E. Type S-3 - Single Safety Glazing: Non-fire-rated. Interior applications
1. Applications: Provide this type of glazing in the following locations:
 - a. Glazed lites in doors, except fire doors.
 - b. Glazed sidelights to doors, except in fire-rated walls and partitions.
 - c. Other locations required by applicable federal, state, and local codes and regulations.
 - d. Other locations indicated on the drawings.
 2. Type: Fully tempered float glass as specified.
 3. Tint: Clear.
 4. Thickness: 1/4 inch (6 mm).
- F. Type A-1- Acoustical Glass:
1. Applications: All sound retardant doors.
 2. Type: one lite of 1/4" tempered glass and one lite of 3/8" thick laminated clear float glass comprised of two 3/16" thick glazing quality clear float glass lites, laminated to each side of a clear 0.030 inch thick polyvinyl butyral (PVB) interlayer.
- G. Type S-4 – Single Vision Glazing with film
1. Applications: All interior glazing unless otherwise indicated.
 2. Type: Heat-strengthened float glass.
 3. Tint: Clear.
 4. 15mil film on secured side of glass, anchored to frame with Dow 995 structural sealant with BondKap over sealant. Must achieve minimum 1/2" contact between Dow 995 bead to frame and minimum 1/2" contact between Dow 995 bead to window film.
 5. Doors with Glass – 15mil film applied glass edge-to-glass edge on secure side of glass and Dow 995 applied under caps/stops to adhere film-to-frame-to-cap/stop
- H. Type IR-1 (Interior applications): Security Glazing 9/16" ASTM F1233-08 Class 1.3 Clear, Glass-clad poly with glass on exposed surfaces:
1. Basis of Design: Childguard-2118 by Global Security Glazing
 - a. Safety glazing at locations as required by code
- I. Type IR-2 (Interior Applications) Security Glazing 3/8" to 1/2" ASTM F1233-08 Class 1.3 Clear, Glass-clad poly with glass on exposed surfaces:
1. Basis of Design: Childguard by Global Security Glazing
 - a. Safety glazing at locations as required by code
- J. Type IR-3 (Exterior Applications)
1. Overall thickness 1-1/8" comprised of one lite of 1/4" glass, one lite of 3/8" glass separated by 1/2" airspace.
 2. Air space to be dual sealed and meeting the certification requirements of IGCC for a CBA rating
 3. Exterior Outboard Lite: Security Glazing 3/8" to 1/2" ASTM F1233-08 Class 1.3 Clear, Glass-clad poly with glass on exposed surfaces: Basis of Design: Childguard by Global Security Glazing,

Safety glazing at locations as required by code. Tinting: Field verify and match existing glazing color.

Interior/ Inboard Lite shall be: Heat-strengthened float glass, 1/4 inch (6 mm) thick fully tempered glass. Complying with ASTM C1048 Type 1 Class 1 (clear) Quality 3, Kind FT.

2.2 EXTERIOR GLAZING ASSEMBLIES

- A. Structural Design Criteria: Select type and thickness to withstand dead loads and wind loads acting normal to plane of glass at design pressures calculated in accordance with all applicable codes code.
 - 1. Use the procedure specified in ASTM E1300 to determine glass type and thickness.
 - 2. Limit glass deflection to 1/175 or flexure limit of glass, whichever is less, with full recovery of glazing materials.
 - 3. Thicknesses listed are minimum.
- B. Air and Vapor Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier:
 - 1. In conjunction with vapor retarder and joint sealer materials described in other sections.
 - 2. To maintain a continuous air barrier and vapor retarder throughout the glazed assembly from glass pane to heel bead of glazing sealant.

2.3 GLAZING COMPOUNDS

- A. Manufacturers:
 - 1. Bostik Inc: www.bostik-us.com.
 - 2. Momentive Performance Materials, Inc (formerly GE Silicones): www.momentive.com.
 - 3. Pecora Corporation: www.pecora.com.
 - 4. BASF Construction Chemicals-Building Systems: www.buildingsystems.basf.com.
 - 5. Substitutions: Refer to Section 01 60 00 - Product Requirements.

2.4 GLAZING MATERIALS AT HOLLOW METAL FRAMES

- A. Use glazing compounds and preformed glazing sealants approved for the application, conforming to Glazing Materials portion of FGMA Glazing Manual.
- B. Sealant should be one part acrylic polymer sealant conforming to FS TT-S-00230 or silicone, FS TT -S-0023-C. Use of glazing of all fixed glass. Include primer as recommended by manufacturer's instruction.
- C. Setting blocks should be hard rubber or clean grain softwood.
- D. Back-up material should be foamed polyethylene or polystyrene rodstock, sizes as required by joint condition, and compatible with sealant.
- E. Glazing Tape should be DAP#1202 or as approved.
- F. Glazing gaskets are extruded neoprene, free of porosity, surface defects, dimensional irregularities, and conforming to physical properties of ASTM C509.
- G. Use of metal sash putty will not be permitted, but compound conforming to FS T-G-410 will be permitted. The use of nonskinning compounds, nonresilient type preformed sealers, and preformed impregnated type gasket will not be permitted.
- H. Use DOW "Dowsill 995 Silicon Structural sealant" at IR gasket replacement locations. Refer to manufacturer's requirements for testing of completed system.

2.5 APPROVED MANUFACTURERS

- A. Subject to compliance with requirements indicated herein, provide products of one of the listed manufacturers:
1. Guardian Industries Corp; www.sunguardglass.com
 2. Pilkington North American Inc; www.pilkington.com
 3. PPG Industries, Inc; www.ppgglazing.com
 4. Viracon, Inc; www.viracon.com

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that openings for glazing are correctly sized and within tolerance.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

3.2 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant.
- D. Install sealants in accordance with ASTM C1193 and GANA Sealant Manual.
- E. Install sealant in accordance with manufacturer's instructions.

3.3 CLEANING

- A. Remove glazing materials from finish surfaces.
- B. Remove labels after Work is complete.
- C. Clean glass and adjacent surfaces.

3.4 PROTECTION

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

END OF SECTION 08 80 00

SECTION 08 87 00
SECURITY GLAZING FILM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Security Glazing film applied to new and existing glazing assemblies.
- B. Locations: As identified in the Contract Documents.

1.2 RELATED SECTIONS

- A. Drawings and general provision of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 REFERENCED STANDARDS

- A. American National Standards Institute (ANSI)
 - 1. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test; Current Version.
- B. American Society for Testing and Materials (ASTM)
 - 1. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials; Current Version.
 - 2. ASTM F3561.- Standard Test Method for Forced-Entry-Resistance of Fenestration Systems After Simulated Active Shooter Attack. FTD SA – FILTI Shooter Attack Certification Testing, Filti Testing and Development Shooter Attack Certification.
- C. Code of Federal Regulations
 - 1. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Consumer Products Safety Commission; current edition.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Glazing film manufacturer specializing in manufacture of security glazing films with minimum 5 years' experience manufacturing products meeting specified requirements.
- B. Installer Qualifications: Direct employees of film manufacturer or manufacturer-approved installers trained in all aspects of film installation.
- C. Field Mockup: Apply security glazing film in location(s) as directed to verify installation requirements and to demonstrate application effects and qualities of materials and execution.
 - 1. Obtain approval of field samples before continuing with remainder of installation.
 - 2. Maintain mockup during duration of installation in an undisturbed condition as a standard for judging the completed Work.
 - 3. Approved field mockup may become part of the completed Work.
- D. Film application and performance verification:
 - 1. In addition to only proceeding with reviewed and approved submittals, the awarded contractor/ installer shall certify that the security film installed meets the performance requirements identified within the Contract Documents.

2. Post installation film verification may include the random choosing and removal of up to three pieces of glass with applied film to be tested to verify that film installed meets specification and performance requirements as indicated. Film may need to be removed as part of the verification process.
3. All installed film locations shall be subject to inspection of structural sealant to verify full bite on frames has been achieved.

1.5 SUBMITTALS

- A. Submit under provisions of Division 01.
- B. Test Reports: Detailed reports of full-scale chamber tests to specified criteria, using assemblies commensurate with those required for this project.
- C. Product Data: Manufacturer's data sheets on product to be used, including:
 1. Record of product certification for safety requirements.
 2. Preparation instructions and recommendations.
 3. Storage and handling requirements and recommendations.
 4. Installation methods.
- D. Samples: For each film product to be used, minimum size 4-inches by 6-inches, representing actual product, color, and patterns.
- E. Specimen Warranty.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products as directed 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 authorities having jurisdiction.

1.7 FIELD CONDITIONS

- A. Coordinate installation timeline with General Contractor's and/or Owner's schedule and potential other adjacent work that may create or cause adverse installation conditions.
- B. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside the manufacturer's absolute limits.

1.8 WARRANTY

- A. Provide 15 Year manufacturers replacement warranty to cover film against peeling, cracking, discoloration, and deterioration.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Armoured One, LLC., 386 North Midler Ave. Syracuse, NY 13206. Tel: 315-720-4186; Email: info@armouredone.com; Web: www.armouredone.com.
 1. Basis of design: Armoured One 23mil Shooter Attack Security Film.

- B. Substitutions: Must provide demonstrated equality to specified basis of design product and performance requirements.

2.2 MATERIALS

A. Security Glazing Film

1. Single thickness 23 mil (0.023 inch) thick, clear, UV stable, optically transparent, adhesive backed polyester film for permanent bonding to glass.
 - a. Installing multiple layers of thinner film to accomplish the required thickness is not acceptable nor considered equal to the basis of design.
2. Adhesive Type: Pressure sensitive as recommended by glazing film manufacturer.
3. Performance Requirements:
 - a. FTD SA – Standard for Shooter Attack certification, Class 1 (tested on 1/4-inch tempered glass).
 - b. Tensile Strength: ASTM D-882, 35,000 psi minimum.
 - c. Breaking Strength: ASTM D-882, 640 lbs. / inch.
 - d. Elongation at Break: ASTM D-882, 230%
 - e. Haze: ASTM D1003, <4%
 - f. Color b: ASTM D2244, 4.2
 - g. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84 (Class A).
4. Cleaners, Primers, and Sealers: Types recommended by glazing film manufacturer.

B. Anchoring System

1. Structural Sealant: Per manufacturer's recommendations for the installation application.
 - a. Acceptable product: DOW Corning DOWSIL795 Silicone Building Sealant, DOWSIL 995 Structural Silicone Sealant, or glazing film manufacturer approved equal.
2. Provide supplemental anchoring system components as required.

PART 3 - EXECUTION

3.1 GENERAL

- A. At existing glazed openings, retrofit glazing assemblies to provide impact resistance and forced/attack resistance complying with FTD-SA-C1, ANSI Z97. I and CPSC 16 CFR 1201 Category II.

3.2 EXAMINATION

- A. Field-Applied Film: Verify that existing conditions are adequate for proper application and performance of film.
- B. Examine glass and frames, ensure that existing conditions are adequate for proper application and performance of film.
- C. Verify glass is not cracked, chipped, broken, or damaged.
- D. Verify that frames are securely anchored and free of defects.

3.3 PREPARATION

- A. Clean glass of dust, dirt, paint, oil, grease, mildew, mold, and other contaminants that would inhibit adhesion.
- B. Blade the inside surface of window glass with industrial razors to ensure removal of foreign contaminants.
- C. Immediately prior to applying film, thoroughly wash glass with neutral cleaning solution.
- D. Protect adjacent surfaces.
- E. Do not begin installation until substrates have been properly prepared.

3.4 INSTALLATION

- A. Install in accordance with manufacturer's instructions, without air bubbles, wrinkles, streaks, bands, thin spots, pinholes, or gaps, as required to achieve specified performance.
- B. Seams. Seam film only as required to accommodate material sizes, seam without overlaps. Seam orientation to be identified and coordinated during shop drawing review and verified in field prior to installation.
- C. Apply bead of structural sealant overlapping 3/4-inch of the exposed edge of film and overlapping 3/4-inch of glazing system frame. Allow to cure before cleaning.
- D. Clean glass and excess structural sealants from finished surfaces.
- E. Remove any labels or protective covers. Do not encapsulate anything under the film.

3.5 POST INSTALLATION VERIFICATION

- A. Awarded contractor will be required to verify that film installed meets the requirements highlighted in this bid. By submitting a bid, contractor understands that three pieces of glass, chosen at random will be removed and film applied will be measured to verify that film installed meets specifications as requested. Film may need to be removed as part of the verification process.

3.6 PROTECTION

- A. Protect installed products until completion and final acceptance of project.
- B. Repair or replace damaged products before Substantial Completion.

END OF SECTION 08 8753

SECTION 08 91 00
STATIONARY BLADE WALL LOUVERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Extruded aluminum stationary louvers with drainable blades.

1.2 RELATED SECTIONS

- A. Section 03 30 00 - Cast-In-Place Concrete.
- B. Section 04 20 00 - Masonry Units.
- C. Section 05 12 00 - Structural Steel.
- D. Section 06 10 00 - Rough Carpentry.
- E. Section 07 62 00 – Roofing Related Sheet Metal Flashing and Trim.
- F. Section 07 90 05 - Joint Sealers.
- G. Section 09 90 00 – Painting and Coating.
- H. Section 23 37 13 - Air Distribution Devices.
- I. Section 23 33 00 – Ductwork Accessories.
- J. Section 23 09 63 – Energy Management and Control System.

1.3 REFERENCES

- A. AAMA 2604 – High Performance Organic Coatings on Architectural Extrusions and Panels.
- B. AAMA 2605 - High Performance Organic Coatings on Architectural Extrusions and Panels.
- C. AAMA 611 – Voluntary Specification for Anodized Architectural Aluminum.
- D. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
- E. AMCA 511 - Certified Ratings Program for Air Control Devices.
- F. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.
- G. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- I. ASTM D822 - Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings
- J. ASTM D2244 - Standard Test Method for Calculation of Color Differences From Instrumentally Measured Color Coordinates.
- K. ASTM D4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films.

1.4 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. Rain-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.5 ACTION SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: For each product to be used, including:
 - 1. Manufacturer's product data including performance data.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Installation methods.
- C. Shop Drawings:
 - 1. Submit shop drawings indicating materials, construction, dimensions, accessories, and installation details.
- D. Product Schedule: For louvers. Use same designations indicated on Drawings.
- E. Samples: Submit sample of louver to show frame, blades, bird screen, gutters, downspouts, vertical supports, sill, accessories, finish, and color.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and Installer.
- B. Product Test Reports: For each type of louver, for tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For manufacturer's warranties.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. The manufacturer shall have implemented the management of quality objectives, continual improvement, and monitoring of customer satisfaction to assure that customer needs and expectations are met.
 - 2. Manufacturer shall be International Organization for Standardization (ISO) 9001 accredited.
- B. Installer Qualifications:
- C. Product Qualifications:
 - 1. Louver licensed to bear AMCA Certified Ratings Seal. Ratings based on tests and procedures performed in accordance with AMCA 511 and comply with AMCA Certified Ratings Program. AMCA Certified Ratings Seal applies to air performance and water penetration ratings.
 - 2. Louvers shall be factory engineered to withstand the specified seismic loads.
 - a. Minimum design loads shall be calculated to comply with ASCE – 7, or local requirements of Authority Having Jurisdiction (AHJ).

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store materials in a dry area indoors, protected from damage and in accordance with manufacturer's instructions.
- C. Handling: Protect materials and finishes during handling and installation to prevent damage.
- D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

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. Manufacturer shall provide standard limited warranty for louver systems for a period of one year from date of installation, no more than 18 months after shipment from manufacturing plant. When notified in writing from the Owner of a manufacturing defect, manufacturer shall promptly correct deficiencies without direct financial cost to the Owner.
- B. Manufacturer shall provide 20 year limited warranty for fluoropolymer-based finish on extruded aluminum substrates.
 - 1. Finish coating shall not peel, blister, chip, crack or check.
 - 2. Chalking, fading or erosion of finish when measured by the following tests:
 - a. Finish coating shall not chalk in excess of 8 numerical ratings when measured in accordance with ASTM D4214.
 - b. Finish coating shall not change color or fade in excess of 5 NBS units as determined by ASTM D2244 and ASTM D822.
 - c. Finish coating shall not erode at a rate in excess of 10%/ 5 year as determined by Florida test sample.
- C. Manufacturer shall provide a 5 year limited warranty for Class I and a 3 year limited warranty for Class II anodized finish on extruded aluminum substrates.
 - 1. Seller warrants the Finish under normal atmospheric conditions.
 - a. Will not crack, craze, flake or blister
 - b. Will not change or fade more than (5) Delta-E Hunter units as determined by ASTM method D-2244
 - c. Will not chalk in excess of ASTM D-4214-07 number (8) rating, determined by the procedure outlined in ASTM D-4214-07 specification test.
 - 2. Any forming or welding must be done prior to finishing. Post forming or welding will void the warranty.
 - 3. This Warranty applies only if the anodized aluminum product is installed in strict accordance with Seller's recommended practices and maintained in accordance with AAMA (American Architectural Manufacturers Association) publication number 609 and 610-09 ("Cleaning and Maintenance Guide for Architecturally Finished Aluminum").

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Ruskin Company; 3900 Dr. Greaves Road, Kansas City, Missouri 64030. Tel: (816) 761-7476.
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00. Alternative manufacturers include but are not limited to:
 - 1. Airolite, P. O. Box 410, Schofield, WI 54476 (715) 841-8757, www.airolite.com
 - 2. Kingspan Benchmark, 720 Marion Road, Columbus, OH 43207 1-888-332-5862.
 - 3. Greenheck, PO Box 410, Schofield, WI 54476 715.359.6171 www.greenheck.com
 - 4. Mestek, Inc., 1020 Prince Frederick Blvd. Ste. 305, Prince Frederick, MD 20687 (570) 420-7079 airlinelouvers.com

2.2 STATIONARY BLADE LOUVER

- A. Model: ELF375DX as manufactured by Ruskin Company – Basis of design.
- B. Fabrication:
 - 1. Design: Stationary drainable louver type with drain gutters in each blade and head with downspouts in jambs and mullions with all welded construction. Hidden vertical supports to allow continuous line appearance up to 120 inches (3,048 mm). Steeply angled integral sill.
 - 2. Frame:
 - a. Frame Depth: 4 inches (102 mm).
 - b. Wall Thickness: 0.081 inch (2.1 mm), nominal.
 - c. Material: Extruded aluminum, Alloy 6063-T6.
 - 3. Blades:
 - a. Style: Drainable. 37.5 degrees at 5-3/32 inches (129 mm), nominal.
 - b. Wall Thickness: 0.081 inch (2.1 mm), nominal.
 - c. Material: Extruded aluminum, Alloy 6063-T6.
 - 4. Minimum Assembly Size: 12 inches wide by 12 inches high (305 mm x 305 mm).
 - 5. Maximum Factory Assembly Size: Single sections shall not exceed 120 inches wide by 90 inches high (3048 mm x 2286 mm) or 90 inches wide by 120 inches high (2286 mm x 3048). Louvers larger than the maximum single size shall be require field assembly of smaller sections.
 - 6. Recycled Content: 18% post-consumer. 55% pre-consumer, post-industrial, total 73% by weight.
- C. Performance Data:
 - 1. Based on testing 48 inch x 48 inch (1,219 mm x 1,219 mm) size unit in accordance with AMCA 500.
 - 2. Free Area: 54 percent, nominal.
 - 3. Free Area Size: 8.58 square feet (0.79 m²).
 - 4. Maximum Recommended Air Flow through Free Area: 873 feet per minute (4.4 m/s).
 - 5. Air Flow: 7490 cubic feet per minute (212 m³/s).
 - 6. Maximum Pressure Drop (Intake): 0.15 inches w.g. (0.035 kPa).
 - 7. Water Penetration: Maximum of 0.01 ounces per square foot (3.1 g/m²) of free area at an air flow of 873 feet per minute (4.4 m/s) free area velocity when tested for 15 minutes.
- D. Design Windload: Per Code.
- E. Louvers shall be factory engineered to withstand the specified seismic loads.
 - 1. Minimum design loads shall be calculated to comply with ASCE – 7, or local requirements of Authority Having Jurisdiction (AHJ).

2.3 ACCESSORIES

- A. Blank-Off Panels: 0.040 (1 mm) aluminum sheet, factory installed with removable fasteners and neoprene gaskets.
- B. Hinged Frame: Continuous piano hinge attached to angle subframe.

- C. Aluminum Filter Racks: Formed channel racks to accept standard thick filters. Unused bottom portion blanked off with 0.040 inch (1 mm) aluminum sheet.
 - 1. Filter: 2 inch (51 mm) thick.
- D. Extended Sills:
 - 1. Extruded aluminum, Alloy 6063-T6. Minimum nominal thickness 0.060 inch (1.5 mm).

2.4 FINISHES

- A. Anodized Finish:
 - 1. Class 1 Color Anodized.
 - a. Comply with Aluminum Association AA-C21A44.
 - b. Apply finish following chemical etching and pretreatment.
 - c. Minimum Thickness: 0.7 mils (0.018 mm), 60 minute anodizing process.
 - d. Class 1 Color Anodized: Dark Bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Inspect areas to receive louvers. Notify the Architect of conditions that would adversely affect the installation or subsequent utilization of the louvers. Do not proceed with installation until unsatisfactory conditions are corrected.
- B. If opening preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean opening 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. Install louvers at locations indicated on the drawings and in accordance with manufacturer's instructions.
- B. Install louvers plumb, level, in plane of wall, and in alignment with adjacent work.
- C. The supporting structure shall be designed to accommodate the point loads transferred by the louvers when subject to the design wind loads.
- D. Install joint sealants as specified in Section 07 90 05.

3.4 CLEANING

- A. Clean louver surfaces in accordance with manufacturer's instructions.
- B. Touch-up, repair or replace damaged products before Substantial Completion.
 - 1.

END OF SECTION 08 91 00

SECTION 09 01 60.91

WOOD GYM FLOORING RESTORATION

CONDITIONS OF THE CONTRACT, SUPPLEMENTARY CONDITIONS AND DIVISION 1 APPLY TO THIS SECTION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Refer to Section AB - Instructions to Proposers and Section AF – Subcontractor and Manufacturer Prequalification for substitutions.
- B. Scope of Work:
 - 01 Restripe gymnasium floor.
 - 02 Refinish wood flooring.
 - 03 Provide court graphics / striping as indicated on the drawings. 04 Specialty floor graphics to be provided by allowance.

1.2 SUBMITTALS

- A. Review and comply with all provisions of section 01 33 00 – Submittal Procedures. 01 Failure to follow required provisions may result in submittal being rejected without review.
- B. Product Data: Submit manufacturer’s literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.
 - 01 Product data shall include test certificates / reports, other certifications and applicable documentation to demonstrate compliance and as required by the specification.
- C. Samples: Submit full range of colors, patterns, textures and finishes available for selection, including the following:
 - 01 Color Chips: Provide complete duplicate sets of color chips for color selection.
 - 02 Small Applied Samples: Provide pieces of actual material on which paint will occur with minimum dry mil thickness of specified paint.
 - 03 Sheen Samples: Provide full range of varying sheens when sheens are controllable by intermixing.
- D. Installation Instructions: Submit manufacturer’s complete installation instructions, including preparation, for all products and / or assemblies proposed to be furnished.
- E. Maintenance Instructions: Submit manufacturer’s complete maintenance instructions and recommendations for all products and / or assemblies proposed to be furnished.
 - 01 Include recommended cleaning products and instructions for use.
 - 02 Where applicable, provide recommended maintenance schedules and procedures.
 - 03 Provide paint cards indicating the following, upon submission of extra materials at the end of the project:
 - a. Project and area
 - b. Manufacturer’s stock number and date of manufacturer

- c. Contents by volume, formula for pigment and vehicle constituents
 - d. Color name and number.
- F. Mockup:
- 01 Notify CFISD Project Manager once work is scheduled to begin.
 - 02 CFISD representative to be given the opportunity to review the striping layout prior to painting.

1.3 WARRANTY

- A. Warrant the work specified for one year against becoming unserviceable or causing an objectionable appearance, resulting from either defective or nonconforming materials and workmanship. Defects shall include, but not be limited to, the following:
- 01 Noticeable discoloration, streaking, blooming, darkening, or fading.
 - 02 Mildewing.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Finish: Buckeye International, inc. 314-291-1900, www.buckeyeinternational.com
- 01 Cleaning Solvent: Buckeye International "Coliseum" waterless cleaner
 - 02 Wood Floor Sealer: Buckeye International "Coliseum" 450 Low VOC Oil Modified Urethane
 - 03 Wood Floor Paint: Gym Marking Paint as recommended by Buckeye Int'l
 - 04 Wood Floor Finish Coat: Buckeye International "Coliseum" 450 Low VOC Oil Modified Urethane
- B. Vented Base:
- 01 Size: 4" x 3" heavy-duty molded, vented rubber cove base. 02 Provide pre-molded corners.
 - 03 Color as selected by Architect.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine flooring carefully.
- B. Remove existing finish by sanding.
- 01 Protect volleyball sleeve covers.
 - 02 Take care not to sand across volleyball sleeve covers. 03 Remove existing base as required to complete work.
- C. Prior to the commencement of flooring work, test bleacher roller function and notify CFISD Project Manager of any issues.

3.2 FINISHING

- A. Sanding:
- 01 Sand until flooring members are in a condition that no sanding marks show through the finish.

- 02 Protect against moisture and dirt accumulation during the finishing process.
- B. Gym Stripping: Apply stripping in accordance with approved shop drawings.
- C. Finish:
 - 01 Apply finish as recommended by manufacturer.
- D. Base:
 - 01 Install new vented cove base anchored to walls with base cement or mechanical fastener. Use pre-molded outside corners and neatly mitered inside corner.

3.3 CLEANING

- A. Test bleacher roller function with CFISD representative present to confirm bleachers are in working order.
- B. Deep clean all surfaces withing gym after refinishing wood floors, including bar joists at roof deck.

END OF SECTION

SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Metal stud wall framing.
- C. Metal channel ceiling framing.
- D. Acoustic insulation.
- E. Gypsum sheathing.
- F. Cementitious backing board.
- G. Gypsum wallboard.
- H. Joint treatment and accessories.
- I. Textured finish system.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 07 25 00 - Weather Barriers: Water-resistive barrier over sheathing.
- C. Section 09 30 00 - Tiling (Tile): Tile backing board.

1.03 REFERENCE STANDARDS

- A. ANSI A108.11 - American National Standard for Interior Installation of Cementitious Backer Units; 2013.1.
- B. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2012.
- C. AISI S220 – North American Standard Standard for Cold-Formed Steel Framing-Non Structural members latest edition.
- D. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011.
- E. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2013.
- F. ASTM C920- Standard Specification for Elastomeric Joint Sealants.
- G. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.
- H. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2013.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittals, for submittal procedures.
- B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.
- C. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.
- D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- E. Test Reports: For all stud framing products that do not comply with AISI S220 or C754, provide independent laboratory reports showing maximum stud heights at required spacing and deflections.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing gypsum board application and finishing, with minimum 5 years of documented experience.

1.06 WARRANTY

- A. Exterior sheathing weather warranty covering in-place exposure damage to exterior sheathing for twelve months. Exterior sheathing warranty against manufacturing defects for five years. Abuse Resistant Panel weathering warranty covering in-place exposure damage to sheathing for six months. Abuse Resistant Panel warranty against manufacturing defects for three years. Glass-mat sheathing weathering warranty covering in-place exposure damage to sheathing for three months. Glass-mat sheathing warranty against manufacturing defects for three years. Tile backer board warranty against manufacturing defects for 20 years.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

- A. Exterior Sheathing, meeting ASTM C1177, shall be 5/8 inch thick water resistant treated gypsum core with front and back glass mats faced or embedded in core, contain a weather resistant surface, zero flame spread, and zero smoke. Use as exterior sheathing in metal stud framed construction behind face brick in cavity wall construction and behind plaster.
- B. Gypsum Wallboard shall be 5/8 inch thick, tapered-edged, and conform to ASTM C1396, Type X. Sizes shall be 4 feet-0inches wide by longest practical length to minimize joints. Moisture resistant gypsum is also 5/8 inch thick with moisture resistance, is green faced, with tapered-edged. Sizes shall be 4 feet 0 inches wide by longest practical length to minimize joints. Provide fire rated core where required to maintain fire rating of adjacent assembly.
- C. Abuse Resistant Gypsum panel (Moderate Duty) is 5/8 inch thick, Type X, with a tapered edge.
- D. Impact Resistant gypsum panel (Heavy Duty) is 5/8 inch thick, Type X, with a tapered edge. Use in all common spaces including stud framed stair enclosures and the cafeteria. Use up to 8'-0" at all gypsum school corridors.
- E. Gypsum shaft liner is made up of a gypsum core for added fire resistance and multi-layered green paper facings that are treated to resist moisture penetration.
- F. Cement Tile Backer Board, used in wet/humid areas, is 1/2 inch thick and is used as sheathing at shower areas and restrooms, or as scheduled on walls to receive ceramic tile. Use greatest width by longest practical length to minimize joints. Use joint reinforcement and fasteners in accordance with manufacturer's instructions. For fiber and cement backer boards, provide waterproof membrane behind backer board per TCA W/244. Coated glass-mat water-resistant gypsum board does not require waterproofing membrane per TCA W/245.
- G. Moisture Resistant Tile Backer Board (Dry Areas) shall be 1/2 inch thick.
- H. Joint Compound is typically by gypsum manufacturer for intended use. Fire rated type must be used on fireproof systems. Perlite and other additives are not permitted.
- I. Laminating Adhesives should be recommended by manufacturer of product to be laminated.
- J. Use single-component non-shrinking, non-hardening synthetic rubber for the acoustical sealing of gypsum board partitions. STC rating in accordance to manufacturer's instructions.
- K. 9 gauge galvanized hanger wire and 16 gauge tie wire.
- L. Screws shall be 1 inch and 1-5/8 inch long self-drilling, self-tapping cadmium plated bugle head type.
- M. Resilient Clips should be used in accordance with wallboard manufacturer's recommendations.
- N. Control joints shall be metal with 1/4 inch open joint and perforated flanges for floating in place.
- O. Wall fixture reinforcement should be 6 inches from 14 gauge cold formed steel galvanized channels.
- P. Glass fiber Mesh Tape shall be a minimum 2 inches wide self-adhering glass fiber type with 10x10 threads per inch.
- Q. Silicone Joint Sealant, meeting ASTM C920, Type S, grade NS, shall be compatible with exterior sheathing tape and sheathing, instructed by tape and sheathing manufacturers for use with glass-fiber mesh sheathing tape and for covering exposed fasteners.
- R. Waterproof membrane under cementitious / fiber tile backer board shall be minimum 15-pound building felt or 4-mil polyethylene film.

- S. Provide waterstop at all wet area walls such as mechanical, janitor, restrooms, custodial where a concrete curb is not possible. Manufacturer: Henry Synko-Flex.

2.02 METAL FRAMING MATERIALS

- A. Studs meeting AISI S220 shall be C-channel, roll formed from hot-dipped galvanized steel with corrosion resistant coating. Channel type screw studs shall be roll formed with gauge as galvanized steel, unless noted otherwise, 20 gauge (I/360) galvanized steel at walls to receive tile. The section modulus for studs shall be $S=0.135$ for 3-5/8 inch studs, and $S=0.082$ for 2 1/2 inch studs.
- B. Tracks, meeting requirements of AISI S220 shall also be C-channel, roll-formed from hot dipped galvanized steel.
 - 1. Use deflection track at non-rated walls extending to structure to allow for 3/4 inch movement in either direction. Do not fasten studs directly to Deflection Track.
 - 2. Contractor shall use a deflection track and firestop system at head of fire rated partitions. System shall use "Shadowline" deflection track, mineral fiber, sealant clips and accessories required to achieve fire ratings shown or required. System shall comply with deflection track and Firestop System.
 - 3. Channel Bridging and Bracing: U-Channel Assembly; Base metal thickness of 0.0538 inch (1.37 mm) and minimum 1/2 inch wide flanges.
 - 4. The galvanized sheet steel flat strip and backing plate for blocking and bracing in length and widths is subject to compliance with requirements.
- C. Channels shall be gauge designed by manufacturer in cold formed steel channels with hot dip galvanized finish. Use for suspended ceilings.
- D. Galvanized sheet metal furring channels are 2-3/4 inches wide by 7/8 inch deep
- E. Corner beads are made from 28 gauge galvanized steel with 1-1/4 inch legs and should be used at all exterior corners.
- F. Shaft Wall Studs and Accessories: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.02 GENERAL

- A. Install sheathing without openings, gaps, cracks or holes.
- B. Attach sheathing to metal framing with gold side out and with screws spaced 8 inches on center at perimeter where there are framing supports and 8 inches on center along intermediate framing in field.
- C. Drive fasteners to bear tight against and flush with surface of sheathing. Do not countersink.
- D. Locate fasteners minimum 3/8 inch from edges and ends of sheathing panels.

3.03 INTERIOR METAL FRAMING INSTALLATION

- A. Attach floor track to floor at 24 inches maximum centers with shoot-in pins or concrete nails.
- B. Fasten ceiling track at 24 inch intervals, staggered. Where shown or required to extend above ceiling, brace to the structure at intervals not exceeding 4 feet -0 inches.
- C. Drywall suspension System: Use at gypsum drywall suspended ceilings, where required.
- D. Metal Studs should be single lengths position vertically straight and plumb in the runners, spaced 16 inches on center, unless noted otherwise.
- E. Anchor all studs located adjacent to door and window frames, partition intersections and corners to runner flanges by positive screw engagement through each stud flange and engaging the floor and ceiling runners.
 - 1. Use positive screw attachments with 3/8 inch or 1/2 inch Type "S" or S'12" pan head screws through each stud flange and runner flange.

- F. Provide solid bridging spanning between wall studs at all wall mounted fixtures, finish hardware, toilet partitions, accessories and equipment.

3.04 SHAFT WALL INSTALLATION

- A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
 - 1. Fasten runners to structure with short leg to finished side, using appropriate power-driven fasteners at not more than 24 inches (600 mm) on center.
 - 2. Install studs at spacing required to meet performance requirements.
- B. Shaft Wall Liner: Cut panels to accurate dimension and install sequentially between special friction studs.
 - 1. On walls over sixteen feet high, screw-attach studs to runners top and bottom.
 - 2. Seal perimeter of shaft wall and penetrations with acoustical sealant.

3.05 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.

3.06 BOARD INSTALLATION

- A. Double-Layer Non-Rated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board at exterior walls and at other locations as indicated. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.
- B. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- C. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.
- D. Apply all ceiling boards first, cut boards so that they slip easily into place, butt all joints loosely, and place tapered or wrapped edges next to one another.
- E. Select the maximum practical length to minimize end joints. All end joints shall be neatly fitted and staggered. Joints on opposite sides of partition shall be so arranged as to occur on different studs.
- F. Whenever possible, apply boards perpendicular to framing and in lengths that will span ceilings and walls without creating end (butt) joints. If butt joints do occur, stagger and locate them as far from the center of walls and ceilings as possible.
- G. Support all ends and edges of gypsum board on framing, except long edges at right angles to framing and where end joints are to be floated between frame members and back-blocked.
- H. Install metal corner bead at external corners. Where length of the corner does not exceed standard stock lengths, use a single length.
- I. Install gypsum board 1/2 inch above surface of slab to prevent wicking of moisture.
- J. Install metal trim where indicated or as required.
- K. To ensure level surfaces at joints, arrange board application so that the leading edge of each board is attached to the open or unsupported edge of a steel stud flange.
- L. The leading edge of gypsum board shall not be attached to the web edge of a flange.
- M. Fasten wallboard at 12 inches on center except at the edges / joints which shall be at 8 inches on center.
- N. Position edge-grip clips on the back of the panels and drive prongs into panel edges. Space clips 16 inches on center Screw-attach clip to framing, furring or wall surface.
- O. Apply at least two coats of joint compound over beads, screw heads and trim, and each coat shall be feathered out onto panel faces. Float out and sand joints to make joints invisible when painted with non-texture paint.
- P. Caulk around pipes, ducts, structure or similar items which penetrate drywall systems.

- Q. Provide acoustical sealant at walls in accordance with manufacturer's instructions.
- R. Control joints shall be located 30 feet 0 inches on center maximum and along building expansion joints. Locations shall be reviewed prior to placement.

3.07 CEMENT TILE BACKER BOARD INSTALLATION - WET AREAS

- A. Install tile backer on walls vertically or horizontally.
- B. Coated Glass Mat Backer Boards: Install tile backer directly on metal stud framing system in showers and other wet areas in accordance with manufacturer's recommendations and TCA, Methods W245 at walls and B420 for shower installations.
- C. Cementitious/ Fiber Backer Boards: Install tile backer on approved waterproof membrane in showers and other wet areas in accordance with manufacturer recommendations and TCA, Methods W244 at walls and B419 for shower installations.
- D. Substrate for tile: Apply clear silicone sealant to corners and board joints. Apply glass mesh joint tape over joints. Embed tape in setting material specified for tile finishes. Seal penetrations with setting material or silicone sealant.

3.08 MOISTURE RESISTANT TILE BACKER BOARD INSTALLATION- DRY AREAS

- A. Install Tile backer on walls vertically or horizontally.
- B. Install tile backer on walls in accordance with manufacturer and TCA, Method W245.
- C. Substrate for tile: Apply glass mesh joint tape over joints. Embed tape in setting material specified for tile finishes. Allow joints to dry prior to installing tile systems.

3.09 CEILING FRAMING INSTALLATION

- A. Main runners: 9-gauge hanger wires shall be spaced not over 4 feet 0 inches in the direction of 1-1/2 inch main runner channels and not over 4 feet-0inches in the direction of right angles to the main runners and within 6 inches of the ends of main runners and of boundary walls, girders or similar interruptions of ceiling continuity. Main runners shall be spaces not over 4 feet-0inches on center.
- B. Cross tees shall be spaced in accordance with manufacturer's recommendations or in conformance with UL Fire Resistance Directory.
- C. Furring Channels: Space 16 inches on center, and saddle-tie with two strands of 16 gauge tie wire to main runners or main support members. Do not let into or come in contact with abutting masonry walls. End splices shall be provided by nesting channels or studs no less than 8 inches and security wire-tie.
- D. Drywall Suspension System: Install in accordance with manufacturer's instructions.
- E. Provide control joints in ceiling at maximum 30 feet on center and, if possible, to coincide with expansion joints in the roof above.

3.10 CEILING BOARD INSTALLATION

- A. Apply gypsum board of maximum practical length with the long dimension at right angles to the furring channel and fastened with one inch drywall screws spaced 12 inches on center in the field of the board and along abutting ends.
- B. Align abutting end or edge joints over the web surface of the furring channel. Tie neatly and accurately with end joints staggered.
- C. Install gypsum board ceiling panels in drywall suspension system.

3.11 WORKMANSHIP TOLERANCES

- A. 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 on 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 abuts other material or when end is exposed.
- G. Float Control Joints flush with wall surface so that ceiling wall mold specific separately will align with wall surface flat and straight.
- H. 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 protected.

3.12 JOINT TREATMENT

- A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 - 1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
 - 2. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).
- C. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

END OF SECTION 09 21 16

SECTION 09 24 00
PORTLAND CEMENT PLASTERING

PART 1 – GENERAL

1.1 SUMMARY

- A. Portland cement plasterwork on **metal lath and unit masonry – plaster.**

1.2 SUBMITTALS

- A. Product data: submit product data for each plaster and accessory required, including specifications showing compliance with requirements.
- B. Samples: submit 2 samples, approximately 12-inch (300 mm) square, of each plaster finish and texture required, showing full range of variations to be expected.

1.3 PROJECT CONDITIONS

- A. Environmental requirements, general: comply with requirements of referenced plaster application standards and recommendations of plaster manufacturer for environmental conditions before, during, and after plaster application.

1.4 QUALITY ASSURANCE

- A. Installers Qualifications: Work is to be performed by installer having a minimum of three (3) years' experience for work relating to this Section. Submit installer qualifications.

1.5 WARRANTY

- .A. Upon completion, provide minimum five (5) year manufacturer's warranty.

PART 2- PRODUCTS

2.1 Metal lath:

- A. Expanded-metal lath: **self-furring diamond mesh** with hot-dip galvanized zinc coating.
- B. Vapor-permeable paper backing at exterior locations.

2.2 ACCESSORIES

- A. Foundation weep screed: hot-dip galvanized-steel sheet.
- B. Cornerite.
- C. External-corner reinforcement: metal lath with hot-dip galvanized zinc coating.
- D. Metal trim: bead **and joint** trim.
 - 1. Zinc-coated (galvanized) steel.

2. Fiber for base coat.
3. Bonding compound.
4. Colorants for job-mixed finish coats.
5. Plaster mixes:
 - a. Base-coat mixes for use over metal lath: for scratch and brown coats of three-coat plasterwork.
 - b. Base-coat mix for use over **concrete unit masonry**: for single base coat of two-coat plasterwork.
 - c. **Ready-mixed** finish-coat mix: for parex sand coarse (1.5) finish.

2.3 CEMENT PLASTER MATERIALS AND MIXES

- A. Provide three-coat cement plaster on metal lath, complying with ASTM c 1063 and ASTM c 926 and at the locations indicated on the drawings.
- B. Furring materials: cold rolled steel channels; 300-lb./1000 lf. For 3/4-inch size, 475-lb./1000 lf for 1-1/2-inch size; rust-inhibitive paint for interior locations except hot-dipped galvanized at exterior and "high humidity" areas.
- C. Hangers and hanger anchorages: provide galvanized steel wire hangers conforming to ASTM a 641, class 1, for suspended plaster work. Size hanger anchorage devices to develop full strength of hanger but not less than 3x calculated hanger load, except size direct pull-out concrete inserts for 5x calculated hanger load as determined by testing (ASTM e 488) conducted by a qualified independent testing agency.
- D. Metal lath: expanded steel; fs qq-l-101, 3.4-lb./yd., hot-dipped galvanized finish at exterior and "high humidity" areas. Provide self-furring type where indicated or required.
- E. Metal beads and accessories: solid zinc alloy at exterior and "high humidity" areas. Types include square edge casing beads and no. 40 expansion joints and no. 15 control joints by metalex (keene) or inryco/milcor, pittcon industries, inc. "softforms" extruded aluminum trim, and standard preformed interior corner reinforcement.
- F. Extruded aluminum trim: fry reglet corp., norcross, ga; mm systems corp, tucker, ga; or pittcon industries "softforms", riverdale, md. Provide shapes as indicated.
- G. Scratch coat mix: 1-part portland cement, 1- to 2-parts masonry cement, 2-1/2- to 4-parts sand (ASTM c 897).
- H. Brown coat mix: 1-part portland cement, 1- to 2-parts masonry cement, 3- to 5-parts sand (ASTM c 897).
- I. Base coat fibers: add dur-o-wal "dur-o-fiberglass" to above mixes as directed by manufacturer, but not to exceed 2-lb./cu. Ft. Of cementitious materials. Reduce sand quantity as required to maintain workability.
- J. Finish coat mix (interior): water-based, lightweight acrylic coating with integral color and texture and formulated with dpr chemistry as manufactured by dryvit "e finishes" in sandpebble fine texture. Color to be selected by architect from full line of colors. Coordinate with architect for location of mock-up sample.
- K. Finish coat (exterior): acrylic finish coat system, medallion series pmr, by dryvit or equal. Color and texture to be selected by architect. Contractor shall place three (3) 40"x40" color/texture samples on building for selection by architect. Coordinate with architect for location of samples.

2.4 SHEATHING BOARDS / GYPSUM PANELS

- A. 1/2" densglass gold exterior sheathing or approved equal for all exterior applications
 - 6. Size: densglass gold exterior sheathing: 1/2" (12.7mm) thick by 4' by 8', 9' or 10' (1.9 lb. Per square foot).
 - 7. Composition: gypsum sheathing manufactured in accordance with ASTM c 1177 with glass mats both sides and long edges, water-resistant treated core.
 - 8. Fire resistance: noncombustible when tested in accordance with ASTM e 136. 1/2" or 5/8" densglass gold exterior sheathing: flame spread 10, smoke developed 0, when tested in accordance with ASTM e 84.
 - 9. Refer to manufacturer for product application and limitations.

- B. Glass mat, moisture-resistant interior wall panel: coated glass mat-faced, moisture-resistant, treated core gypsum wallboard. Physical properties conforming to the applicable sections of ASTM c 1177 and ASTM c 630, densarmor plus interior panels as manufactured by g-p gypsum corp or approved equal.
 - 10. Panel size: provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
 - 11. Long edges:tapered

Part 3 - EXECUTION

3.1 SHEATHING/ GYP BOARD FURRING

- A. Provide densglass gold exterior sheathing where indicated on drawings. Install sheathing in accordance with manufacturer's instructions and applicable instructions in ga-253 and ASTM c 1280.
- B. Install densglass gold exterior sheathing with gold side out.
- C. Use maximum lengths possible to minimize number of joints.
- D. Attach densglass gold exterior sheathing to metal framing with screws spaced 8" o.c. At perimeter where there are framing supports; and 8" o.c. Along intermediate framing in field. A greater number of fasteners may be specified to obtain specific values and is allowed up to 4" o.c. Spacing.
- E. Drive fasteners to bear tight against and flush with surface of sheathing. Do not countersink.
- F. Locate fasteners minimum 3/8" from edges and ends of sheathing panels, tight against and flush with surface of sheathing.
- G. Weather resistant barrier: if a weather barrier is required by the local building code, design professional, owner or cladding manufacturer over densglass gold exterior sheathing, one of the following procedures may be used. Consult building code or design authority for proper application selection. Follow manufacturer's installation recommendations.
 - 1. Entire exterior face of gypsum sheathing covered with an asphalt impregnated felt or synthetic fiber wrap such as tyvek® commercial wrap, or equal.
 - 2. Liquid applied barriers such as sto guard® as manufactured by sto corp., dryvit's backstop® nt or equal.
 - 3. Self adhering membranes.
- H. Install densarmor plus according to manufacturer's instructions for use in interior applications.

3.2 LATH AND FURRING INSTALLATION, GENERAL

- C. Standards: comply with ml/sfa 920, "guide specifications for metal lathing and furring," and ASTM c 1063.
- D. Install supplementary framing, blocking, and bracing at terminations in work and for support of fixtures, equipment services, heavy trim, grab bars, handrails, furnishings, and similar work to comply with details indicated or, if not otherwise indicated, to comply with applicable written instructions of lath and furring manufacturer.

At exterior soffits provide cross bracing and additional furring at hanger wires to resist a uniform wind uplift pressure of 31 psf.

- E. Isolation: where lathing and metal support system abut building structure horizontally and where partition or wall abuts overhead structure, isolate from structural movement to prevent transfer of loading from building structure.

Frame both sides of control joints independently and do not bridge joints with furring and lathing or accessories.

- F. Install additional framing, furring, runners, lath, and beads, as required to form openings and frames for other work as indicated. Coordinate support system for proper support of framed work that is not indicated to be supported independently of metal furring and lathing system.

3.3 NON-LOAD-BEARING FRAMING INSTALLATION

- A. Ceiling suspension systems:
 - 1. Preparation and coordination: coordinate installation of ceiling suspension system with installation of overhead structural systems to ensure inserts and other structural anchorage provisions have been installed to receive ceiling hangers in a manner that will develop their full strength and at spacings required to support ceiling.
 - 2. Hanger installation: comply with ml/sfa 920, "guide specifications for metal lathing and furring," and with referenced standards.
 - A. Do not attach hangers to metal deck tabs.
 - 3. Install ceiling suspension system components of sizes and spacings indicated, but not in smaller sizes or greater spacings than those required by referenced lathing and furring installation standards.

3.4 LATHING

- B. Install where plaster base coats are required. Provide appropriate type, configuration, and weight of metal lath selected from materials indicated that comply with referenced ml/sfa specifications and ASTM lathing installation standards.

1. Suspended and furred ceilings: use flat diamond-mesh lath.
2. Vertical metal framing and furring: use flat, diamond-mesh lath and cold-rolled channel stud framing.
3. Ceramic-tile setting beds: use flat, diamond-mesh lath.
4. Monolithic surfaces: use self-furring, diamond-mesh lath or vertical metal framing and furring as required for plaster thickness.

3.5 PREPARATIONS FOR PLASTERING

- A. Protect contiguous work from damage and deterioration caused by plastering with temporary covering and other provisions necessary.
- B. Clean plaster bases and substrates for direct application of plaster, removing loose material and substances that may impair the work.
- C. Etch concrete and concrete unit masonry surfaces indicated for direct plaster application. Scrub with acid-etching solution on previously wetted surface and rinse thoroughly with clean water. Repeat application, if necessary, to obtain adequate suction and mechanical bond of plaster (where dash coat, bonding agent, or additive is not used).
- D. Apply bonding agent on concrete and concrete unit masonry surfaces indicated for direct plaster application.
- E. Apply dash coat on concrete surfaces indicated for direct plaster application. Moist-cure dash coat for at least 24 hours after application and before plastering.
- F. Install temporary grounds and screeds to ensure accurate rodding of plaster to true surfaces; coordinate with scratch-coat work.
- G. Refer to section 07 62 00 – Roofing Related Sheet Metal Flashing and Trim for furnishing and installing prefinished metal flashings.
- H. Surface conditioning: immediately before plastering, dampen concrete and concrete unit masonry substrates, except where a bonding agent has been applied, to produce optimum suction for plastering.
- I. Exterior finish system: plaster shall be finished smooth and allowed to cure a minimum of 28 days prior to application of finish. Rough surfaces shall be skimmed with dryvit genesis or genesis dm mixture to provide a smooth, flat and level base.

3.6 PLASTERING ACCESSORIES INSTALLATION

- A. General: comply with referenced lathing and furring installation standards for provision and location of plaster accessories. Miter or cope accessories at corners; install with tight joints and in alignment. Attach accessories securely to plaster bases to hold accessories in place and in alignment during plastering.
 1. External corners: install corner reinforcement at external corners bend lath around external angles without using corner beads or reinforcement.
 2. Terminations of plaster: install casing beads, unless otherwise indicated.
 3. Control joints: install at locations indicated or, if not indicated, at locations complying with the following criteria and approved by the city:

- A. Where an expansion or contraction joint occurs in surface of construction directly behind plaster membrane.
- B. Distance between control joints: not to exceed 18-feet (5.4-m) in either direction or a length-to-width ratio of 2-1/2 to 1.
- C. Wall areas: not more than 144-sq. Ft. (13-sq. M).
- D. Horizontal surfaces: not more than 100-sq. Ft. (9-sq. M) in area.
- E. Where plaster panel sizes or dimensions change, extend joints full width or height of plaster membrane.

3.7 PLASTER APPLICATION

- A. Portland cement plaster application: apply portland cement plaster materials, composition, mixes, and required finishes to comply with ASTM c 926. Moisture cure plaster base and finish coats to comply with ASTM c 926, including written instruction for time between coats and curing in "annex a2 design considerations".
- B. FINISH COATS:
 - 1. Float finish: apply finish coat to a minimum thickness of 1/8-inch (3-mm) to completely cover base coat, uniformly floated to a true even plane with fine-textured finish matching sample.
 - 2. Moist-cure plaster base and finish coats to comply with ASTM c 926, including written instructions for time between coats and curing in "annex a2 design considerations."

3.8 CUTTING, PATCHING, AND CLEANING

- A. 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.
- B. Remove temporary covering and other provisions made to minimize spattering of plaster on other work. Promptly remove plaster from door frames, windows, and other surfaces not to be plastered. Repair surfaces stained, marred or otherwise damaged during plastering work.

END OF SECTION 09 24 00

SECTION 09 30 00

TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tile for floor applications
- C. Stone thresholds.
- D. Ceramic accessories.
- E. Ceramic trim.
- F. Non-ceramic trim.

1.02 RELATED REQUIREMENTS

- A. Section 07 90 05 - Joint Sealers.

1.03 REFERENCE STANDARDS

- A. ANSI A108 Series/A118 Series/A136.1 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2013.1.
- B. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2013.1.
- C. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2013.1.
- D. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2013.1.
- E. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-set Ceramic Tile and Dimension Stone Installation; 2013.1.
- F. ANSI A118.13 - American National Standard Specifications for Bonded Sound Reduction Membranes for Thin-Set Ceramic Tile Installation; 2013.1.
- G. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2012.
- H. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2013.1.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
- D. Samples: Mount tile and apply grout on two plywood panels, minimum 18 x 18 inches (450 x 450 mm) in size illustrating pattern, color variations, and grout joint size variations.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Maintenance Data: Include recommended cleaning methods, cleaning materials, stain removal methods, and polishes and waxes.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum 5 years of documented experience.
- B. Installer Qualifications: Company specializing in performing tile installation, with minimum of 5 years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature of 50 degrees F (10 degrees C) during installation of mortar materials.

PART 2 PRODUCTS

2.01 TILE

- A. Manufacturers: All products of each type by the same manufacturer.
 - 1. Basis of Design: Crossville - Refer to Finish Schedule and drawings for all tile specified.
 - 2. American Olean: www.americanolean.com.
 - 3. Summitville Tiles, Inc: www.summitville.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Porcelain Tile:
 - 1. 5/16/ inch thick through-body porcelain tile with cushioned edge and manufacturer's standard slip resistant finish to meet coefficient of friction code requirements.
 - a. Color: As indicated on drawings or from full range of colors
 - b. Finish: Unpolished and polished finish as directed.
 - c. Locations: Each type as shown on finish schedule and drawings.
 - d. Base: Porcelain tile base to match porcelain tile.
 - 2. Mortar Adhesive:
 - a. LATICRETE 254 Platinum Thin set mortar as manufactured by Laticrete international
 - b. FlexBond Premium Flexible Bonding Mortar as manufactured by Custom Building Products
 - c. 1300 Universal Bonding Mortar as manufactured by Dal-Tile Corporation
 - d. Ultraflex 3 as manufactured by Mapei Industries.
 - e. No substitutions.
 - 3. Epoxy Grout (used at all interior tile installations): use 100 percent solids epoxy grout in accordance with ANSI A118.3. No substitutions. Color shall be selected by Architect from manufacturer's full range of available colors.
 - 4. Crack Isolation Membrane:
 - a. Sheet Membrane used to eliminate transmission of substrate cracks.
 - b. Liquid membrane with fiberglass mesh in accordance with ANSI A118.12.
 - 5. Expansion Joint:
 - a. Filler: Flexible and compressible closed-cell type, rounded at surface to contact sealant as instructed by sealant manufacturer to suit intended use.
 - b. 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.
 - c. 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.
 - 6. Latex Floor Leveling Material: ARDEX C-15 Self-Leveling Underlayment Concrete manufactured by ARDEX Engineered Cements, No substitutions.
 - 7. Edge Protection and Transition Strips:
 - a. Porcelain Tile to Gyp Bd: Schluter- QUADec transition strips in aluminum finish at all porcelain tile wainscot to gyp board transition locations.
 - b. Porcelain Tile to Porcelain Tile: Schluter QUADec transition strips in aluminum finish at all porcelain tile wall outside corner locations.
 - c. Porcelain Tile to Carpet: Schluter SCHIENE transition strips in aluminum finish at porcelain tile to carpet transition locations.

- d. Porcelain Tile to Sealed Concrete: Schluter RENO-U edge protection in satin aluminum finish at porcelain tile to sealed concrete.
 - e. Stair nosing: Schluter TREP-S GS 10 S aluminum support with thermoplastic rubber insert.
 - f. Provide all corners and connectors as required for a complete and detailed finished installation.
8. EXTRA Tile: Deliver one unopened box of tile of each color and base from the same tile production run to the Owner at Substantial completion. Label each box with name of school and date installed.
- C. Quarry tile
1. Manufacturers: Basis of Design as listed in the drawings.
 - a. American Olean Tile Co. , Sure-Step
 - b. Dal-Tile Corp., Suretread
 - c. Metropolitan Ceramics, Metrotread
 - d. Summitville Tiles, Inc.
 2. Square edged quarry tile.
 3. Face Size: 6 by 6 inches (152 mm by 152 mm).
 4. Thickness: 1/2 inch (12.7 mm).
 5. Wearing Surface: Abrasive aggregate embedded in surface.
 6. Tile Color and Pattern: Selected by Architect; Anticipate moderate complexity patterns. Allow for angles and cutting of tiles.
 7. Epoxy Grout Color: Refer to Finish Schedule.
 8. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile.
 9. Base: Coved with surface bullnose top edge, face size 6 inches by 6 inches (152 mm by 152 mm).
 10. Tile Setting Epoxy and Epoxy Grout: ANSI A118.30. Use for quarry tile in kitchen, toilet rooms, and where indicated. 100 percent solids epoxy grout.
 - a. Manufacturers: Subject to compliance with requirements, provide one of the following:
 - 1) Polyblend Tile Grout; Custom Building Products.
 - 2) SpectraLOCK PRO Stainless Grout; Laticrete International, Inc.

2.02 TRIM AND ACCESSORIES

- A. Ceramic Trim: Matching bullnose, double bullnose, cove base, and cove ceramic shapes in sizes coordinated with field tile.
1. Applications: Use in the following locations:
 - a. Open Edges: Bullnose.
 - b. Inside Corners: Jointed.
 - c. Floor to Wall Joints: Cove base.
 2. Manufacturer: Same as for tile.
- B. Non-Ceramic Trim: Satin brass anodized extruded aluminum, style and dimensions to suit application, for setting using tile mortar or adhesive.
1. Applications: Use in the following locations:
 - a. Open edges of wall tile.
 - b. Open edges of floor tile.
 - c. Wall corners, outside and inside.
 - d. Transition between floor finishes of different heights.
 - e. Expansion and control joints, floor and wall.
 - f. Floor to wall joints.
 - g. Borders and other trim as indicated on drawings.
 2. Manufacturer:
 - a. Schluter-Systems: www.schluter.com.
 - b. Genesis APS International: www.genesis-aps.com.

- c. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Thresholds: Marble, color as selected by Architect from full range of colors, honed finish; 2 inches (50 mm) wide by full width of wall or frame opening; 1/2 inch (12 mm) thick; beveled one long edge with radiused corners on top side; without holes, cracks, or open seams.
 - 1. Applications: Provide at the following locations:
 - a. At doorways where tile terminates.
 - b. At open edges of floor tile where adjacent finish is a different height.

2.03 SETTING MATERIALS

- A. Epoxy Adhesive and Mortar Bond Coat: ANSI A118.3.
 - 1. Applications: Where indicated.
 - 2. Products:
 - a. Bostik Inc: www.bostik-us.com.
 - b. LATICRETE International, Inc; LATICRETE LATAPOXY 300 Adhesive: www.laticrete.com.
 - c. ProSpec, an Oldcastle brand; B-7000 Epoxy Mortar and Grout: www.prospec.com.

2.04 GROUTS

- A. Epoxy Grout: 100 percent solids in accordance with ANSI A118.3 chemical resistant and water-cleanable epoxy grout. No substitutions.
 - 1. Applications: All Ceramic Tile applications.
 - 2. Color(s): As selected by Architect from manufacturer's full line.
 - 3. Products:
 - a. Bostik Inc: www.bostik-us.com.
 - b. LATICRETE International, Inc; LATICRETE SpectraLOCK PRO Premium Grout: www.laticrete.com.
 - c. Merkrete, by Parex USA, Inc; Merkrete Pro Epoxy: www.merkrete.com.
 - d. ProSpec, an Oldcastle brand; B-7000 Epoxy Mortar and Grout: www.prospec.com.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Stain Resistant Grout Additive: Liquid admixture for sanded and unsanded cement-based grouts; mix with dry grout material in place of water.
 - 1. Applications: Where indicated.
 - 2. Products:
 - a. ProSpec, an Oldcastle brand; ProColor Stain Guard Grout Additive: www.prospec.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
 - 1. Applications: Between tile and plumbing fixtures.
 - 2. Color(s): As selected by Architect from manufacturer's full line.
 - 3. Products:
 - a. ARDEX Engineered Cements; ARDEX SX: www.ardexamericas.com.
 - b. LATICRETE International, Inc; LATICRETE Latasil: www.laticrete.com.
 - c. Merkrete, by Parex USA, Inc; Merkrete Colored Caulking: www.merkrete.com.
 - d. ProSpec, an Oldcastle brand; ProColor Advantage Caulk: www.prospec.com.
- D. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
 - 1. Composition: Water-based colorless silicone.
 - 2. Products:
 - a. Merkrete, by Parex USA, Inc; Merkrete Grout Sealer: www.merkrete.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.05 THIN-SET ACCESSORY MATERIALS

- A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not intended as waterproofing.
 - 1. Thickness: 20 mils (0.5 mm), maximum.

2. Crack Resistance: No failure at 1/16-inch (1.6 mm) gap, minimum.
3. Products:
 - a. LATICRETE International, Inc; LATICRETE Blue 92 Anti-Fracture Membrane: www.laticrete.com.
 - b. Merkrete, by Parex USA, Inc.; Merkrete Fracture Guard 5000: www.merkrete.com.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Waterproofing Membrane at Floors: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
 1. Type: Fluid-applied.
 2. Material: SBS rubber.
 3. Thickness: 25 mils (0.6 mm), minimum, dry film thickness.
 4. Products:
 - a. ARDEX Engineered Cements; ARDEX 8+9: www.ardexamericas.com.
 - b. AVM Industries, Inc; System 750 with polyester fabric reinforcing at edges, corners, joints, and cracks: www.avmindustries.com.
 - c. LATICRETE International, Inc; LATICRETE Hydro Ban: www.laticrete.com.
 - d. Merkrete, by Parex USA, Inc.; Merkrete Hydro Guard 2000: www.merkrete.com.
- C. Underlayment at Floors: Specifically designed for bonding to thin-set setting mortar; not primarily a waterproofing material and having the following characteristics:
 1. Sound Reduction: Comply with ANSI A118.13, bonded membrane.
 2. Crack Isolation: Comply with ANSI A118.12.
 3. Water Resistance: Comply with ANSI A118.10, bonded waterproofing.
 4. Uncoupling Function: Allow for separation between membrane and the mortar adhering tile to the membrane when subjected to excessive substrate movement.
 5. Suitable for installation over green concrete.
 6. Suitable for installation over wood-based substrates.
 7. Type: Fluid-applied.
 8. Do Not Use: Gypsum or cementitious based self-leveling underlayment.
- D. Expansion Joints:
 1. Expansion Joint Filler: Flexible and compressible, closed cell tape, rounded at surface to contact sealant as instructed by sealant manufacturer to suit intended use.
 2. 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 change sin materials, where floor tile abuts perimeter walls, curbs, columns, and pipes: and 24 feet to 36 feet elsewhere.
- E. Miscellaneous Metals:
 1. Cement based Floor Leveling Material: Self-leveling underlayment concrete Gypsum-based products are prohibited.
 2. Transition strips: Of type and size recommended to suite application. Color shall be as selected by Architect from manufacturer's standards colors.
- F. Extra Tile:
 1. Deliver one unopened box of each type and color of wall and floor tile to the Owner in accordance with Section 01 77 00 Closeout Procedures. Label with School Name and deliver to Maintenance shop. Label each box with name of school and date installed.

PART 3 EXECUTION

3.01 EXAMINATION, INSTALLATION, CLEANING AND PROTECTION

- A. 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.
- C. Installation:
1. Align joints (no staggering)
 2. 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.
 3. 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 substrates.
 4. Allow minimum of 24 hours after tile is set before grouting.
 5. Lay out tile so that the minimum size tile used is 1/2 size.
 6. Form internal angles square.
 7. Install expansion joints in accordance with manufacturer's recommendations.
- D. Installation Porcelain Tile:
1. Crack Isolation Membrane:
 - a. 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 crack. Install in accordance with TCA F125 and manufacturer's instructions.
 - b. Install joint sealant in joint of first tile on both sides of control joint and crack.
 - c. Install membrane with products or methods approved by membrane manufacturer when joining, sealing, fastening, or adhering sheet membranes.
 2. Install porcelain wall tile and porcelain pavers with aligned joints (no staggering), 1/8 inch to 3/16-inch joint width.
 3. 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.
 4. Do not use damaged porcelain tile, including those with broken or cracked edges.
 5. Lay out all work so that, where possible, no tiles less than have size occur.
 6. Install expansion joints in accordance with TCA publication EJ171. Install porcelain tile joints aligned with floor joints.
 7. Install grout in accordance with ANSI A108.10 and manufacturer's instructions.
 8. Install edge protection and transition strips in accordance with manufacturer's instructions.
 9. Damp cure grout in accordance with manufacturer's instructions. Clean all porcelain tile surfaces upon completion. Protect finish porcelain tile work from damage.
- E. Cleaning and Protection:
1. Clean work at completion of installation, remove excess grout from tile surfaces. Clean tile and grout surfaces prior to installation of plumbing fixtures.
 2. Wipe all tile with a clean damp cloth, and buff lightly, leaving tile surfaces clean and ready to use.
 3. Remove grout from adjacent finish surfaces.
 4. Protect finished installation until final acceptance.
 5. Do not permit traffic over finished floor surface.
- F. Repair:
1. Repair or replace damaged tile, including those with broken or cracked edges at no expense to the Owner.

END OF SECTION

SECTION 09 51 00
ACOUSTICAL CEILINGS

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

1.2 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 07 21 00 - Thermal Insulation: Acoustical insulation.
- C. Section 07 90 05 - Joint Sealers: Acoustical sealant.
- D. Section 26 51 13 - Interior Lighting: Light fixtures in ceiling system.

1.3 REFERENCE STANDARDS

- A. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2013a.
- B. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2008e1.
- C. CAL (CHPS LEM) - Low-Emitting Materials Product List; California Collaborative for High Performance Schools (CHPS); current edition at www.chps.net/.
- D. GEI (SCH) - GREENGUARD "Children and Schools" Certified Products; GREENGUARD Environmental Institute; current listings at www.greenguard.org.
- E. ANSI S12.60 "Acoustical Performance Criteria, Design Requirements and Guidelines for Schools".
- F. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate grid layout and related dimensioning.
- C. Product Data: Provide data on suspension system components.
- D. Samples: Submit two samples 12x12 inch (305x305 mm) in size illustrating material and finish of acoustical units.
- E. Manufacturer's Installation Instructions: Indicate special procedures.

- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.6 QUALITY ASSURANCE

- A. Fire-Resistive Assemblies: Complete assembly listed and classified by UL for the fire resistance indicated.
- B. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.7 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

1.8 WARRANTY

- A. Provide warranty for standard ceiling panels to be free from sagging, warping, shrinking, buckling or delaminating as a result of manufacturing defects for a period of one year from the date of Substantial Completion.
- B. Provide warranty for sag resistant ceiling panels to be free from sagging, warping, shrinking, buckling or delaminating as a result of manufacturer's defects for a period of ten (10) years from the date of Substantial Completion.
- C. Provide warranty for standard suspension system to be free from defects in material or factory workmanship and shall not incur 50 percent red rust for a period of ten (10) years from the date of Substantial Completion.
- D. Suspension System / Ceiling Panels: Provide a manufacturer's standard 15 year warranty for suspension system when used in combination with same manufacturer's sag resistant ceiling panels. Ceiling panels should be free from sagging, warping, shrinking, buckling, or delaminating as a result of manufacturing defects. Suspension systems shall not incur 50 percent red rust during the period of the warranty.

PART 2 – PRODUCTS

2.1 ACOUSTICAL UNITS

- A. Manufacturers:
 - 1. Basis of Design: Refer to Finish drawings and schedules.
 - 2. USG
 - 3. CertainTeed Corporation: www.certainteed.com.
 - 4. Armstrong.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Acoustical Units - General: ASTM E1264, Class A.
 - 1. Units for Installation in Fire-Rated Suspension System: Listed and classified for the fire-resistive assembly as part of suspension system.
- C. Acoustical Tiles:

1. Basis of Design: Refer to Finish Schedule & match existing adjacent
2. VOC Content: As specified in Section 01 61 16.
3. Size: 12 x 12 inches (300 x 300 mm).
4. Surface Color: White.
5. Suspension System: Exposed grid Type A.

2.2 SUSPENSION SYSTEM(S)

- A. Manufacturers:
 1. Same as for acoustical units.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.
- C. Exposed Steel Suspension System Formed steel, commercial quality cold rolled; heavy-duty.
 1. Basis of Design: USG 15/16"
 2. Profile: Tee; 15/16 inch (24 mm) wide face or match existing.
 3. Finish: White painted.
 4. Fire rated as required or to match existing.

2.3 ACCESSORIES

- A. Shadow molding shall be at all locations (whether detailed or not) where an acoustical lay-in ceiling abuts a gypsum board ceiling in the same plane, provide a "W" shaped reveal or "shadow" molding.
- B. Fire Resistance Rating to provide required ceiling assembly rating as scheduled. Located at fixtures being installed in new fire rated ceiling assemblies.
- C. Provide hold down clips throughout.
- D. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- E. Acoustical Insulation: Specified in Section 07 21 00.
- F. Gypsum Board: Fire rated type; 5/8 inch (15 mm) thick, ends and edges square, paper faced.
- G. Acoustical Sealant For Perimeter Moldings: Non-hardening, non-skinning, for use in conjunction with suspended ceiling system.
- H. Gasket For Perimeter Moldings: Closed cell rubber sponge tape.
- I. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.2 INSTALLATION

- A. Install acoustical ceiling systems to comply with manufacturer's instructions and CISCA "Ceiling Systems Handbook" and ASTM C636.

- B. Typically install system so that panels are centered in the space in both directions to limit small cut pieces to minimum of three inches on any side, or so that light fixtures are centered in areas.
- C. Suspend main beams from structure (but not bridging) above by means of 12 gauge galvanized wire, spaced at 4'-0" on center, both directions, wrapped tightly at least three full turns. Powder actuated devices in metal deck are not permitted for field cross tees to main beam with a positive interlock. Pop rivets will not be permitted for field splices.
- D. Align beams or tees with angle molding at corners.
- E. At perimeter areas, secure angle molding to vertical surfaces, ends of tees to rest on bottom flange molding. Attachment of cross tees to wall angles with pop rivets will not be permitted. Hanger wire at 45 degree approximately ten inches long may be used to tie the grid to the wall above the ceiling to prevent eventual disengagement of the two components.
- F. Refer to UL Assemblies Drawings for Fire Rating requirements of ceiling material at rated floor and roof assemblies.
- G. Install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating requirements.
- H. Install hold-down clips on panels within 20 ft (6 m) of an exterior door.
- I. Cutting Acoustical Units:
 - 1. Make field cut edges of same profile as factory edges.
- J. Where round obstructions occur, provide preformed closures to match perimeter molding.

END OF SECTION 09 51 00

SECTION 09 52 00
ACOUSTICAL CEILING PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Acoustic room components including the following:
 - 1. Acoustical ceiling panels.

1.2 RELATED SECTIONS

- A. Section 09 51 00 – Acoustical Ceiling.

1.3 REFERENCES

- A. American Society of Civil Engineers (ASCE):
 - 1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.
- B. ASTM International (ASTM):
 - 1. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - 2. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 3. ASTM E 413 - Classification for Rating Sound Transmission.
 - 4. ASTM E795 - Practices for Mounting Test Specimens during Sound Absorption Tests.
- C. Underwriter's Laboratory (UL):
 - 1. UL 723 - Test for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Maintenance instructions and recommendations.
- B. Shop Drawings:
 - 1. Submit component and project specific installation drawings, cut sheets, and schedules showing all information necessary to fully explain the design features, appearance, function, fabrication, installation, and use of system components in all phases of operation. Submit for approval before beginning any fabrication, installation, or erection.
 - 2. Include fabrication and installation details. Distinguish between factory and field work.
 - 3. Include plans, elevations, sections, attachments and work by other trades.
- C. Verification Samples:
 - 1. Exposed Finishes and Finish Materials: Not less than 4 by 4 inches (102 by 102 mm), for each type, color, pattern, surface and material selected.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain all products from a single manufacturer through one source providing a comprehensive material and installation package:
- B. Manufacturer Qualifications: Minimum 5 years' experience in design and manufacturing of similar products on projects of similar size, scope and complexity, and with the production capacity to meet the construction and installation schedule.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original unopened containers with manufacturer's labels attached. Do not deliver material until spaces to receive them are clean, dry, and ready for their installation. Ship to jobsite only after roughing-in, painting and other finishing work has been completed, installation areas are ready to accept work.
- B. Handle and install materials to avoid damage.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install materials until spaces are enclosed and weather tight, wet work in spaces is complete and dry, HVAC system is operating and maintaining ambient temperature at occupancy levels during the remainder of the construction period.
- B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.8 WARRANTY

- A. Special Warranty for Acoustic Room Components: Manufacturer's written warranty indicating manufacturer's intent to repair or replace panels that fail in materials or workmanship. Failures are defined to include, but are not limited to, the following:
 - 1. Fracturing or breaking of unit components which results from normal wear and tear and normal use other than vandalism.
 - 2. Warping of components not resulting from leaks, flooding, or other uncontrolled moisture or humidity.
 - 3. Failure of unit to perform acoustically in accordance with manufacturer's published data.
 - 4. Sound-Absorbing and Sound-Diffusing Panels Warranty Period: 5 years.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Requests for substitutions shall be considered in accordance with provisions of Section 01 60 00 - Product Requirements.
 - 1. Manufacturers seeking approval shall submit the following:
 - a. Product data, including third-party certified acoustical data and proposed graphic/drawing layout for this project.
 - b. Project references: Minimum of 5 installations not less than 3 years old, of comparable size, scope and complexity of this project, complete with owner contact information.
 - c. Sample warranty.
 - 2. Submit substitution request not less than required days prior to bid date.
 - 3. Approval shall be indicated by issuance of written Addendum.
 - 4. Approved manufacturers shall meet separate requirements of Submittals Article.
 - 5. Manufacturers' products that are either listed as pre-approved in these Specifications or who have been granted approval as an alternate must still demonstrate all of the material performance and operational characteristics required by this Section.

2.2 TRADITIONAL ACOUSTIC PANEL SERIES

- A. Basis of Design: Provide a system of acoustical panels, as manufactured by Wenger Corporation, that absorb or diffuse sound in a configuration designed to reduce excess sound energy levels and improve sound distribution throughout the space.
- B. Performance Requirements: Provide sound absorbing and sound-diffusing panels meeting requirements with the following characteristics:
 - 1. Ceiling Diffuser Panel Mounting Types for Acoustical Performance Characteristics according

- to ASTM E 795, with measurements determined according to ASTM C 423:
- a. No air space.
- C. Pyramidal Ceiling Diffuser Panels: Acoustically-configured, offset pyramidal molded thermoplastic impact-resistant panel 0.125 inch (3 mm) thick, length and width indicated.
1. Basis of Design Product: Wenger Pyramidal Ceiling Diffuser.
 2. Finish: Manufacturer's standard textured white.
 3. Ceiling Panel Mounting Method:
 - a. Lay-in ceiling grid clip. All lay-in ceiling panels include safety cable attachment to permanent ceiling grid in all four corners of panel.
 4. Acoustical Performance, Sound Absorption Coefficients, One-third Octave Band Center Frequency, Hz, for 48 by 48 inches (1219 by 1219 mm) unit, Mounting Type A.
 - a. 125Hz = 0.27.
 - b. 250Hz = 0.18.
 - c. 500Hz = 0.09.
 - d. 1000Hz = 0.06.
 - e. 2000Hz = 0.03.
 - f. 4000Hz = 0.00.
- D. Fabric Facing Material: 100 percent woven plain weave polyester 2-ply, with the following characteristics:
1. Light Fastness: AATCC 16, Option 3: 40 hours.
 2. Fastness to Crocking: AATCC 8: #4 Wet and Dry.
 3. Flammability: ASTM E 84, Class A or 1.
 4. Basis of design product: Guilford of Maine, FR-701.
- E. Airborne Noise Reduction: Provide acoustical panels in layout designed by computer simulation based on Fitzroy formulas to provide the following sound reduction: **TBD**
1. Band: _____ dB +/- 0.5dB.
 2. Orchestral: _____ dB +/- 0.5dB.
 3. Choral: _____ dB +/- 0.5dB.
- F. Reverberation Time: Provide acoustical panels in layout designed by computer simulation based on Fitzroy formulas to provide the following reverberation times and amount of variability available in each room:
1. Band: 0.6 +/- 0.2 seconds. Degree of change: _____ seconds.
 2. Orchestra: 0.8 > +/- 0.2 seconds. Degree of change: _____ seconds.
 3. Choir: 0.6 +/- 0.2 seconds. Degree of change: _____ seconds.
- G. Fire-rating: The fully assembled product, as installed, shall meet Class A fire protection. Test results for flame spread and smoke developed shall be provided upon request. Individual component level fire test data is not sufficient to meet Class A fire protection requirements and shall not be accepted.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine installation areas and mounting surfaces with Installer present, for compliance with manufacturer's installation tolerances including required clearances, floor level, location of blocking and anchoring reinforcements, and other existing conditions that may affect installation or performance.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Proceed with installation only after correction of unsatisfactory conditions.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION - GENERAL

- A. Install manufactured units in accordance with manufacturer's recommendations, approved submittals, and in proper relationship with adjacent construction.
- B. Clean exposed surfaces. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

3.4 INSTALLATION OF ACOUSTIC ROOM COMPONENTS

- A. Install housings utilizing manufacturer's supplied brackets and fasteners recommended for application. Adjust upper and lower limits individually after installation.

3.5 FIELD QUALITY CONTROL

- A. Inspect installed work to verify compliance with requirements.
 - 1. Verify that HVAC work and electrical work complies with manufacturer's submittals and written installation requirements.
 - 2. Perform installation and startup checks as recommended by manufacturer.
 - 3. Prepare inspection reports and submit to Architect.

3.6 DEMONSTRATION

- A. Train Owner's personnel to adjust, operate, and maintain equipment. Turn over keys, tools, and operation and maintenance instructions to Owner.

3.7 CLEANING AND PROTECTION

- A. Repair or replace defective work as directed by Architect upon inspection.
- B. Clean surfaces. Touch up marred finishes, or replace damaged components that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by manufacturer.
- C. Protect installed products from damage, abuse, dust, dirt, stain, or paint until completion of project. Do not permit use during construction.

END OF SECTION

SECTION 09 64 55
RESILIENT WOOD STAGE FLOOR ASSEMBLIES

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: Fabrication and installation of resilient stage subflooring and performance surface as indicated on the Drawings and specified herein.
- B. Related Work:
 - 1. Division 01 – General Requirements
 - 2. Section 03 30 00 – Cast-In-Place Concrete
 - 3. Section 08 71 00 – Door Hardware: Hardware for Thresholds at Door Openings

1.3 SYSTEM DESCRIPTION

- A. A damp-proof vapor barrier to prevent moisture intrusion.
- B. A semi-sprung subfloor consisting of resilient blocks/pads, insulation, wood sleepers, and 2 layers of T&G plywood.
- C. A sacrificial top layer with a matte black paint finish.

1.4 REFERENCES

- A. ANSI E1.26: Recommended Testing Methods and Values for Shock Absorption of Floors Used in Live Performance Venues
- B. ANSI E1.34: Measuring and Specifying the Slipperiness of Floors Used in Live Performance Venues
- C. ASTM D2103-10: Standard Specification for Polyethylene Film and Sheeting

1.5 SUBMITTALS

- A. Provide materials list of items proposed to be provided.
- B. Submit data sufficient to demonstrate compliance with specifications and drawing requirements, including technical data showing compliance with ANSI E1.26 values.
- C. Submit shop drawing with fully dimensioned details showing installation, and catalog cuts of items to be provided. Manufacturer or producer's standard drawings and technical information may be acceptable when complete enough to determine acceptability.
- D. Submit 18" x 18" mockup of floor assembly with proposed finish.
- E. Test Reports: Submit in duplicate to Architect using an approved independent testing agency, arranged and paid for by the Contractor.
 - 1. Moisture Control Testing: Undertake tests to determine moisture present in existing concrete slabs prior to starting work, obtaining written approval from approved product manufacturer, or his authorized representative, prior to installation of any work of this section. Do not install floors over concrete where the moisture is measured to be greater than 5%.
 - 2. Humidity Level Tests: Test storage and in-service use areas to ensure that the Relative Humidity levels conform to the manufacturer's latest printed recommendations, ranging between 35% to 50% maintaining a temperature range of 55° F. and 78° F. (12.8° C. and 25.6° C.).

1.6 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement:
 - 1. Installed surfaces and level changes shall be compliant with requirements of CBC Chapter 11B and ADAAG.

2. Heat, light and ventilation shall be provided and operating during installation, and until the completion of the project; maintaining a temperature range of 55 degrees to 78 degrees F. and a relative humidity range of 35 to 50 percent.
- B. Products and materials to be provided are to be from manufacturers and producers regularly engaged full-time in the manufacture or production of theatrical stage and dance floors, with a history of successful manufacture or production acceptable to the Owner.
- C. In addition to complying with pertinent codes and regulations, comply with industry and trade standards normally associated with this product or material, except where specified product or material is superior in quality to industry and trade standards.
- D. Qualifications of Installers: Installers shall be approved by the flooring products manufacturer and shall have at least five (5) years proven experience consistent with the Work of this section, as well as have passed the installation program of a certified wood flooring manufacturer.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver products and materials to the project, and store in a safe, dry place with shop-supplied protection and labeling intact and legible until set, applied, or installed.
- B. Materials shall not be delivered, stored or installed until all masonry, painting, plastering, tile work, marble and terrazzo work are completed. All overhead mechanical work, lighting, fire sprinklers, and rigging systems are installed. Room temperature of at least 55 to 80 degrees and relative humidity of 35 to 50 percent are to be maintained. Ideal installation/storage conditions are the same as those which will prevail when the building is occupied.
- C. Use reasonable means necessary to protect products and materials before, during, and after installation.
- D. In event of damage, regardless of responsibility and culpability, make repairs and replacements necessary to satisfaction of Owner, at no additional cost to Owner.
- E. **PROJECT/SITE CONDITIONS**
 1. Sequence:
 - a. Do not install floor system until concrete has been cured at least 60 days and the requirements in Paragraph 1.05.E are obtained. Concrete will be free of sealers, hardeners and curing agents.
 - b. Permanent heat, light and ventilation shall be installed and operating during and after installation. Maintaining a temperature range of 55 to 80 degrees and a relative humidity range of 35 to 50 percent.
 2. Concrete Slab Tolerances: Ensure receiving slabs are smooth and level to at least a tolerance of 1/8-inch: 10 ft. (3mm; 3m) radius, with not greater than 1/2- inch (12.7mm) deviation in level over entire length of floor area; ensure high areas are ground down and low areas are filled before proceeding with Work of this section.
 3. Concrete Slab Depressions: Ensure dimensions are correct as required to accept flooring systems prior to proceeding with Work of this section.

1.8 WARRANTY

- A. Provide Owner with a written warranty as a condition of work acceptance, signed by Contractor and installer (where applicable), agreeing to maintain, repair and/or replace products and materials for three (3) years following acceptance, without additional cost to Owner. Sacrificial layer(s) are to be warranted for one (1) year, against defects in installation and materials only.

1.9 REGULATORY REQUIREMENTS

- A. Flooring shall be stable, firm, and slip resistant. CBC Section 11B-302.1.

PART 2 - PRODUCTS

2.1 PERFORMANCE

- A. Flooring system is to exhibit uniformity in properties listed below. The tested value at any point on the floor shall be within 5% of the average value for any property.

- B. Shock Absorption: Flooring system should achieve a minimum KA of 40%, not to exceed 65%, per ANSI E1.26.
- C. Deformation: Standard deformation, StV, shall not exceed 5mm, per ANSI E1.26.
- D. Deformation Depression: W_{500} shall not exceed 20%, per ANSI E1.26.
- E. Rolling Load: Flooring system shall be rated for >1500N rolling load.
- F. Point Load: Flooring system shall be capable of handling the following loads. Adjust sleeper spacing and resilient pad size/thickness/durometer as required to meet criteria.
 - 1. Stage: 150 PSF

2.2 FLOORING SYSTEM

- A. Vapor Barrier: Minimum 6mil thickness, clear polyethylene film sheets; conforming to ASTM D2103-10; to full length of slab areas, maximum standard width to minimize jointing.
- B. Resilient Pads: Mason Industries Super W 4"x4"x3/4" Neoprene Pad or equivalent. Thickness, quantity and durometer to be selected to meet performance specifications of flooring system.
- C. Wood Sleepers: 2"x4" clear pine.
- D. Insulation: Un-faced fiberglass insulation with thickness equal to 25%-50% of height of void below subfloor (approximately 1"). Install in continuous fashion between rows of resilient pads.
- E. Wood Subfloor: Two layers of 3/4" void-free tongue and groove plywood.
- F. Performance Surface: 1/4" S2S Linseed Tempered Hardboard.
- G. Finish: Rosco ToughPrime satin black primer.
- H. Vented Base Moulding: Base moulding with venting. See Architectural drawings for color and material.

2.3 APPROVED MANUFACTURERS

- A. American Harlequin Corporation
1531 Glen Ave.
Moorestown, NJ 08057
800.642.6440
www.harlequinfloors.com
- B. Stagestep, Inc.
4701 Bath St. #46B
Philadelphia, PA 19137
800.523.0960
www.stagestep.com
- C. Hur Flooring Company
15204 Stagg St.
Van Nuys, CA 91405
888.434.8449
www.hurflooring.com
- D. O'Mara Sprung Floors
3116 Eugene St.
Burton, MI 48519
810.743.8281
www.sprungfloors.com
- E. Junckers Hardwood
270 Lafayette St. #1200
New York, NY 10012
800.878.9663
www.junckers.com

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine existing concrete slab for proper installation.
- B. Verify required slab depression for accepted flooring system prior to wood floor installation.

3.2 FLOORING INSTALLATION

- A. Acclimatization: Wood performance flooring materials to be placed in stage area for at least 72 hours prior to installation.
- B. Moisture Protection: Place moisture barrier over entire slab area to receive wood flooring, overlapping joints 6 inches (150mm) and extending up walls 2 inches (50mm). Seal edges using a compatible sealant, as recommended by manufacturer.
- C. Sub-Floor: Install plywood with the seams of each layer offset as indicated in detail drawings.
- D. Performance Surface:
 - 1. Tempered Hardboard:
 - a. Install panels with long dimension running stage left/right. Provide an upstage/downstage seam at center stage.
 - b. Paint both sides and edges of panels with a minimum of 2 coats of specified finish and allow to cure at least 24 hours prior to panel installation.
 - c. Attach sacrificial layer with screws. Countersink and predrill screw holes to ensure a flat surface after installation.
- E. Provide expansion space at walls and terminations of flooring. At sides leave 1/4- inch space for every running 10 feet in width. In length, leave 1/8-inch space for every running 10 feet in length.
- F. Division and Trimming Strips: Apply wood strips, matching color and finish of flooring, where changes of floor finishes occur; apply metal plates and/or thresholds to cover spaces at doorways and changes in floor finish.
- G. Install at perimeter-void, air-flow cove base, 3" x 4", with ventilating ports. Fasten screws through base into plastic anchors set in walls. Screw heads shall be countersunk and color shall match base. Carefully miter inside and outside corners. Base material to be selected by architect.

3.3 CLEANING

- A. After completion of this work, clean up and remove resultant debris from the site.

END OF SECTION

SECTION 09 65 00
RESILIENT FLOORING AND BASE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Resilient base.
- B. Installation accessories.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

1.03 REFERENCE STANDARDS

- A. ASTM E 648 – Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source or NFPA 253 – Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
- B. ASTM E 662 – Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials or NFPA 258 – Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
- C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
- D. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2004 (Reapproved 2010)e1.
- E. ASTM F1861 - Standard Specification for Resilient Wall Base; 2008 (Reapproved 2012).

1.04 SUBMITTALS

- A. See Section 01 33 00 – Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
- D. Concrete Testing Standard: Submit a copy of ASTM F710.
- E. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of sub-floor is acceptable.
- F. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Materials: Provide 4 percent or one unopened carton of each color (whichever is greater) of each color and pattern of tile, base, stair stringer skirting, stair treads/ risers material selected. One gallon container of each type of adhesive used for flooring, base, and stringer striking.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect roll materials from damage by storing on end.

1.06 FIELD CONDITIONS

- A. Maintain temperature in storage area between 55 degrees F (13 degrees C) and 90 degrees F (72 degrees C).
- B. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F (21 degrees C) to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F (13 degrees C).
- C. Areas to receive material should be clean, fully enclosed and weather tight. The permanent HVAC should be fully operational and controlled and set at a minimum temperature 65° F (18.3° C). If this is not possible, the areas should be acclimated and controlled by means of temporary HVAC to the service level conditions expected during occupancy. The temperature and humidity should range from 75° F ± 10°F (23.9° C ± 5.5° C) with a 50% ± 10% ambient relative humidity. These conditions **MUST** be established at least seven days prior to beginning the installation, maintained during the installation, and continued for at least seven days following the installation.
- D. The flooring material should be conditioned in the same manner for at least 48 hours prior to the installation.
- E. Substrate evaluation and preparation should not begin until a stable, conditioned environment has been established as described in this section.
- F. Areas to receive flooring must have adequate lighting to allow for proper inspection and preparation of the substrate, installation of the flooring and final inspection.

PART 2 PRODUCTS

2.01 RESILIENT FLOORING

- A. Basis of Design: As shown on the Finish Schedule and Plans
 - 1. Color: As selected by Architect from full range of colors
 - 2. Accessories: as required by manufacturer.
 - 3. Adhesive: EZ-on 100 for tile and Sustain 100 for sheet, or as required by manufacturer to provide a 100% RH adhesive. Contractor shall perform a PH test prior to installation and report findings to manufacturer and architect.

2.02 RESILIENT BASE

- A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove, and as follows:
 - 1. Height: 4 inch (100 mm).
 - 2. Thickness: 0.125 inch (3.2 mm) thick.
 - 3. Finish: Satin.
 - 4. Length: Roll.
 - 5. Color: Color as selected from manufacturer's standards.
 - 6. Accessories: Premolded external corners and end stops.
 - 7. Manufacturers:
 - a. Basis of Design: Refer to Drawings and Finish Schedule.
 - b. Burke Flooring: www.burkemercer.com.
 - c. Johnsonite, a Tarkett Company: www.johnsonite.com.
 - d. Roppe Corp: www.roppe.com.

- e. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ACCESSORIES

- A. Joining and edge finish moldings are used for flooring terminations with other flooring. The rubber moldings are tapered or bullnosed as required per the type of flooring and one inch wide by 1/8 inch thick.
- B. Flooring adhesives should be clear set and should be the same brand as flooring or as instructed by manufacturer.
- C. Base adhesive should be the same brand as base or as instructed by base manufacturer.
- D. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- E. Primers, Adhesives, and Seaming Materials: Waterproof; types recommended by flooring manufacturer.
- F. Moldings, Transition and Edge Strips: Same material as flooring.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Prepare concrete floors to receive flooring in accordance with ASTM F710.
- C. Verify substrates are smooth, level, at required finish elevation, and without more than 1/8 inch in 10 feet -0 inch variation from level or slopes shown on the drawings.
- D. Level substrate by grinding high spots or filling low spots with latex cementitious subfloor filler as required. Verify substrates are smooth, level, at required finish elevation, and are ready to receive resilient tile flooring and base.
- E. Conduct moisture test in accordance with ASTM F1869- maximum allowable amount of moisture emission from floor is 3.0 pounds per 1,000 square feet in 24 hour period, and shall not exceed maximum allowable moisture content as allowed by flooring manufacturer.
- F. Install materials only after finishing operations, including painting, have been completed and after permanent heating and cooling system is operating. Verify that moisture content of concrete slabs, building air temperature, and relative humidity are within the limits recommend by the manufacturer of the materials used.

3.02 INSTALLING BASE:

- A. Use factory-preformed exterior corners, and factory preformed or job-mitered interior corners.

3.03 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's instructions.

END OF SECTION

SECTION 09 65 19.11
LUXURY VINYL TILE FLOORING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Luxury vinyl flooring, adhesive attached with accessories in locations shown on drawings.
 2. Resilient base adhesive attached in locations shown on drawings.

1.02 REFERENCES

- A. ASTM International:
1. ASTM F 1861 Standard Specification for Resilient Wall Base
 2. ASTM F 1869 Standard Test Method for Measuring Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
 3. ASTM F 2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

1.03 SUBMITTALS

- A. Product Data:
1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 2. Manufacturer's installation instructions.
- B. Samples:
1. Actual samples or color charts showing manufacturer's full range of colors for Architect's selection.
 2. 3 – 7-inch wide by 18-inch tile in each color selected and 12 inch long pieces of base material in each color selected for approval.
- C. Certification: Manufacturer's affidavits that materials used in the Project contain no asbestos.
- D. Closeout Submittals: Submit the following:
1. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.
 2. Warranty: Warranty documents specified herein

1.04 QUALITY ASSURANCE

- A. Single-Source Responsibility: provide types of flooring and accessories supplied by one manufacturer, including leveling and patching compounds, and adhesives.
- B. Select an installer who is competent in the installation of resilient solid vinyl tile flooring.
- A. Comply with Division 1 Product Requirements Sections
- B. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

- C. Deliver materials in good condition to the jobsite in the manufacturer's original unopened containers that bear the name and brand of the manufacturer, project identification, and shipping and handling instructions.
- D. Store materials in a clean, dry, enclosed space off the ground, protected from harmful weather conditions and at temperature and humidity conditions recommended by the manufacturer. Protect adhesives from freezing. Store flooring, adhesives and accessories in the spaces where they will be installed for at least 48 hours before beginning installation.

1.05 PROJECT CONDITIONS

- A. Maintain a minimum temperature in the spaces to receive the flooring and accessories of 65°F (18°C) and a maximum temperature of [100°F (38°C)][85°F (29°C)] for at least 48 hours before, during, and for not less than 48 hours after installation. Thereafter, maintain a minimum temperature of 55°F (13°C) in areas where work is completed. Protect all materials from the direct flow of heat from hot-air registers, radiators, or other heating fixtures and appliances..

1.06 LIMITED WARRANTY

- A. Resilient Flooring: Submit a written warranty executed by the manufacturer, agreeing to repair or replace resilient flooring that fails within the warranty period.
- B. Warrant the materials specified herein for a non-prorated twenty (20) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship. Warranty shall include manufacturing defects, dimensional stability, fading & discoloration, delamination, and excess wear.

1.07 MAINTENANCE

- A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials from same production run as products installed. Packaged with protective covering for storage and identified with appropriate labels.
 - 1. Quantity:
 - a. One (1) unopened carton of each color and pattern of material selected.
 - b. One (1) unopened carton of each color, type, and size base selected.
 - c. One (1) gallon container of each type of adhesive used for flooring and base.
 - 2. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage and protection of extra material.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Manufacturers shown on the Finish plans are Basis of Design and no modifications shall be made by contractor during Bidding. Manufacturers listed, whose product meets or exceeds the specifications are approved for use on the Project only with prior approval of the Architect. Other manufacturers will only be considered if there is a product delivery or supply issue and 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.

2.02 MATERIALS – ALL MATERIALS MUST BE ASBESTOS FREE

- A. Luxury Vinyl Tile Plans (LVT):

1. Quality Standard: ASTM F1700
 2. Size: 3-7 inches by 48 inches by 0.1 inches. (As shown in drawings and/or selected by Architect.)
 3. Minimum of 20 mil wear layer; commercial grade.
 4. 20 year minimum product warranty.
 5. Patterns and Colors: Colors and finishes shall be selected by Architect from manufacturer's full range and as shown on the Drawings.
 6. Provide moderate complexity patterns as selected by Architect. Allow for angles and cutting of tiles.
 7. Tile Adhesive compliant with 95% RH or higher of the manufacturer's range. For Gleason ES, adhesive used shall be Aquaflex waterproof adhesive.
- B. Rubber Base:
1. Quality Standard: ASTM 1861
 2. Material: Rubber, vulcanized, Type TS, Group I, Styles A and B. Vinyl base and Type TP are not acceptable.
 3. Type: Topset cove, 48 inch lengths. No rolls permitted.
 4. Thickness: Full 0.125 (1/8) inch.
 5. Color: To be selected by Architect.
 6. Height: Four (4) inches, unless otherwise indicated.
 7. Approved Manufacturers: Roppe Corp., Burke Flooring, Flexco, Nora Rubber Products, or Architect approved equal or to manufacturer to match existing.
- C. Cement-based Floor Leveling Material: ARDEX K-15 Self-Leveling Underlayment Concrete manufactured by Ardex Engineered Cements, Aliquippa, PA; or CX Self-Leveling Underlayment manufactured by BASF Chemrex Inc; or equal. Gypsum-based products are prohibited. Level flush with adjacent floor finish.
- D. Joining and Edge Finish Moldings:
1. Usage: For use at flooring terminations with other flooring.
 2. Type: Tapered or bullnose edge, as required to provide juncture at edge of adjacent floor surfaces.
 3. Size: One (1) inch by 1/8 inch thick or as applicable to the type of flooring and condition.
 4. Material: Brush Aluminum or Stainless Steel metal transition edge.
 5. Color(s): As selected by Architect from manufacturer's full range.
 6. Approved Manufacturers: Schuler, or Architect approved equal.
- E. Other Materials:
1. Provide other materials, not specifically described but required for a complete and proper installation.
- F. Extra Tile:
1. Deliver one unopened box of each type and color of flooring to the Owner in accordance with Section 01 77 00 Closeout Procedures. Label with School Name and deliver to Maintenance shop.

PART 3 - EXECUTION

3.01 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.

3.02 PREPARATION

1. Prepare concrete floors to receive flooring in accordance with ASTM F1869.
2. Verify substrates are smooth, level, at required finish elevation, and without more than 1/8 inch in 10 feet-0 inch variation from level or slopes shown on the drawings.
3. Level substrates by grinding high spots or filling low spots with latex cementitious subfloor filler as required.
4. Broom clean or vacuum the surfaces to be covered, and inspect the substrates.
5. Verify substrates are smooth, level, at required finish elevation, and are ready to receive resilient tile flooring and base.
6. Bring discrepancies to the attention of the Architect and do not proceed until such discrepancies are corrected.
7. Fill cold joints, cracks, saw cuts, and control joints exceeding 1/16" in width. Install backer rod if 3/16" or larger with concrete leveler. Do not install flooring over expansion joints.
8. GC and floor subcontractor to ensure a floor moisture test is performed. Moisture tests results are to be submitted to Owner, Architect and manufacturer's rep prior to installation. Conduct moisture test in accordance with ASTM F1869 – maximum allowable amount of moisture emission from floor is 3.0 pounds per 1,000 square feet in 24 hour period, and shall not exceed maximum allowable moisture content as allowed by flooring manufacturer.
9. Starting work indicates acceptance of existing conditions.

3.03 INSTALLATION OF FLOORING

A. General:

- a. Install materials only after finishing operations, including painting, have been completed and after permanent heating and cooling system is operating.
- b. Verify that moisture content of concrete slabs, building air temperature, and relative humidity are within the limits recommended by the manufacturers of the materials used.

B. Installing Tiles/Planks:

- a. Place units with adhesive cement in compliance with the manufacturer's recommendations.
 - i. Butt units tightly to vertical surfaces, nosings, edgings and thresholds.
 - ii. Scribe as necessary around obstructions and to produce neat joints.
 - iii. Place tiles tightly laid, even, and in straight parallel lines.
 - iv. Place planks tightly laid, random placement with parallel lines.
 - v. Extend units into toe spaces, door reveals, and in closets and similar spaces.
- b. Lay units from center marks established with principal walls, discounting minor offsets, so that units at opposite edges of the room are of equal width.
 - i. Adjust as necessary to avoid use of cut widths less than 3 inches wide at edge of space.
 - ii. Lay units square to axis of room or space.
- c. Match units for color and pattern by using materials from cartons in the same sequence as manufactured and packaged.
- d. Placing joining and edge finish moldings, including reducer strips tightly butted to units and secured with adhesive, providing at all unprotected edges unless otherwise shown.
- e. Vinyl to not be installed to bottom of wall, to provide space for installation of base.

3.04 INSTALLATION OF ACCESSORIES

- A. Install base where shown on drawings in accordance with manufacturer's instructions.
- B. Use factory-preformed exterior corners, and factory preformed or job-mitered interior corners.
- C. Install vinyl $\frac{3}{4}$ inch below the top of bases. Vinyl Base is to be glued to drywall.

3.05 CLEANING

- A. Remove excess adhesive and other blemishes from exposed surfaces, using neutral cleaner recommended by the manufacturer of the resilient materials.

END OF SECTION

SECTION 09 67 23 RESINOUS FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide all labor, materials, equipment and supervision as necessary to install a surface-applied, chemical resistant, decorative colored quartz epoxy resin (**single or double**) broadcast system including cove base that shall consist of primer coat, (**one broadcast coat or two broadcast coats**), and lock/seal coat on (**new or existing**) concrete floor slabs, as shown on the project drawings and as outlined in this specification.
- B. Following all applicable manufacturer's guidelines and application instructions shall be considered a requirement of this specification.
- C. Related Sections:
 - a. Section 07 92 00 – Joint Sealants
 - b. Section 09 90 00 – Painting and Coating
 - c.

1.2 REFERENCES (Specification writer shall add, delete or amend, as deemed necessary)

- A. ASTM C109: Standard Test Method for Compressive Strength of Hydraulic Cement Mortars.
- B. ASTM C190: Method of Test for Tensile Strength of Hydraulic Cement Mortars.
- C. ASTM C580: Standard Test Method for Flexural and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
- D. ASTM F1869-04: Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Sub-floor Using Anhydrous Calcium Chloride.
- E. ASTM F2170-11: Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in Situ Probes.
- F. ICRI Technical Guideline No. 310.2-1997 (formerly 03732): Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.
- G. ICRI Technical Guideline No. 210.3 – 2004 (formerly 03739): Guide to Using In-Situ Tensile Pull-Off Tests to Evaluate Bond of Concrete Surface Materials.

1.3 SUBMITTALS

- A. General: Refer to Conditions of Contract and in Division 1 Specification Sections.
- B. Product Data: Submit manufacturer's technical data sheets, available shop drawings, applicable installation guidelines or recommendations, and material safety data sheets for each product and/or composite system included in this specification.
- C. Material and Mock-up Samples: For **initial selection**, submit manufacturer's standard color charts or cured material samples for review by the specification authority and owner's representative. For **final selection**, submit sample boards or perform mock-ups (**specification writer shall specify sample size**) to exhibit pattern, texture, color and finish of the decorative color quartz broadcast flooring system.
- D. Material certificates signed by the manufacturer certifying that the decorative color quartz broadcast flooring and all components of the system comply with all requirements specified herein.
- E. Warranties: Submit a sample of the manufacturer's standard material warranty and the contractor's labor warranty.

- F. Project Reference List: Contractor shall submit a minimum of 5 recently completed projects that entailed a similar scope of work and include total contract value.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: The manufacturer of the products specified in this section shall have a minimum of 5 years experience in the production of these types of products.
- B. Contractor Qualifications: The contractor installing the products specified in this section shall have a minimum of 3 years experience and have successfully completed no less than 5 projects similar in scope and complexity, and is acceptable to and has been trained by the manufacturer.
- C. Substitutions: Requests for the approval of any product other than those specified in this section must be submitted to the specifying authority two weeks prior to the bid, and shall include complete application specifications and physical characteristics. Any request after this date will not be accepted. Failure of performance requires immediate removal and replacement of unapproved substituted material with those originally specified at no cost to the owner, Architect, construction manager, or general contractor.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original packages and containers with seals unbroken and bearing manufacturer's labels containing brand name, batch or lot numbers, and directions for storage and mixing with other components.
- B. Store materials to comply with manufacturer's directions to prevent from damage and/or deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.

1.6 PROJECT CONDITIONS

- A. Environmental Conditions: Comply with all the manufacturer's directions for maintenance of ambient and substrate temperature, moisture, humidity, ventilation, and other conditions required to execute and protect completed work. In hot and cold weather conditions or when high evaporation rates or adverse conditions may be expected, the contractor will be responsible for the quality of the completed installation. Follow all recommendations and guidelines of the American Concrete Institute, as published in ACI Committee 305 for Hot-Weather Concreting and ACI Committee 306 for Cold-Weather Concreting.
- B. Lighting: Permanent lighting will be in place and working before installing the proposed decorative color quartz broadcast flooring system.
- C. Protection: Protect newly installed mechanical equipment flooring system from rain or other potentially harmful climatic conditions for a minimum of 24 hours, from potential damage due foot or vehicular traffic and/or from the work of other trades.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Approved Manufacturer: Miracote Division of Crossfield Products Corp., 3000 E. Harcourt Street, Rancho Dominguez, CA 90221, (310) 886-9100; also 140 Valley Road, Roselle Park, NJ 07204, (908) 245-2800, www.miracote.com.

2.2 MATERIALS

- A. MiraFlor CQ Broadcast System is a multi-layered, chemical resistant, decorative colored quartz broadcast flooring system consisting of a primer coat, one or two epoxy broadcast coats, colored quartz broadcast aggregate, and a lock/seal coat.

B. System Components:

- a. MiraPrime C – Two-component epoxy primer. (Acceptable primer substitute, MiraFlor CQ Clear) 2. MiraFlor CQ Clear – Two-component epoxy resin base, intermediate, and lock/seal coats.
- b. MiraFlor Color Quartz Aggregate – Broadcast medium.

2.3 PROPERTIES

A. MiraFlor CQ Clear Physical Properties:

Provide a clear, two-component, 100% solids, low-odor, flexible, high-build epoxy resin material that meets or exceeds the listed minimum physical property requirements when tested in accordance with the referenced standard test method.

Compressive Strength ASTM D579 (Resin/Hardener/Aggregate):	10,000 psi
Tensile Strength ASTM C307 (Resin/Hardener/Aggregate):	1,800 psi
Flexural Strength ASTM C580 (Resin/Hardener/Aggregate):	4,000 psi
Surface Hardness ASTM D2240 Shore D:	85-85
Adhesion ASTM D4541: (100% failure in concrete substrate):	>400 psi
Water Absorption MIL-D-3134:	<1%
Abrasion Resistance ASTM D4060: (CS17, 1000gr load, 1000 cycles)	0.09 gr
Flammability ASTM D635:	Self extinguishing (Bonded to concrete)
Microbial Resistant ASTM G61:	Passes Rating 1
VOC:	3 g/L

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine all construction substrates and conditions where the decorative color quartz broadcast flooring system is to be installed. Notify the Specifying Authority of any unsatisfactory conditions that may be detrimental to the proper and timely completion of the work.
- B. Do not proceed with the work until all such deficiencies have been corrected by the Contractor in an acceptable manner, and as approved by the Specifying Authority.

3.2 PREPARATION

- A. Protect all surrounding areas, walls, window glass, landscaping and other adjacent surfaces from the execution of each item of work including, but not limited to, surface preparation and all application steps involved in the installation of the decorative color quartz broadcast flooring system.
- B. Perform surface and crack repairs as necessary to re-profile, re-level or to restore the integrity of the concrete substrate or other surfaces in general, as directed by the specifying authority. Concrete surface repair products shall be from the same manufacturer, or as approved by the manufacturer of the decorative color quartz broadcast flooring system specified herein. Provide letter from the manufacturer of the surface repair materials verifying compatibility with the specified decorative color quartz broadcast flooring system.
- C. Decorative color quartz broadcast flooring system must be applied to a clean, sound and mechanically prepared concrete substrate to a minimum **CSP-3** surface profile, in accordance with the International

Concrete Repair Institutes (ICRI) Technical Guideline No. 310.2-1997 (formerly 03732), **Selecting and Specifying Concrete surface Preparation for Sealers, Coatings and Polymer Overlays.**

- D. Contractor shall perform tensile bond tests, as directed by the Specification Authority, in accordance with International Concrete Repair Institutes (ICRI) Technical Guideline No. 210.3-2004 (formerly 03739), **Guide to Using In-Situ Tensile Pull-Off Tests to Evaluate Bond of Concrete Surface Materials.**

3.3 APPLICATION

- A. General: Follow all manufacturers' directions, as published in their product technical data sheets and/or available installation guidelines regarding the application of the decorative color quartz broadcast flooring system, as specified herein.
- B. Joint Sealants: At the direction of the specifying authority, install backer rod and polyurethane sealant at joints, transitions, and penetrations. Detail all existing concrete slab cracks in accordance with manufacturer's installation guidelines.
- C. Mixing: MiraFlor CQ Broadcast System clear epoxy resin components must be mixed mechanically using a low-speed drill (300-450 rpm) until blended with a "Jiffy-type" or similar Miracote-approved mixing paddle. Empty entire contents of component A and component B into a clean mixing vessel. Mix for approximately 3 minutes keeping the mixing head fully immersed at all times. At least once when mixing, stop to scrape down the sides and bottom of the pail to ensure thorough blending of both components. If not mixing full units, each component must be pre-mixed individually ensuring uniformity prior to use. Once completely mixed and in observance of pot life, dispense material immediately from the pail to the substrate.
- D. Priming Coat: When mixed pour out **MiraFlor CQ** or other suitable primer in a ribbon across the concrete surface to receive broadcast. Using a flat squeegee, spread the material at a rate of 200-250 SF per gallon evenly left to right, and back-roll using only a 3/16" or 1/4" maximum nap roller. Allow the primer to dry until it is completely tack free.
- E. Broadcast Coat: Pour out mixed epoxy broadcast coat in a large ribbon across the primed concrete surface as soon as it becomes tack free. Spread evenly at a rate of 160 SF per gallon with a notched squeegee, and back-roll epoxy with a high quality 1/4" nap roller to achieve millage consistency of the wet film and broadcast aggregate immediately. Repeat in the same manner when installing a double broadcast system, with a spread rate of 65 SF per gallon.
- F. Broadcast Aggregate: Immediately broadcast quartz aggregate in a rainfall pattern over the epoxy base coat at a rate of 1 LB per square foot until refusal ensuring a smooth and even quartz surface. Continue to broadcast color quartz to excess until there are no visible areas of glistening resin. Allow broadcasted epoxy base coat to cure then sweep and vacuum excess quartz aggregate. Repeat in the same manner when installing a double broadcast system.
- G. Lock/Seal Coat: When mixed pour out epoxy or other resinous lock/seal coat of choice in a ribbon across the broadcast quartz surface, and spread the material evenly with a flat squeegee at a rate of 65 – 120 SF per gallon to ensure consistent millage uniformity. Finish with a back-roll using a 1/4" maximum nap roller.
- H. Allow completed decorative color quartz broadcast flooring system to cure for 24 hours before subjecting to foot traffic.

3.4 CLEANING

- A. Clean work area and remove/discard all debris resulting from the application of the decorative color quartz broadcast flooring system to the acceptance of the specifying authority or the owner.

3.5 PROTECTION

- A. Protect all completed work of the application during the specified cure time of the material from vehicular or pedestrian traffic, or any exposure to solid or liquid spillage or any other form of contamination.

END OF SECTION

SECTION 09 68 00

CARPET

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Refer to Instructions to Proposers for substitutions.

1.02 MANUFACTURER'S WARRANTY

- A. Manufacturer shall warrant the carpeting for lifetime against the following defects:
1. Dimensional stability including curling.
 2. Edge ravel.
 3. Delamination of backing.
 4. Wear in excess of 10% by weight.
- B. Manufacturer shall warrant that the generation of static electricity shall not exceed 3.5 KV at 70F at 20% RH for the life of the carpet.

1.03 SUBMITTALS

- A. Shop drawings to the Architect showing layout of all seams and cross seams, location, and type of carpet accessories.
- B. Certificate showing manufacturer's loom on which carpet will be produced, and date of last inspection for specification tolerances.
- C. Samples showing manufacturer's matching color (6" x 6"). Actual base and accessory samples.
- D. Actual sample from loom to produce run of carpet.
- E. Manufacturers product data including base adhesive.
- F. Maintenance instructions.

1.04 SCOPE

- A. Furnish and install all carpet at all locker removal areas in the project.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Provide carpet free of any irregularities in weave or materials, and each color of one dye lot. Carpet shall be moth and vermin-proof, and pre-shrunk carpet.
- B. Carpeting:
1. Tandus Flooring, Refer to Finish Schedule for types used
Color: refer to finish schedule.
 2. Cushion Construction: Powerbond Cushion
 3. Width: 6 feet.

4. Dye Method: 100% Solution Dyed
 5. Total Weight: 84.0 ounces, +/- 5%
 6. Color: To be selected by Architect from full range of colors
- C. Carpet Accessories and Adhesive (refer to Section 09 65 00, Resilient Base):
1. Standard accessories as recommended by the successful carpet manufacturer.
 2. Carpet edge shall be vinyl overlap type for glue-down carpet.
 3. Adhesive as recommended by carpet manufacturer.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Deliver carpet to the job site in original mill scrapings, if full rolls. Store carpet raised above floor, under cover, and in well ventilated spaces, as soon as delivered. Protect carpet from damage, dirt, stains, and moisture.
- B. The floor shall be clean and free of any foreign substances, such as wax, paint, oil, etc.
- C. Cracks and holes shall be filled with latex emulsion filler compatible with adhesive.
- D. Any ridges and high spots in concrete surface shall be brought to the attention of the Architect and the General Contractor.

3.02 INSTALLATION

- A. General:
1. Glue directly to floor using no pad and no foam. Roll carpet with a roller to ensure maximum contact at the pressure recommended by the manufacturer.
 2. Scribe carpet accurately to all vertical surfaces.
Align lines of carpet as woven, using no fill strips less than 15 cm (6") in width, laying all carpet in same direction unless specifically otherwise directed by the Architect.
- B. Seams:
1. Locate seams only where shown on approved shop drawings or where otherwise approved by Architect.
 2. Fabricate seams by the compression method, using a butt joint, and properly bead and seal. Do not stretch seams.
 3. Brush out air bubbles toward seam.
 4. Carefully apply a bead seam adhesive to the cut edge at proper height to lock in tufts and seal edge. Do not use floor adhesive to bead cut edge. Use regular seam adhesive.
- C. Clean-Up:
1. Thoroughly clean all carpet surfaces prior to final acceptance of the carpeted areas by Owner. Leave work in neat, uniform condition, vacuumed and ready for use.
 2. Any spillage of adhesive on the face of the carpet shall be removed immediately with clean-up solvent recommended by the manufacturer.
 3. Avoid traffic for at least twelve hours after installation.
 4. Carpet contractor shall repair any and all damage done by his workmen.
 5. Provide traffic areas with heavy Kraft paper or "Visqueen" to protect against damage and soiling. Provide such protection when directed by the Architect.

3.03 EXTRA CARPET

- A. After completion of the carpet installation, the carpet subcontractor shall provide an additional

3% of total yards installed of carpet (6' wide) to the Owner for future carpet replacement that may be required. This extra stock is to be unused rolls and does not include scraps.

3.04 GUARANTEE

- A. The carpet installer shall be required to re-lay any carpet that does not provide an attractive wrinkle-free appearance, and shall correct any condition due to faulty installation which may appear for a period of one year from date of substantial completion.

END OF SECTION 09 68 00

SECTION 09 84 33
SOUND-ABSORBING WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sound-absorbing wall panels, custom-fabricated and fabric-finished.

1.02 REFERENCES

- A. ASTM International:
 - 1. ASTM C423 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - 2. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 3. ASTM E795 Standard Practices for Mounting Test Specimens During Sound Absorption Tests.

1.03 SYSTEM DESCRIPTION

- A. Performance Requirements:
 - 1. Surface Burning Characteristics (ASTM E84):
 - a. Flamespread: 25 maximum.
 - b. Smoke Developed: 450 maximum.
 - c. Fire ratings for all fabric covered panels is based on testing of the panel wrapped with the standard in-stock fabric, Guilford of Maine, FR 701 Style 2100.

1.04 SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
- B. Product Data: Submit product data sheet, for specified products.
- C. Shop Drawings: Submit shop drawings showing layout, edge profiles and panel components, including anchorage, accessories, finish colors and textures.
- D. Samples: Submit selection and verification samples of finishes, colors and textures.
- E. Test Reports: Certified test reports showing compliance with specified performance requirements.
 - 1. Standard Systems: Submit certified copies of previous test reports substantiating performance of system in lieu of retesting.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with Division 1 Product Requirements Section.
- 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 the manufacturer.

1.06 PROJECT CONDITIONS

- A. Environmental Requirements: Do not install panels until wet work, such as concrete and plastering, is complete; the building is enclosed; and the temperature and relative humidity are stabilized at 60 - 80 degrees F (16 - 27 degrees C) and 35% MINIMUM RH and 55% MAXIMUM RH, respectively. All products constructed with wood or wood fiber content must be stored for at least 72 hours in the controlled environment specified herein prior to installation to allow the materials to stabilize.

PART 2 PRODUCTS

2.01 SOUND-ABSORBING WALL PANELS

- A. Manufacturer: Kinetics Noise Control, Inc.
 - 1. Contact: PO Box 655, 6300 Irelan Place, Dublin, OH 43017; Telephone: (614) 889-0480; Fax: (614) 889-0540; E-mail: intsales@kineticsnoise.com; Web site: www.kineticsnoise.com.
- B. Alternate Manufacturer: Conwed Respond HI Fabric, Direct Attach wall panels.
 - 1. Contact: 1445 Holland Rd, Maumee OH 43537 419-871-9084 www.conwed.com

2.02 MANUFACTURED UNITS

- A. High Impact HardSide Panels:
 - 1. Thickness: [1 1/8 inches (29 mm)] [2 1/8 inches (54 mm)] [3 1/8 inches (79 mm)] [4 1/8 inches (105 mm)].
 - 2. Size: As indicated on the drawings up to a maximum 48 inches (1219 mm) x 120 inches (3048 mm) panel.
 - 3. Core: [1 inch (25.4 mm)] [1 1/2 inches (38 mm)] [2 inches (51 mm)] [3 inches (76 mm)] [4 inches (102 mm)] thick fiberglass, 6 - 7 pcf (96 - 112 kg/m³) density, with bonded facing layer of [10 pcf (192 kg/m³)], 1/8 inch (3.2 mm) thick impact resistant fiberglass.
 - 4. Edge Detail: [Square] [Round] [Mitered] [Beveled] [Pencil] hardened with a Class A hardening solution.
 - 5. Facing: [100% polyester fabric, FR 701 Style 2100 by Guilford of Maine] [Factory approved customer selected fabric]. Designer selected fabrics must be approved by the panel manufacturer as acceptable quality for wrapping and covering core materials.

Some fabrics are unstable, too stiff, or lack the weight and thread density for producing an acceptable finish product.

- a. Color: As selected from fabric manufacturer's full range of colors.
6. Sound Absorption (ASTM C423): Noise Reduction Coefficient as follows:
 - a. 1-1/8 inches (29 mm) panel: 1.00, minimum.
 - b. 2 1/8 inches (54 mm) panel: 1.05, minimum.
7. Mounting Accessories: HS impaling clips.

2.03 FABRICATION

- A. General: Treat fabric wrapped panels using heat shrink process to develop fully taut facing.
- B. Wrap panel edges and return facing fabric 1 - 2 inches (25.4 - 51 mm) on back of panel. Secure fabric with adhesive applied to edges and back of panel only.

PART 3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions and product carton instructions for installation.

3.02 EXAMINATION

- A. Site Verification of Conditions: Verify that substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.
 1. Verify that stud spacing is 16 inches (406 mm) o.c., maximum, for panels installed over open studs.
 2. Do not install panels until unsatisfactory conditions are corrected.

3.03 CLEANING

- A. Follow manufacturer's instructions for cleaning panels soiled during installation. Replace panels that cannot be cleaned to as new condition.
- B. Keep site free from accumulation of waste and debris.

END OF SECTION

SECTION 09 84 34
ACOUSTICAL WALL PANELS

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 back-mounted acoustical wall panels.

1.3 DEFINITIONS

- A. NRC: Noise reduction coefficient.

1.4 SUBMITTALS

- A. Product Data: For each type of panel edge, core material, and mounting indicated.
- B. Shop Drawings: For acoustical wall panels. Include mounting devices and details; details at panel head, base, joints, and corners; and details at ceiling, floor base, and wall intersections. Include elevations showing panel sizes and direction of fabric weave and pattern matching. Indicate panel edge and core materials.
- C. Samples for Initial Selection: For each type of fabric facing material from acoustical wall panel manufacturer's full range.
- D. Samples for Verification: For the following products. Prepare Samples from same material to be used for the Work.
 - 1. Fabric: Full-width by 36-inch- (914-mm-) long Sample from dye lot to be used for the Work, and as follows:
 - a. Show complete pattern repeat.
 - b. Mark top and face of fabric.
 - 2. Panel Edge: 12-inch- (300-mm-) long Sample showing edge profile, corner, and finish.
 - 3. Core Material: 12-inch- (300-mm-) square Sample showing corner.
 - 4. Mounting Device: Full-size Sample.
 - 5. Sample Panels: 36 by 36 inches (914 by 914 mm). Show joints and mounting methods.
- E. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that 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.
- B. Source Limitations: Obtain acoustical wall panels through one source from a single manufacturer.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with fabric and acoustical wall panel manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and panels in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.
- C. Protect panel edges from crushing and impact.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical wall panels 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.
- B. Lighting: Do not install acoustical wall panels until a lighting level of not less than 50 fc (538 lux) is provided on surfaces to receive acoustical wall panels.
- C. Air-Quality Limitations: Protect acoustical wall panels from exposure to airborne odors, such as tobacco smoke, and install panels under conditions free from odor contamination of ambient air.
- D. Field Measurements: Verify locations of acoustical wall panels by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of acoustical wall panels that fail in performance, materials, or workmanship within specified warranty period.
 - 1. Failure in performance includes, but is not limited to, acoustical performance.
 - 2. Failures in materials include, but are not limited to, fabric sagging, distorting, or releasing from panel edge; or warping of core.
 - 3. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCT

2.1 CORE MATERIALS

- A. Glass-Fiber Board: ASTM C 612, Type IA or Types IA and IB; density as specified, unfaced, dimensionally stable, molded rigid board, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.2 BACK-MOUNTED, EDGE-REINFORCED ACOUSTICAL WALL PANELS WITH GLASS-FIBER BOARD CORE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Sound Seal – Rectangular Shaped Panels
 - a. S-2100 High-Impact Wall Panels
 - b. 1 1/8" Square Hardened Edges
 - c. Cut to Rhombus Shape per Drawings
 - d. Maharam #458640 Medium fabric wrap in colors as selected from complete line of available fabrics or as indicated on drawings
 - e. Impaling Clips
 - 2. MBI ColorSonix Series 1818F
- B. Panel Construction: Manufacturer's standard panel construction consisting of facing material laminated to front face, edges, and back border of dimensionally stable, rigid glass-fiber board core; with edges chemically hardened to reinforce panel perimeter against warpage and damage.
- C. Nominal Core Density: 6 to 7 lb/cu. ft. (96 to 112 kg/cu. m).
- D. Facing Material: Fabric as noted above and from same dye lot;
- E. Nominal Core Thickness and Overall System NRC: 1.125 inches and not less than NRC 0.90 for Type A mounting per ASTM E 795.
- F. Panel Width and height: As indicated on Drawings
- G. Panel Edge Detail: Square.
- H. Corner Detail: Square to form continuous profile to match edge detail.

2.3 FABRICATION

- A. Sound-Absorption Performance: Provide acoustical wall panels with minimum NRCs indicated, as determined by testing per ASTM C 423 for mounting type specified.
- B. Acoustical Wall Panels: Panel construction consisting of facing material adhered to face, edges and back border of dimensionally stable core; with rigid edges to reinforce panel perimeter against warpage and damage.

1. Glass-Fiber Board: Resin harden areas of core for attachment of mounting devices.
- C. Fabric Facing: Stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other foreign matter. Applied with visible surfaces fully covered.
1. Where square corners are indicated, tailor corners.
 2. Where fabrics with directional or repeating patterns or directional weave are indicated, mark fabric top and attach fabric in same direction so pattern or weave matches in adjacent panels.
- D. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch (1.6 mm) for the following:
1. Thickness.
 2. Edge straightness.
 3. Overall length and width.
 4. Squareness from corner to corner.
 5. Chords, radii, and diameters.
- E. Back-Mounting Devices: Concealed on backside of panel, recommended to support weight of panel, with base-support bracket system where recommended by manufacturer for additional support of panels, and as follows:
1. As recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fabric, substrates, and conditions, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of acoustical wall panels.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install acoustical wall panels in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other panels, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with acoustical wall panel manufacturer's written instructions for installation of panels using type of concealed mounting accessories indicated or, if not indicated, as recommended by manufacturer. Anchor panels securely to supporting substrate.
- C. Match and level fabric pattern and grain among adjacent panels.
- D. Installation Tolerances: As follows:

1. Variation from Level and Plumb: Plus or minus 1/16 inch (1.6 mm).

3.3 CLEANING

- A. Clip loose threads; remove pills and extraneous materials.
- B. Clean panels with fabric facing, on completion of installation, to remove dust and other foreign materials according to manufacturer's written instructions.

3.4 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, to ensure that acoustical wall panels are without damage or deterioration at time of Substantial Completion.
- B. Replace acoustical wall panels that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 098434

SECTION 09 90 00
PAINTING AND COATING

PART 1 - GENERAL

1.01 SECTION INCLUDES:

- A. Surface preparation.
- B. Field application of paints, stains, varnishes, and other coatings.
- C. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following.
- D. Do Not Paint or Finish the Following Items:
 - 1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - 5. Floors, unless specifically so indicated.
 - 6. Glass.
 - 7. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

- A. Section 04 20 00- Masonry
- B. Section 05 50 00- Metal Fabrications
- C. Section 09 21 16- Gypsum Board Assemblies.

1.03 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials; 2007.
- C. GreenSeal GS-11 - Paints; 1993.

1.04 SUBMITTALS

- A. See Section 01 33 00 – Submittals.
- B. Product Data: Provide complete list of all products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.
 - 1. Where sheen is specified, submit samples in only that sheen.
 - 2. Where sheen is not specified, submit each color in each sheen available.
 - 3. Allow 30 days for approval process, after receipt of complete samples by Architect.
 - 4. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as masonry, have been approved.
 - 5. Provide 2'x2' samples on walls as directed by the Architect.
- D. Certification: By manufacturer that all paints and coatings comply with VOC limits specified.
- E. Manufacturer's Instructions: Indicate special surface preparation procedures, substrate conditions requiring special attention.

- F. Operations and Maintenance Data: Submit data on cleaning, touch-up and repair of painted and coated surfaces.
 - 1. Provide paint cards indicating the following, upon submission of extra materials at end of the project with the following information:
 - a. Project and area
 - b. Manufacturer's stock number and date of manufacture.
 - c. Contents by volume, formula for pigment and vehicle constituents.
 - d. Mixed by:
 - e. Color name and number

1.05 MOCK-UP

- A. See Section 01 40 00 - Quality Requirements, for general requirements for mock-up.
- B. Provide panel, 2 feet (610 mm) long by 2 feet (610 mm) wide, illustrating coating color, texture, and finish for each color selected at locations as indicated by the Architect.
- C. Mock-up may remain as part of the work.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.07 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- D. Minimum Application Temperatures for Latex Paints: 45 degrees F (7 degrees C) for interiors; 50 degrees F (10 degrees C) for exterior; unless required otherwise by manufacturer's instructions.
- E. Minimum Application Temperature for Varnish Finishes: 65 degrees F (18 degrees C) for interior or exterior, unless required otherwise by manufacturer's instructions.
- F. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

1.08 WARRANTY

- A. Provide two (2) years against becoming unserviceable or causing an objectionable appearance resulting from defective, nonconforming materials and workmanship
- B. Defects shall include but not be limited to: discoloring noticeably by yellowing, streaking, blooming, changing color or darkening; mildewing; peeling, cracking, blistering, alligatoring or releasing from the substrate; chalking or dusting excessively; changing sheen in irregular fashion; softening or becoming tacky; bubbling.
- C. In the event of damage, immediately make all repairs and replacements necessary for approval of the Architect and at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.
- B. All paint materials shall as a system have flame spread, fuel contribution, and smoke density test results less than 25.
- C. Paint materials listed on the basis of specification herein, unless otherwise designated in the "Painting Schedule", are the products of the Sherwin Williams Company, Cleveland, OH and require no further approval as to manufacturer or catalogue number.
- D. PPG Industries, is an approved manufacturer. Provide equal performing product as BOD.

2.02 PAINTS AND COATINGS - GENERAL

- A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
 - 1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 2. Supply each coating material in quantity required to complete entire project's work from a single production run.
 - 3. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.
- B. Primers: Where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.
- C. Volatile Organic Compound (VOC) Content:
 - 1. For architectural paints, coatings and primer applied to interior walls and ceilings, do not exceed the VOC content limits established in Green Seal Standard GS-11.
 - a. Flat paint: 50 g/L maximum
 - b. Non Flat paints: 150 g/L maximum.
 - c. For anti corrosive and anti-rust paints applied to interior ferrous metal substrates do not exceed the VOC content limits of 250 g/L established by Green Seal Standard GC-03, Anti-Corrosive Paints.
 - d. For clear wood finishes, floor coatings, stains, sealers, and shellacs applied to interior elements, do not exceed the VOC content limits established in South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings.
 - e. Clear wood finishes should be varnish 350 g/L or lacquer 550 g/L.
 - f. Floor coatings should be 100 g/L
 - g. Sealers should be 250 g/L.
 - 2. Provide coatings that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - 3. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- D. Colors: To be selected from manufacturer's full range of available colors.
 - 1. Selection to be made by Architect after award of contract.
 - 2. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.
 - 3. In utility areas, finish equipment, piping, conduit, and exposed duct work in colors according to the color schedule listed below.

2.03 PAINT SYSTEMS - EXTERIOR

A. Sherwin Williams Exterior Surfaces

1. Ferrous Metal
 - a. Primer -S/W DTM Bonding Primer (B66A00050)
 - b. Finish -S/W Pro Industrial Multi-Surface Acrylic Egg-Shel (B66-1560 Series)
2. Galvanized Metal
 - a. Primer -S/W DTM Bonding Primer (B66A00050)
 - b. Finish -S/W Pro Industrial Multi-Surface Acrylic Egg-Shel (B66-1560 Series)
3. Wood
 - a. Primer – S/W A-100 Latex Wood Primer (B42W41)
 - b. Finish – S/W A-100 Exterior Latex Satin (A8 Series)
4. Concrete and CMU
 - a. Primer – S/W Loxon XP Waterproofing Coating (A24-1400 Series)
 - b. Finish -S/W Loxon XP Waterproofing Coating (A24-1400 Series)
5. Fiber-Cement Material
 - a. Primer – S/W Loxon Concrete & Masonry Primer Sealer (A24W8300)
 - b. Finish – S/W A-100 Exterior Latex Satin (A8 Series)
6. Parking Lot Lines
 - a. SetFast Acrylic Latex Traffic Marking Paint (TM21 Series)
 - b. Colors
 - i. YELLOW for Parking Stripes
 - ii. RED for Fire Lanes with WHITE Lettering
 - iii. WHITE for Band Practice Field striping

BLUE and WHITE for Handicap Parking symbols

B. PPG Exterior Surfaces

1. Ferrous Metals: Primer: PPG PITT-TECH® Plus Waterborne DTM Acrylic Primer Finish 4020. Paint: PPG PITT-TECH® Plus High Performance Waterborne DTM Acrylic Semi-Gloss Enamel 4216HP.
2. Zinc-Coated Metal: Primer: PPG PITT-TECH® Plus Waterborne DTM Acrylic Primer Finish 4020.
 - a. Paint: PPG PITT-TECH® Plus High Performance Waterborne DTM Acrylic Semi-Gloss Enamel 4216HP.
3. Exterior Galvanized Metal (Low VOC): Primer: PPG PITT-TECH® Plus Waterborne DTM Acrylic Primer Finish 4020. Paint: PPG PITT-TECH® Plus High Performance Waterborne DTM Acrylic Semi-Gloss Enamel 4216HP.
4. Exterior Wood: Primer: PPG SEAL GRIP® Interior/Exterior Acrylic Universal Primer/Sealer 17-921XI.
 - a. Paint: PPG SPEEDHIDE® Exterior 100% Acrylic Latex Satin 6-2045XI Series.
5. Exterior Concrete Masonry Units: Primer: PPG SPEEDHIDE® Int./Ext. Acrylic Masonry Block Filler 6-15XI.
 - a. Paint: PPG SPEEDHIDE® Exterior 100% Acrylic Latex Satin 6-2045XI Series.
6. Field Weld Touch-Up Galvanized Metal: Primer: PPG PITT-TECH® Plus Waterborne DTM Acrylic Primer Finish 4020. Paint: PPG PITT-TECH® Plus High Performance Waterborne DTM Acrylic Semi-

Gloss Enamel 4216HP.

7. Parking Lot Striping / Fire Lanes / Band Practice Field Paint: PPG ZONELINE™ Traffic & Zone Marking Paint 11-53Series. -Yellow for Parking stripes and Red at Fire Lane Curbs with White lettering.
 - a. -White for Band Practice striping. -Blue and White Handicap symbols.

2.04 PAINT SYSTEMS – INTERIOR

A. Sherwin Williams Interior Surfaces

1. Ferrous Metal
 - a. Primer – S/W DTM Bonding Primer (B66A00050)
 - b. Finish – S/W Pro Industrial Multi-Surface Acrylic Egg-Shel (B66-1560 Series)
2. Galvanized Metal
 - a. Primer – S/W DTM Bonding Primer (B66A00050)
 - b. Finish – S/W Pro Industrial Multi-Surface Acrylic Egg-Shel (B66-1560 Series)
3. Wood – Painted
 - a. Primer – S/W Premium Wall and Wood Primer (B28W8111)
 - b. Finish – S/W Pro Industrial Multi-Surface Acrylic Egg-Shel (B66-1560 Series)
4. Wood – Stain
 - a. Stain – S/W WoodClassic 250 Stains
 - b. Top Coat – S/W WoodClassics Waterborne Polyurethane Varnish Gloss (A68 Series)
 - c. Or
 - d. Top Coat – S/W WoodClassics Waterborne Polyurethane Varnish Satin (A68 Series)
5. Gypsum Wallboard
 - a. Primer – S/W PVA Drywall Primer & Sealer (B28-8000 Series)
 - b. Finish – S/W Pro Industrial Multi-Surface Acrylic Egg-Shel (B66-1560 Series)
6. Gypsum Wallboard – Kitchens
 - a. Primer – S/W PVA Drywall Primer & Sealer (B28-8000 Series)
 - b. Finish – S/W Pro Industrial Multi-Surface Acrylic Egg-Shel (B66-1560 Series)
7. Concrete Masonry Units (CMU)
 - a. Primer – S/W Heavy Duty Block Filler (B42W46)
 - b. Finish – S/W Pro Industrial Multi-Surface Acrylic Egg-Shel (B66-1560 Series)
8. Concrete Masonry Units (CMU) – Kitchens
 - a. Primer – S/W Heavy Duty Block Filler (B42W46)
 - b. Finish – S/W Pro Industrial Multi-Surface Acrylic Egg-Shel (B66-1560 Series)
9. Concrete Floors
 - a. Primer – S/W ArmorSeal Floor Plex 7100 Primer (B70W / B70V)
 - b. Finish – S/W ArmorSeal 1K Waterbased Urethane Floor Enamel (B65-775 Series)
10. Masonry/Concrete Ceilings
 - a. Primer – S/W Loxon Concrete & Masonry Primer Sealer (A24W8300)
 - b. Finish – S/W Pro Industrial Multi-Surface Acrylic Egg-Shel (B66-560 Series)

C. PPG Interior Surfaces

1. Interior Gypsum Board: Primer: PPG SEAL GRIP® Interior/Exterior Acrylic Universal Primer/Sealer 17-921XI.
 - a. Paint: PPG PITT-TECH® Plus Interior/Exterior Satin DTM Industrial Enamel 90-1110 Series.
2. Interior Wood: Primer: PPG SEAL GRIP® Interior/Exterior Acrylic Universal Primer/Sealer 17-921XI.
 - a. Paint: PPG PITT-TECH® Plus High Performance Waterborne DTM Acrylic Semi-Gloss Enamel 4216HP.
3. Interior Galvanized Metals:
 - a. Primer: PPG PITT-TECH® Plus Waterborne DTM Acrylic Primer Finish 4020.
 - b. Paint: PPG PITT-TECH® Plus High Performance Waterborne DTM Acrylic Semi-Gloss Enamel 4216HP.
4. Interior Ferrous Metals: Primer: PPG PITT-TECH® Plus Waterborne DTM Acrylic Primer Finish 4020.
 - a. Paint: PPG PITT-TECH® Plus High Performance Waterborne DTM Acrylic Semi-Gloss Enamel 4216HP.
5. Interior Concrete Masonry Unit (CMU): Paint
 - a. Primer: PPG SPEEDHIDE® Int./Ext. Acrylic Masonry Block Filler 6-15XI.
 - b. Paint: PPG PITT-TECH® Plus Interior/Exterior Satin DTM Industrial Enamel 90-1110 Series.
6. Interior Wood – Stain: Primer: PPG DEFT® Oil Based Wood Stain DFT400 Series.
 - a. Paint: PPG DEFT® Clear Polyurethane Interior Water Based Acrylic – Gloss DFT157.
7. Interior Plaster: Primer: PPG SEAL GRIP® Interior/Exterior Acrylic Universal Primer/Sealer 17-921XI.

2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

2.06 EXTRA STOCK MATERIAL

- A. Contractor shall provide 10 percent or a minimum of one gallon, whichever is greater, of each color, type and gloss of paint used in the work, tightly sealing each container and clearly labeling contents and location where used and date installed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 1. Gypsum Wallboard: 12 percent.
 2. Plaster and Stucco: 12 percent.
 3. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
 4. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
 5. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.
 6. Concrete Floors and Traffic Surfaces: 8 percent.

3.02 PREPARATION

- A. Verify that shop applied primers are compatible with specified finish coats.
- B. Spray equipment shall be the type recommended for the application and shall be maintained clean and in proper working order and shall be operated by person(s) or entity specializing in application of paints and coatings of types specified with minimum five years experience.
- C. Temperature in the storage areas shall be between 40 and 110 dEgrees F. Open and mix all materials in the storage area. Apply water-base paints only when temperature of surfaces to be painted and surrounding air temperatures are between 50 and 90 dEgrees F, unless otherwise permitted by paint manufacturer's printed instructions.
- D. Do not paint in snow, rain, fog or mist, or when relative humidity exceeds 85 percent, or to damp or wet surfaces, unless otherwise permitted by paint manufacturer's written instructions. Painting may be continued during inclement weather if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer during application and drying periods.
- E. Surface must be clean to ensure adhesion. Remove oil and grease with paint thinner or as indicated by manufacturer. Wash off dirt with warm soapy water and rinse with clean water. Remove rust by wire brushing or sanding. Wall surfaces must be dry before painting. Very moisture.
- F. Unfinished Surfaces:
 - 1. Wood: Sand smooth and apply one coat of Primer Undercoat. After primer has dried overnight, putty nail holes and cracks, then spot-prime putty with primer. Again, allow the primer to dry overnight, sand and lightly add topcoat.
 - 2. Masonry and Concrete: Remove efflorescence or cement dust on masonry and concrete by etching with a 10 percent solution of muriatic (Hydrochloric) acid. Flush off surface after etching with clean water, and paint while still damp. On surface where muriatic acid cannot be used to neutralize the efflorescence, remove the efflorescence by sanding, scraping or wire brushing and apply a coat of Masonry Conditioner before painting. If efflorescence is not present, no primer is necessary on concrete or masonry surfaces. Fill voids and pores in concrete and haydite blocks with Latex Block Filler and allow to dry overnight before topcoating.
 - 3. Iron and Steel should be primed with metal primer and allowed to dry overnight.
 - 4. Galvanized metal should be primed with galvanized metal primer and allow to dry overnight before topcoating.
- G. Paint Thickness: Provide the following minimum dry film thickness per coat unless noted otherwise:
 - 1. enamels on metal: 1 mil
 - 2. Latex paints: 1 mil
 - 3. Metal primers: 1.5 mils,
 - 4. Undercoats: 1.5 mils,
 - 5. Oil paints: 1.5 mils
 - 6. Epoxy coating: 2.0 mils.
 - 7. Thickness test: use observation gauge that measures "V" shape scratch.
- H. Allow exterior paints to dry 72 hours between coats and interior paint to dry 24 hours between coats. Allow all enamels and varnishes to dry 24 hours between coats. If enamel and varnishes are tacky after 24 hours, allow additional time until finish is dry.
- I. Leveling: apply with proper consistency and quality so paint flows out to a level surface free of brush and roller marks, bubbles, dust, runs, sags, holidays. Spread evenly.
- J. First coat shall be white unless otherwise specified.
- K. Keep project premises free of painting related debris. Collect material that may constitute a fire hazard, place in closed metal containers, and remove daily from site.
- L. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- M. Seal surfaces that might cause bleed through or staining of topcoat.
- N. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

- O. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Exterior Wood to Receive Opaque Finish: If final painting must be delayed more than 2 weeks after installation of woodwork, apply primer within 2 weeks and final coating within 4 weeks.
- C. Apply products in accordance with manufacturer's instructions.
- D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- E. Apply each coat to uniform appearance.
- F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 PROTECTION

- A. Protect finished coatings until completion of project.

END OF SECTION 09 90 00

SECTION 10 01 00
MISCELLANEOUS SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire Department Rapid Entry System (Knox Box)

1.02 SUBMITTALS

- A. See Section 01 33 00 - Submittals, for submittal procedures.
- B. Product Data: Provide manufacturer's data on all miscellaneous specialties.
- C. Shop Drawings: Indicate wall elevations, dimensions, special anchor details.
- D. Manufacturer's printed installation instructions.

1.03 WARRANTY

- A. See Section 01 77 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year warranty for all installed items.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Knox Company No. 3200 recessed, with recessed mounting kit. To be installed at Front Entry and Fire Riser Room. Verify model number required with Authority Having Jurisdiction
- B. Fire Loop Gates: Install Knox Box at all Fire Loop Gates. District will provide lock at gate; District key will be located in Knox Box.
- C. Knox Elevator Box: Knox p/n 1403, install at locations with elevators. Verify model number required with Authority Having Jurisdiction

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that wall is ready to receive work and positioning dimensions are as indicated on shop drawings.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

END OF SECTION

SECTION 10 11 01
VISUAL DISPLAY BOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Markerboards and Tackboards.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Blocking and supports.
- B. Section 09 21 16 - Gypsum Board Assemblies: Concealed supports in metal stud walls.
- C. Section 09 90 00 - Painting and Coating: Finishing of wood frame and chalkrail.
- D. Section 10 22 26.33 - Folding Panel Partitions: Installation of visual display boards on operable partitions.

1.03 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2009.
- B. ASTM A424 - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2009a.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2013a.

1.04 SUBMITTALS

- A. See Section 01 33 00 Submittals, for submittal procedures.
- B. Product Data: Provide manufacturer's data on markerboard, tackboard, tackboard surface covering, trim, and accessories.
- C. Shop Drawings: Indicate wall elevations, dimensions, joint locations, special anchor details.
- D. Samples: Submit color charts for selection of color and texture of markerboard, tackboard, tackboard surface covering, and trim.
- E. Test Reports: Show conformance to specified surface burning characteristics requirements.
- F. Manufacturer's printed installation instructions.
- G. Maintenance Data: Include data on regular cleaning, stain removal.
- H. LEED Submittal: Provide documentation of compliance with appropriate LEED points.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide fifty (50) years warranty for markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.
- C. Provide 5-year warranty on tackboards.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Visual Display Boards:
 - 1. Basis of Design for Markerboard: Claridge Products and Equipment, Inc; Product Liquid Chalk with the ability to use liquid chalk writing system markers and magnets. Surfaces Series 1: www.claridgeproducts.com.
 - 2. Basis of Design for Tackboards: "Fabricork" 1380
 - 3. The following manufacturers are acceptable provided proposed products meet or exceed all specified requirements.
01 ASI Group

- 02 Moore Company
- 03 Best-Rite
- 04 Carolina Specialties
- 05 Nelson Adams
- 06 Platinum Visual Systems.

2.02 VISUAL DISPLAY BOARDS

- A. Markerboards: Porcelain enamel on steel, laminated to core.
 - 1. Color: Porcelain plus
 - 2. Metal Face Sheet Thickness: 0.024-inch, 24 gage (0.61 mm).
 - 3. Core: 2-ply Hardboard, 1/2 inch (13 mm) thick, laminated to face sheet.
 - 4. Backing: .015-inch Aluminum foil, laminated to core. 1/2-inch total thickness
 - 5. Height: 48 inches (1220 mm).
 - 6. Length: As indicated on drawings.
 - 7. Frame: snap on aluminum similar to No. 273A in dull stain anodized, with concealed fasteners similar to No. 277 at top and sides.
 - 8. Accessories: Provide map rail, 2-flag holders, and marker trough series/ Type A with extended rear flange and endcaps under all markerboards. Map rail similar to No. 275A shall run across top of markerboard and 4 map clips similar to No. 76M shall be included with no adhesive. Provide 12 markers per liquid chalk writing surfaces. Three each black, blue, red and green.
- B. Tackboards: As per BOD above.
 - 1. Color: As selected from manufacturer's full range.
 - 2. Backing: Hardboard, 1/4 inch (6 mm) thick, laminated to tack surface.
 - 3. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
 - 4. Height: 48 inches (1220 mm).
 - 5. Length: As indicated on drawings.
 - 6. Frame: Same type and finish as for markerboard.
 - 7. Frame Profile: Manufacturer's standard
 - 8. Frame Finish: Anodized, dull satin.
 - 9. Accessories: Provide four #76M display hooks per board, one set of #76RB roller brackets for each board and termination caps for all aluminum end sections.
- C. Tack Strip
 - 1. Design is based on Claridge Hang-Tight Rail System 79.
 - 2. Tackable cork strip insert.
 - 3. Insert extrusion at bottom.
 - 4. Size 2" height; 1-1/8" depth.
 - 5. Length: full length of associated marker board. Provide at all marker boards.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.

3.02 INSTALLATION

- A. Install boards in accordance with manufacturer's instructions.
- B. Secure units level and plumb.

- C. Rigidly anchor to backup material to withstand 200 lb. load. Set without mastic on gypsum board partitions.
- D. Install trim plumb with joints closely fitted and corners mitered. Secure trim with fasteners spaced 16 inches on centers maximum. Provide screws in lead shield on concrete and masonry walls and direct attachment to studs or metal backing on drywall construction. Use concealed fasteners.
- E. Markerboard: Secure marker trough to backup materials with concealed fasteners through rear flange. Slip marker board into carrier slot. Then, install side and top ground clips and trim in accordance with manufacturer's printed instructions.
- F. Provide all grounds, brackets, anchors, trim and accessories for a complete installation.

3.03 CLEANING

- A. Clean board surfaces in accordance with manufacturer's instructions.
- B. Cover with protective cover, taped to frame.
- C. Remove temporary protective cover at date of Substantial Completion.

END OF SECTION

SECTION 10 12 00
DISPLAY CASES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This section includes Recessed Trophy and Display Cases.

1.02 REFERENCED STANDARDS

- A. ASTM E84
B. ASTM B221

1.03 SUBMITTALS

- A. Shop Drawings: Provide shop drawings for each type of recessed display or trophy case required.
B. Product Data: Provide technical data for materials specified. Include Material Safety Data Sheets, when applicable.
C. Samples:
1. Manufacturer's color charts.
2. Composition samples of material and trim to illustrate finish, color and texture.
D. Manufacturer's Instructions: Provide manufacturer's installation instructions.

1.04 OPERATION AND MAINTENANCE

- A. Include data on regular cleaning, stain removal, and precautions

1.05 REGULATORY REQUIREMENTS

- A. Conform to applicable code for flame/smoke rating in tackboards in accordance with ASTM E84.

1.06 QUALITY ASSURANCE

- A. Manufacturer shall be a firm engaged in the manufacture of display cases in the United States.
B. Manufacturer shall have a minimum of 5 years' experience in the manufacture of display cases.

1.07 FIELD CONDITIONS

- A. Field measure prior to preparation of shop drawings and fabrication to ensure proper fit.

1.08 WARRANTY

- A. Submit a standard warranty, stating that when installed in accordance with manufacturer's instructions and recommendations, Claridge recessed trophy and display cases are guaranteed for one year against defects in materials and workmanship. Guarantee does not cover normal wear and tear, improper handling, any misuse, or any defects caused by vandalism or subsequent abuse. Guarantee covers replacement of defective material but does not include cost of removal or reinstallation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Recessed Display and Trophy Cases – 370 Series Recessed or as shown on the drawings – as manufactured by Claridge Products and Equipment, Inc., Harrison, Arkansas. Phone: 870-743-2200; Toll Free 800-434-4610; Fax: 870-743-1908

2.02 MATERIALS

- A. Recessed Trophy and Display Case Fronts
1. Tackable Back Panels: (Select from Claridge Designer Fabric; Hook-Fab; or Tan Nucork or as shown in the drawings.)
2. Laminate Back Panels: (Select from Walnut or Oak grained low-pressure laminate finish)
3. Sizes -as shown in the drawings.
4. Housing: 370 Series with 3-1/2" extruded aluminum angle perimeter trim; 1370 Series with 3-1/2" extruded aluminum perimeter trim with a 2" radius;
5. Inside depth: as shown in the drawings.

1. Glass Doors: 370 Series - 3/16" tempered sliding glass doors. Sliding glass doors have ground-in finger pulls, doors slide on glides.
- B. Glass Shelves: Three adjustable glass shelves furnished with brackets and shelf standards. Architect to specify shelf width – 6, 8, 10 or 12-inch wide.
- C. Metal Trim and Accessories: Provide aluminum extrusions as manufactured by Claridge Products and Equipment, Inc. Trim shall be heavy gauge extruded aluminum and shall meet or exceed ASTM B221 alloy standards. Finish to be etched and anodized satin finish. (Color anodized and powder coat finish trim optional.)
- D. Colors: As selected from manufacturer's standard colors.
- E. LED lights; custom sizes; custom styles

2.03 FABRICATION

- A. Shop assembly: Provide factory assembled cases to requirements indicated on shop drawings.
- B. Units shall be of dimensions shown in details and in accordance with manufacturer's shop drawings, as approved by architect.

PART 3 EXECUTION

3.01 PROJECT CONDITIONS

- A. Verify before installation that interior moisture and temperature approximate normal occupied conditions.
- B. Verify that wall surfaces are prepared and ready to receive cases.

3.02 INSTALLATION

- A. Deliver cases KD to be reassembled on job.
- B. Follow manufacturer's instructions for storage and handling of units before installation.
- C. Install level and plumb, in accordance with manufacturer's recommendations.

3.03 ADJUST AND CLEAN

- A. Verify that all accessories are installed as required for each unit.
- B. At completion of work, clean glass surfaces, back panels and trim, in accordance with manufacturer's recommendations, leaving all materials ready for use.

END OF SECTION

SECTION 10 14 00

SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Room and door signs.
- B. Interior directional and informational signs & other special use signs.
- C. Emergency evacuation maps.
- D. Plaque.
- E. Traffic signs.

1.02 RELATED REQUIREMENTS

- A. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
- B. Section 26 51 00 - Interior Lighting: Exit signs required by code.

1.03 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 21 00 - Allowances, for cash allowances affecting this section.
- B. Room and door signs are not covered by the allowance.
- C. Allowance amount covers purchase, delivery, and installation only for Principal's discretionary signage. All other signage indicated below is included in Base Bid.

1.04 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; Final Rule; current edition; (ADA Standards for Accessible Design).
- B. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 - 1. When room numbers to appear on signs differ from those on the drawings, include the drawing room number on schedule.
 - 2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
 - 3. Submit for approval by Owner through Architect prior to fabrication.
- D. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.

- E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.

1.08 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.01 SIGNAGE APPLICATIONS AND MATERIALS

- A. Accessibility Compliance: All signs are required to comply with ADA Standards for Accessible Design and ANSI/ICC A 117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
- C. Cast Metal Dedication Plaque: Alluminium Alloy or Bronze (verify with Architect prior to submittal)
 - 1. The casting shall be free of pits and gas holes and all letters shall be sharp and hand tooled with a single line standard border design.
 - a. Lettering shall be Helvetica Medium in both upper and lower case letters, unless shown otherwise.
 - b. The border and letters should have a satin finish with a leatherette texture sprayed background with Gun Metal Gray acrylic lacquer for Aluminum and Black acrylic lacquer for Bronze.
 - c. The plaque shall be chemically cleaned and etched and shall be sprayed with two coats of clear acrylic lacquer.
 - 2. Concealed fasteners and hardware of size and type recommended by manufacturer shall be provided for attachment of plaque on brick or finish wall material.
 - 3. Names of the Board of Trustees and Administration staff are to be listed as follows:
 - Board of Trustees
 - President
 - Vice President

- Secretary
 - Remaining Trustees in alphabetical order of last name
Administration
 - Superintendent
 - Chief of Staff
 - Remaining Associate Superintendents in alphabetical order of last name
 - General Counsel
- Name of Architect and General Contractor to be the same font size.

D. Cast Metal Letters:

1. Casting shall be of 319 aluminum alloy with satin polished faces and matte sides. Letters shall be finished in clear anodized finish and shall be 12 inch high in Helvetica Medium upper case letters, unless noted otherwise.
2. Concealed fasteners and hardware of size and type recommended by manufacturer shall be provided for attachment of signage on applicable wall.

E. Room Identification Signage:

1. Signage should be constructed of one or two high pressure laminates, laminated to a 1/8 inch thick acrylic back with a radius or square corners with square-cut edges painted.
2. Room Numbers, Symbols and Restroom Copy shall be matte finished acrylic, raised 1/32 inch, of color contrasting to the face laminate. Characters and pictograms shall be chemically welded to the acrylic backing, through the face laminate, to assure permanent adhesion. Room numbers and restroom copy shall be accompanied by Grade II braille by means of "VisiTouch Duradot System". Glass or metallic "Duradots" shall have 0.059 inch surface diameter with body of sphere pressure secured below face laminate. Routed boxes or glued on dots are not acceptable.
3. Lower or secondary copy must be a minimum of 5/8 inch thick high incised sans serif style, (Helvetica, Optima, Futura), all caps, paint-filled in a color.
4. Restroom pictograms shall appear on a maximum six inch square, unobstructed field.
5. Window (Slotted) Signs are open on both ends for an over insert, window shall be a non-glare acrylic window with an exposed color laminate behind in color.
6. Fasteners are 1/8 inch thick, double-sided foam tape of type recommended to suit application and commercial grade silicone sealant. Back-up plates shall be supplied, where shown or required, for signage mounted on glass.
7. Numbering of spaces will start with 1000 on the 1st floor, 2000 on the 2nd floor, etc. Rooms within a room will have the next continuous number, e.g., a storage room within Classroom 1001 will be numbered Storage Room 1002. No room number will have a letter following it, e.g., 1001A. In cases where a room is added within a room and room graphics are not being replaced, XXX.1 may be used. Stairwells will be labeled A, B, C, e.g., 1st Floor Stairwell A, 1st Floor Stairwell B; 2nd Floor Stairwell A, 2nd Floor Stairwell B.

F. Traffic Signs:

1. Signage is made of 0.080 inch thick aluminium or galvanized steel sign with 1-1/2 inch silk screen upper case letters, copy and border high reflective finish. Signs shall have a 1- 1/2 inch radius at corners typically.

2. Accessibility (Handicapped Parking) signs with lettering and graphics shall comply with local codes.
 3. "Stop", "No Parking" and "One Way" signs with lettering and graphics shall comply with local codes.
 4. Provide galvanized steel mounting hardware as instructed by manufacturer. Sign Posts: Either 2- 3/8" diameter galvanized steel pipe or 2"x12"1/4" galvanized tube steel. Provide concrete footings of 3,000 psi compressive strength at 28 days, unless noted or directed otherwise.
- G. Wayfinding: Directional signs should be used to help students, staff and visitors find their way.
1. Building Directory:
 - a. Locate in area immediately visible from the primary building entry-consult with Architect for location
 - b. Flush mounted or recessed.
 - c. Letters and numbers to match existing building directory.
 2. "You Are Here" Maps:
 - a. Locate at each floor's neighborhood entry and at main hallways- final location to be selected by Architect
 3. Directional Signs- Provide 16 signs.
- H. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
- I. Interior Directional and Informational Signs:
1. Allow for 20 signs 4 inches high by 16 inches long.
- J. Emergency Evacuation Maps:
1. Allow for one map per classroom and per main hallway.
 2. Map content to be provided by Owner.
 3. Use clear plastic panel silk-screened on reverse, in brushed aluminum frame, screw-mounted.
- K. Roof Hatch Signs
1. Signage material and attachment similar to Room identification signage.
 2. Signage text to indicate roof has "20 Year Roof Warranty" and indicate "warranty start date:"
- L. Fire Department Connection:
1. Signage material similar to Traffic signs- White background with red lettering
 2. Graphics: FDC Connection
- M. Fire Sprinkler Riser Room:
1. Signage material and attachment similar to Room Identification signage.
 2. Signage material must be weatherproof
 3. Graphics: Fire Sprinkler Riser Room
- N. Exterior Entrance and Fencing Man-Gate Door Numbering:

1. Building: Exterior Entrances are to be labeled, on the exterior and interior, with a numbered sign starting with the number “1” at the front main entry and continuing clockwise around the building for all remaining entries.
2. Grounds: Fencing Man-Gates are to be labeled, on both sides of the gate, with a lettered sign starting with the letter “A” at the first gate to the left of the front entrance when facing the building and continuing clockwise around the building for all remaining gates.
3. Signs shall be 9” wide by 6” high, with gloss white background and 4” high gloss black numbers / letters. Confirm final materials and graphics with CFISD.
4. Building Entrance signs shall be mounted above the entrance, interior and exterior, with mechanical fasteners or clear double sided VHB Tape.
5. Fencing Man-Gate signs shall be centered on the gate, one on each side, with through-bolt attachment of signs to metal mesh.

2.02 MANUFACTURERS:

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. South Texas Graphics, (713) 467-4499
2. A.R.K. Ramos Architectural Signage Systems; (405) 235-5505.
3. InPro Corporation (IPC); (800) 222-5566.
4. ProWorx Architectural Signage; (713) 666-3131.
5. Riot Creative Imaging; (713) 988-9200.
6. Stanley Signature Signs; (281) 395-6106.
7. The Southwell Co.; (210) 223-1831.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Cast Metal Dedication Plaque:
 1. Install in accordance with manufacturer's instructions, with concealed fasteners of threaded bolt screwed into back of plaque and inserted into hole drilled in brick at an angle and filled with cement. Location, if not shown on drawings, to be selected by Architect.
- C. Cast Metal Letters:
 1. Install in accordance with manufacturer's instructions, with concealed fasteners in flush mounting or projected mounting. Location if not shown on drawings, to be selected by Architect.
- D. Room Identification Signage:
 1. Install in accordance with manufacturer's instructions with double sided foam tape and a bed of silicone sealant. Location, if not shown on drawings, to be selected by Architect.
 2. Where shown or required, mount signs on glass using back-up plates.

- E. Traffic Signs:
 - 1. Install sign posts in concrete footings, with signs set to heights as shown on drawings or in accordance with manufacturer's instructions and codes.
- F. Post and Panel Sign for Site Directory / Directional Signage:
 - 1. Install signposts in concrete footings, with signs set to heights as shown on drawings and in accordance with manufacturer's instructions.
- G. Install neatly, with horizontal edges level.
- H. Protect from damage until Substantial Completion; repair or replace damage items.

END OF SECTION

SECTION 10 21 13.19
PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Solid plastic toilet compartments.
- B. Urinal screens.

1.02 RELATED REQUIREMENTS

- A. Section 05 12 00 - Structural Steel Framing: Concealed steel support members.
- B. Section 05 50 00 - Metal Fabrications: Concealed steel support members.
- C. Section 06 10 00 - Rough Carpentry: Blocking and supports.
- D. Section 10 28 00 - Toilet Room Accessories.

1.03 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless-Steel Sheet, Strip, Plate, and Flat Bar; 2010.
- B. All toilet partitions shall be in compliance with NFPA 286.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.05 SUBMITTALS

- A. See Section 01 33 00 Submittals, for submittal procedures.
- B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
- C. Product Data: Provide data on panel construction, hardware, and accessories.
- D. Samples: Submit two samples of partition panels, 12x12 inch (300x300 mm) in size illustrating panel finish, color, and sheen.
- E. Manufacturer's Installation Instructions: Indicate special procedures.

PART 2 PRODUCTS

2.01 SOLID PLASTIC TOILET COMPARTMENTS

- A. Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid molded high-density polyethylene (HDPE), floor-mounted headrail-braced.
 - 1. Basis of Design: Plasti-Glaze 280, as manufactured by Scranton Products.
 - a. Color: Black with white fleck; "Black paisley in orange peel finish.
- B. Doors:
 - 1. Thickness: 1 inch (25 mm).
 - 2. Width: 24 inch (610 mm).
 - 3. Width for Handicapped Use: 36 inch (915 mm), out-swinging.
 - 4. Height: 55 inch (1397 mm).

5. Edges machined to a radius of 0.25 inch and all exposed edges to be free of saw marks made of HDPE fabricated from polymer resins compounded under high pressure.
- C. Panels:
1. Thickness: 1 inch (25 mm).
 2. Height: 55 inch (1397 mm).
 3. Depth: As indicated on drawings.
- D. Pilasters:
1. Thickness: 1 inch (25 mm).
 2. Width: As required to fit space; minimum 3 inches (76 mm).
 3. Floor mounted at urinals and lavatories.
- E. Screens: Without doors; to match compartments; mounted to wall with two panel brackets with vertical support/bracing same as compartments. 24 inches deep by 60 inches high mounted at 12 inches above finished floor.
- F. All toilet partitions shall be floor mounted, overhead braced, with non-corrosive panel doors and pilaster of solid polymer and in the dimensions and arrangements indicated on the drawings. Partitions between urinals and lavatories shall have floor mounted pilasters. Panels, doors and pilasters shall be fabricated from Polymer resins under high pressure forming a single component section which is waterproof, non-absorbent and has a self-lubricating surface that resists marking with pens, pencils and other writing utensils. The panel shall have a manufacturer applied texture similar or equal to EX from Scranton Products.
- G. Edging Strips are aluminum fastened to the bottom edge of all doors and panels utilizing vandal-proof stainless-steel fasteners.

2.02 ACCESSORIES

- A. Pilaster Shoes: Formed ASTM A666, Type 304 stainless steel with No. 4 finish, 3 in (75 mm) high, concealing floor fastenings. 3-inch-high 20 gauge with theft proof sex bolts.
- B. Head Rails: fabricated from heavy aluminum extrusion (6463-T5 Alloy) with mill finish in anti-grip configuration weighing not less than 1.188 lbs. per linear foot similar or equal to section #58993. Fasten to tops of pilaster and headrail brackets with thru-bolting with one-way sex bolts. Head rail brackets to be 16-gauge stainless steel.
- C. Pilaster Brackets: Polished stainless steel.
- D. Wall Brackets: Continuous type, (6463-T5 Alloy) with mill finish weighing not less than 1.685 lbs. per linear foot similar or equal to section #58992 for all panels to pilaster, pilaster to wall, and panel to wall connections. Manufacturer to pre-drill holes spaced every six inches along full length of brackets. Thru bolts to panels and pilasters with one-way sex bolts.
- E. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
- F. Hardware:
1. Full length continuous adjustable helix hinge in brushed finish surface manufactured from 14-gauge, 304 Stainless steel, with stainless steel pin welded and ground. Both hinges shall be fastened with 3/4-inch-long #14 stainless steel screws.
 2. Each door requires one coat hook/ bumper with rubber bumper. No Zamac coated hardware.
 3. Handicapped doors also include one door pull and one wall stop.
 4. Dorr Strike and keeper are fabricated from heavy aluminum extrusion (6463-T5 Alloy) with clear anodized finish with wrap around flange, surface mounted and thru-bolted with one-way sex bolts. Size of strike shall be six inches.
 5. Door Latch housing shall be fabricated from heavy aluminum extrusion (6463-T5 Alloy) with clear anodized finish, surface mounted and thru bolted to door with one-way sex bolts. Slide bolt and button shall be heavy aluminum with similar or equal to "Tuff-Coat Black" finish.

2.03 SOLID PLASTIC BENCHES

- A. Benches at showers as indicated

- B. 1" thick HDPE locker benches with 16" CMU base, Black paisley color, anchored 30-36" oc or as shown on the drawings.

2.04 SHOWER COMPARTMENT

- A. Equipment:
 - 1. Curtain Rod / Head Rails: Aluminum with anti-grip (2 per stall).
 - 2. Hooks: Chrome Plated Steel.
 - 3. Curtains: Heavy duty, 8gauge vinyl (2 per compartment/dressing & shower). Antimicrobialtype curtain.
 - 4. Soap Dish: chrome plated.
 - 5. Seats: provide HDPE material seats (each) at ADA showers sized accordingly per ADA requirements.
 - 6. Provide two sets of 1" thick HDPE pilasters. One set between the dressing and shower compartments. And the second set at the end of the dressing compartments. Head rail with integral curtain track shall be mounted continuously at the tops of each pilaster set.
 - 7. Valves and Shower Heads: refer to the plumbing section.
 - 8. Clothing Hooks: provide two (2) clothing hooks at panels in dressing compartments.
- B. Shower Stalls:
 - 1. HDPE panels.
 - 2. Use continuous stainless steel or aluminum brackets for mounting.
 - 3. Mounting: Floor mounted, overhead braced and vandal-proof stainless steel fasteners.
 - 4. Shower Unit Type: Basis of Design: Comtec's Shower and Dressing Compartments or as shown in the drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify correct spacing of and between plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

- A. Provide blocking/ anchoring devices to secure to wall. Anchoring devices must be compatible to wall type to ensure adequate strength.
- B. Install partitions and compartments in substantial manner, straight, plumb, and true in accordance with manufacturer's instructions.
- C. Install all partitions and compartment where indicated on the drawings, and as indicated on the shop drawings, anchoring all components firmly in place for a long life under hard use and in complete accordance with manufacturer's instructions.
- D. Pilaster shoes shall be anchored to the floor with No. 5 plastic anchors and No. 14 stainless steel Philips head screws.
- E. Attachment of brackets to adjacent wall construction shall be accomplished by one theft proof mushroom nail in head anchor directly behind the vertical edge of panels and pilasters at every 12 inches along the length of bracket and two No. 5 plastic anchors and NO. 14 1-1/4-inch stainless steel Philips head screws at each 12-inch intervals alternately spaced between anchor connections.
- F. No evidence of drilling, cutting or patching shall be visible in the finished work. Defaced finish will not be permitted. Damaged, scratched or marred defective materials will be rejected and shall be replaced with new materials.
- G. Clearance of vertical edges of doors shall be uniform top to bottom and shall not exceed 3/16 inch.

- H. Except for toilet partitions for the handicapped, adjust doors to remain at a uniformly open position when unlocked.
- I. Maintain 3/8 to 1/2-inch (9 to 13 mm) space between wall and panels and between wall and end pilasters.

END OF SECTION

SECTION 10 22 13

WIRE MESH PARTITIONS 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 specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Shop Drawings: Show plan and elevation of each partition, with verified dimensions, partition construction, anchorage details, door details, hardware schedule, and finishes.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Any one (1) of the manufacturer's listed 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 to be considered.
 - 1. Acorn Wire and Iron Works, Inc.; (800) 552-2676.
 - 2. California Wire Products Corp.; (877) 214-4078.
 - 3. G-S Company Wire & Iron Works.; (410) 284-9549.
 - 4. Indiana Wire Product.; (800) 451-0406
 - 5. Kentucky Metal Products Co.; (502) 966-0555.
 - 6. Standard Wire & Steel Works.; (708) 333-8300
 - 7. Superior Wire and Metal Products, Inc.; (567) 331-0544.
 - 8. Central Wire & Iron Works.; (515) 244-2532

2.2 MATERIALS

- A. Wire Mesh Partitions:
 - 1. Mesh: 1-1/2 inch diamond mesh of not less than 10-gauge wire complying with ASTM A510.
 - 2. Intermediate Bars: Pair of 1 inch by 1/2 inch by 1/8 inch cold rolled channels bolted together, allowing mesh to pass.
 - 3. Vertical Frames: pair of 1-1/4 inches by 5/8 inch "C" channels with I-beam stiffeners of 5/16 inch x 2 inch bars.
 - 4. Horizontal Frames: Pair of 1 inch by 1/2 inch x 1/8 inch channels.
 - 5. Top Caps: 2-1/4 inches by 1 inch cold rolled channels.
 - 6. Head Track (sliding): With four (4) wheel ball bearing trucks.
 - 7. Erection Hardware: As necessary to secure and complete the installation.
 - 8. Floor Shoes: Weldable ductile iron, 1-1/4 inches high, with set screw adjustment.
 - 9. 1-1/2 inch diameter galvanized steel handrail verticals and horizontals with mesh panel inserts as shown on drawings.
 - 10. Horizontal Bracing: Provide at wall as needed at 10 feet-0 inches high to produce strong durable installation.

- B. Wire Mesh Doors: Provide sliding doors at the dimensions and arrangements shown on the drawings and the following features. Provide swing type doors as indicated on the drawings.
 - 1. Framing: 1-1/4 inch x 1/2 inch by 1/8 inch hot rolled channels, with 1-1/4 inches by 1/8 inch flat bar cover on three (3) sides.
 - 2. Provide 1-3/8 inches by 3/4 inch by 1/8 inch angle riveted to lock sides.
 - 3. Provide continuous head track and wheel trucks
 - 4. Provide a continuous 12 gauge strike bar
 - 5. Provide cylinder locks at swing gates and sliding doors. Locks shall be master keyed to Owner's "Sargent" master keyed system.

- C. Finish: provide shop applied prime coat of rust-inhibitive paint compatible with the finish coat provided under Section 09 90 00.

- D. Miscellaneous Materials: provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect. Provide District BEST core(s).

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.

3.2 INSTALLATION

- A. Install the Work of this Section in accordance with the manufacturer's recommendations and shop drawings as approved by the Architect, anchoring all components firmly into position, true to line, and aligned horizontally and vertically within a tolerance of one in 500.

- B. Adjust operating components for optimum smooth function.

END OF SECTION 10 22 13

SECTION 10 22 26.33
FOLDING PANEL PARTITIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Acoustic operable panel partition.
- B. Ceiling track, ceiling guards, and operating hardware.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood blocking and track support shimming.
- B. Section 07 90 05 - Joint Sealers: Acoustical sealant.
- C. Section 08 71 00 - Door Hardware: Lock cylinders for panels.
- D. Section 10 11 01 - Visual Display Boards: Product requirements for chalkboard finish for installation by this section.

1.03 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2013a.
- B. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- C. ASTM E413 - Classification for Rating Sound Insulation; 2010.
- D. ASTM E557 - Standard Guide for Architectural Design and Installation Practices for Sound Isolation between Spaces Separated by Operable Partitions; 2012.
- E. ASTM E596 - Standard Test Method for Laboratory Measurement of Noise Reduction of Sound-Isolating Enclosures; 1996 (Reapproved 2009).
- F. ASTM F793 - Standard Classification of Wallcovering by Use Characteristics; 2010a.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on partition materials.
- C. Shop Drawings: Indicate opening sizes, track layout, details of track and required supports, and stacking depth.
- D. Samples for Selection: Submit two samples of full manufacturer's color range for selection of colors.
- E. Samples for Review: Submit two samples of surface finish, 12 x 12 inches (300 x 300 mm) size, illustrating quality.
- F. Certificates: Certify that partition system meets or exceeds specified acoustic requirements.
- G. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods. Describe cleaning materials detrimental to finish surfaces and hardware finish.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of this section with minimum three years of experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Modernfold Acousti Seal 932 paired panel system with full height markerboard surface on both sides. Manually operated.
- B. Other Acceptable Manufacturers:
 - 1. Hufcor, Inc: www.hufcor.com.

2. Moderco, Inc.
3. Kwick-Wall Model 2030.

2.02 COMPONENTS

- A. Operable Panel Partition: Side opening; paired panels; side stacking; manually operated.
 1. Panel Finish: Markerboard
 2. Noise Reduction Coefficient (NRC): ASTM E596, NRC of 0.65 minimum.
 3. Sound Transmission Class (STC): 50 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90, on panel size of 100 sq ft (9.3 sq m).
 4. Surface Burning Characteristics of Panel Finish: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.
 5. Installed partition system track capable of supporting imposed loads, with maximum deflection of 1/360 of span.
- B. Suspension Track: Track shall be structural aluminium Type 7/8 track. Static loading of track with brackets at 48 inch centers shall show no failure of track or brackets at 5,000 lbs point loading at mid-span. Track shall be supported by adjustable steel hanger brackets connected to structural supports by pairs of 3/8 inch diameter rods.
 1. Exposed track soffit: Track soffit to be integral to track shape and shall be powder-coated off white paint finish. Track must accommodate termination of plenum sound barriers on both sides of track for maximum sound control.
- C. Carriers: One trolley per panel with 3-inch diameter glass-reinforced nylon all steel precision-ground ball bearing wheels. Steel-wheeled or reinforced polymer trolley on aluminum track not permitted. Trolleys shall attach to panels with 1/2 inch diameter pendant bolt mounted to welded steel plate.
- D. Sound seals:
 1. Vertical seals between panels shall consist of tongue and groove airlock. When engaged, each pair of panels shall result in a single straight unit.
 2. Horizontal Top Seal: continuous contact extruded vinyl shapes.
 3. Horizontal Bottom Seal: 1-1/2 inch clearance, automatically actuated by the movement of one panel-pair against the other. Seals shall not contact floor during movement. Fixed sweep bottom is not recommended.
- E. Hardware: Latching door handles of cast steel, satin chrome finish; lock cylinder keyed to building keying system..

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated and opening conforms to ASTM E557.
- B. Verify track supports are laterally braced and will permit track to be level within 1/4 inch (6 mm) of required position and parallel to the floor surface.
- C. Verify floor flatness of 1/8 inch in 10 feet (3 mm / 3 m), non-cumulative.
- D. Verify wall plumbness of 1/8 inch in 10 feet (3 mm / 3 m), non-cumulative.

3.02 INSTALLATION

- A. Install partition in accordance with manufacturer's instructions and ASTM E557.
- B. Fit and align partition assembly and pocket doors level and plumb.
- C. Lubricate moving components.

3.03 ADJUSTING

- A. Adjust partition assembly to provide smooth operation from stacked to full open position. Do not over-compress acoustic seals.
- B. Visually inspect partition in full extended position for light leaks to identify a potential acoustical leak.
- C. Adjust partition assembly to achieve lightproof seal.

3.04 CLEANING

- A. Clean finish surfaces and partition accessories.
- B. Condition markerboard surfaces in accordance with manufacturer's instructions.

3.05 CLOSEOUT ACTIVITIES

- A. Demonstrate operation of partition and identify potential operational problems.
- B. Provide 2 operating tools per campus at closeout.

END OF SECTION

SECTION 10 26 01 CORNER GUARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Corner guards.

1.02 RELATED REQUIREMENTS

- A. Section 05 50 00 - Metal Fabrications: Anchors for attachment of work of this section, concealed in wall.
- B. Section 06 10 00 - Rough Carpentry: Blocking for wall and corner guard anchors.

1.03 REFERENCE STANDARDS

- A. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2013a.
- C. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2012.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate physical dimensions, features, anchorage details, and rough-in measurements.
- C. Samples: Submit two sections of corner guard, 24 inch (600 mm) long, illustrating component design, configuration, color and finish.

1.05 WARRANTY

- A. Warranty the work specified herein for five (5) years from substantial completion date against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Wall and Corner Guards:
 - 1. Basis of Design: Surface Mount: Construction Specialist, Inc. p/n SM20.
 - 2. American Floor Products, Inc
 - 3. ADP Lemco Incorporated, (AL Inc)
 - 4. Arden Architectural Specialties Inc.
 - 5. Pawling Corporation, Standard Products Division
- B. Stainless steel corner guards at Kitchen
 - 1. Basis of Design: Koroseal Koroguard Stainless Steel

2. Balco Metalines
3. Pawling Corporation
4. ADP Lemco.

2.02 FABRICATION

- A. Fabricate components with tight joints, corners and seams.
- B. Pre-drill holes for attachment.
- C. Form end trim closure by capping and finishing smooth.
- D. Dimensions: three (3) inches x three (3) inches x wall height, unless noted otherwise.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
- B. Verify that field measurements are as instructed by the manufacturer.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to wall framing members only.
- B. Position corner guard 4 inches (100 mm) above finished floor to 2 inches (50 mm) high.

3.03 TOLERANCES

- A. Maximum Variation From Required Height: 1/4 inch (6 mm).
- B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch (6 mm).

END OF SECTION

SECTION 10 28 00
TOILET ROOM ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Accessories for toilet rooms and utility rooms.
- B. Grab bars.

1.02 RELATED REQUIREMENTS

- A. Section 09 30 00 - Tiling: Ceramic washroom accessories.
- B. Section 10 21 13 – Plastic Toilet Compartments

1.03 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; Final Rule; current edition; (ADA Standards for Accessible Design).
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2012.
- C. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium; 2011e1.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.05 SUBMITTALS

- A. See Section 01 33 00 - Submittals, for submittal procedures.
- B. Product Data: Provide data on accessories describing size, finish, details of function, attachment methods.
- C. Samples: Submit two samples of each accessory, illustrating color and finish.
- D. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Products listed are made by Bobrick Washroom Equipment Inc.
- B. Other Approved Manufacturers:
 - 1. A&J Washroom Accessories
 - 2. American Specialties Inc (ASI)
 - 3. Bradley Wash fountain Co.
 - 4. General Accessory Mfg Co.
 - 5. McKinney/Parker
 - 6. Watrous, Inc.

7. GAMCO, General Accessory Mfg Co.

2.02 COMPONENTS

- A. Accessories shall be shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation. Grind welded joints smooth and fabricate units made of metal sheet of seamless sheets, with flat surfaces.
- B. Stainless Steel sheets shall meet ASTM A666 Type 302 and 304 and stainless-steel tubing shall meet ASTM A269. Both shall have a No. 4 satin, unless otherwise specified, finish and a 22 US stainless gauge minimum thickness.
- C. Chromium Plating shall be over nickel and comply with ASTM C456 Type SC 2
- D. Framed mirrors shall be 1/4-inch-thick with an electrolytic copper backing and shall be FS DD-G-451-C, silvering quality No. 1 float or plate.
 - 1. Require warranty of fifteen years against silver spoilage.
- E. Fasteners, Screws and Bolts shall be hot dip galvanized, tamper-proof & theft resistant.
- F. Expansion Shields shall be fiber, lead or rubber as recommended by accessory manufacturer for component and substrate.
- G. Concealed backing to comply with local codes and as required for substrate conditions; or manufacturers standard mounting kits.

2.03 FINISHES

- A. Stainless Steel: No. 4 satin brushed finish, unless otherwise noted.
- B. Chrome/Nickel Plating: ASTM B456, SC 2, satin finish, unless otherwise noted.
- C. Baked Enamel: Pretreat to clean condition, apply one coat primer and minimum two coats epoxy baked enamel.
- D. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.
- E. Back paint components where contact is made with building finishes to prevent electrolysis.

2.04 TOILET ROOM ACCESSORIES

Washroom Equipment:

- Paper Towel Dispenser: (Owner Furnished Contractor Installed)
 - Mounting: Surface
 - Model: Baywest 86500
 - Locations: Refer to drawings.
- Sanitary Napkin Disposal:
 - Mounting: Surface
 - Model No.: Continental 250C
 - Liners: Provide four (4) dozen liner units
 - Locations: One (1) at each (staff) women's restrooms stall and (student) girl's restroom stall.
- Stainless Steel Wainscot Panels:
 - Mounting: Surface
 - Model No.: Custom
 - Dimensions: 18 gauge thick panels, 42 inches high x sink width
 - Location: At each mop sink.

- Sanitary Napkin Dispenser:
 - Mounting: Surface
 - Model No.: B-2800
 - Operation: Single coin (25 cents)
 - Capacity: 31 Napkins / 22 Tampons
 - Locations: One (1) at each (staff) women's restroom and (student) girl's restrooms
- Mop and Broom Holders:
 - Mounting: Surface.
 - Model No.: B-223 x 48
 - Capacity: Five (5) holders.
 - Location: One (1) at each Custodial Room, Two (2) at Kitchen custodial room
- Grab Bars:
 - Size/Finish: 1-1/2 inch diameter Satin Finish Stainless Steel.
 - Wall Clearance: 1-1/2 inch between rail and wall.
 - Model No.: B-6806 x 42 inches / B-6806 x 36 inches.
 - Mounting: Attach with concealed mounting and parallel to floor.
 - Location: Refer to drawings and code/ADA requirements
- Mirrors:
 - Mounting: Surface.
 - Model No.: B-290 2436.
 - Size/Locations: 24 inches x 36 inches. One (1) at each lavatory.
- Soap Dispensers: (Owner Furnished Contractor Installed)
 - Mounting: Surface.
 - Model: Symmetry 9902001
 - Locations: One (1) at each lavatory.
- Toilet Paper Dispenser: (Owner Furnished Contractor Installed)
 - Mounting: Surface.
 - Model: Kimberly Clark 09507
 - Locations: One (1) at each water closet.
- Hand Dryers:
 - Mounting: Surface with concealed fasteners
 - Model: Saniflow M06AF-UL or Bradley 2902-280000 – 120 V
 - Location: Per drawings
 - At middle schools and high schools only.
- At Elementary Schools – In Special Needs Toilet Rooms:
 - CFISD to furnish and install changing table

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.
- D. Verify that field measurements are as indicated on drawings.

3.02 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on the drawings.
- B. Contractor shall be responsible for supplying all opening, blocking, and other components necessary for installation of all toilet accessories.
- C. Use approved theft-resistant type fasteners.
- D. Install plumb and level securely and rigidly anchored to substrate.
- E. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

3.04 PROTECTION

- A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

SECTION 10 44 00
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.
- B. Section 09 90 00 - Painting and Coating: Field paint finish.

1.03 REFERENCE STANDARDS

- A. NFPA 10 - Standard for Portable Fire Extinguishers; 2013.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate cabinet physical dimensions and show locations.
- C. Product Data: Provide extinguisher operational features.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.05 FIELD CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fire Extinguisher Cabinets and Accessories:
 - 1. JL Industries, Inc; : www.jlindustries.com.
 - 2. Larsen's Manufacturing Co; : www.larsensmfg.com.
 - 3. Potter Roemer.
- B. Substitutions: No substitutions.

2.02 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent. Provide Fire Extinguishers with the State of Texas certification.
- B. Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gage.
 - 1. Class: UL 4A-80 B:C.
 - 2. Size: 10 pound (4.54 kg).
 - 3. MP 10 Series mounted with eye brackets for direct wall mounting to hook and in Cabinets.
 - 4. Finish: Baked polyester powder coat, red color.
 - 5. Provide initial inspection tag for each extinguisher.

2.03 FIRE EXTINGUISHER CABINETS

- A. Cabinet Configuration: Semi-recessed type with 2 1/2 inch return trim rolled edge, ADA compliant
 - 1. Exterior nominal dimensions of 24 inch (60.5 mm) wide x 9 1/2 inch (24 mm) high x 6 inch (19.53 mm) deep.
- B. Box Construction: Double wall of 18 gauge cold rolled steel with baked acrylic enamel finish.

- C. Door and Frame shall be 18 gauge minimum 304 stainless steel door and frame with vertical decal lettering "FIRE EXTINGUISHER" in red color, unless directed otherwise. Door to be solid stainless steel.
- D. Hardware consists of a continuous concealed piano hinge constructed of material which matches door and trim material, and a satin finish pull handle with cam cylinder lock with safety pull designed to release upon firm pull on handle.
- E. The cabinet should have #4 stainless steel finished exterior.
- E. Provide a fire rated cabinet as needed, 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.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure rigidly in place.
- C. Place extinguishers and accessories in cabinets.
- D. Install fire extinguisher cabinets in locations required by governing code and as directed by Owner. Contractor is responsible for providing quantity required for project.

END OF SECTION

SECTION 10 50 50

METAL LOCKERS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as indexed, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Metal lockers including locks and all accessories.

1.2 MINIMUM COMPLIANCE STANDARDS

- A. The following document governs the work, except where more restrictive items are specified - Federal Specification AA-L-00486H(1).

1.3 WARRANTY

- A. Warrant the work specified herein for ten 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:
 - 01 Rapid deterioration of finish.
 - 02 Loose or missing parts.
 - 03 Non-functioning components and mechanisms.
- C. Athletic lockers shall have a ten (10) year warranty. All others to have a two (2) year warranty.

1.4 SUBMITTALS

- A. Product Data: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.
- B. Samples: Submit full range of colors, patterns, textures, and finishes available for selection.
- C. Locker/Lock Schedule: Manufacturer shall furnish the Owner prior to Substantial Completion a schedule for all lockers. The schedule shall contain the locker number, serial number of the lock installed, key number, or combinations, as applicable, for each locker. Furnish the schedule in spread-sheet form, i.e. Excel, etc. Furnish schedule in three (3) hard copies and flash drive. This information is to be given to CFISD Maintenance who will distribute to the campus.
- D. Close-out Submittals:
 - 1. Updated As-Built drawings.
 - 2. Manufacturer contact names and addresses
 - 3. Product and accessory model numbers and contact names/addresses for future reordering parts by Owner.

1.5 OWNER STOCK

- A. Provide 25 additional locks of each non-ADA type locks installed. Provide 10 additional ADA locks. Include keys for owner stock locks.

PART 2 - PRODUCTS

2.1 LOCKERS

- A. Basis of design based on products of Republic Storage Systems Co. Canton, OH, Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project:
- B. Approved Manufacturers:
- | | | |
|----|---|----------------|
| 01 | Art Metal products Co., Chicago, IL 60623 | (312) 247-7011 |
| 02 | Lyon Metal Products, Inc., Aurora, IL 60507 | (312) 892-8941 |
| 03 | Penco Products, Inc., Oaks, PA 19456 | (215) 666-0500 |
| 04 | DeBourgh Manufacturing Co., LaJunta, CO 81050 | (800)328-8829 |
| 05 | Interior / Medart | |
- C. Academic Lockers: 12 inches wide x 12 inches deep x 36 inches high, with interior hooks and louvered door. Key to master key system.
- D. PE Lockers: 12 inches wide x 15-16 inches deep with friction catch, use Master Lock 1654 locks or size as indicated in the drawings whichever is larger.
- E. Athletic Lockers: Sized per Athletic Locker Standards with interior hooks and diamond perforation doors.
- F. Food service lockers: 12 inches x 12 inches by 72 inches high, double tier with interior hooks and louvered door.
- G. Material: Each locker shall be fabricated from mild cold rolled sheet steel and capable of taking a high grade enamel finish.
- H. All lockers shall be painted inside and outside with the same color.
- I. Trim and Accessories: Such as recess trim, sloping tops, bases and fillers of all types shall be of material and gauge to suit application and shall match lockers using the same finish process as lockers.
- J. Hinges: Hinges shall be piano style continuous hinge.
- K. 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.
- L. Construction: Lockers shall be built on the unit principle - each locker shall have an individual door and frame, individual top, bottom, back and shelves with common intermediate uprights separating compartments.
- M. Number Plates: Each locker door shall have a polished aluminum number plate not less than 1/2 inch high for easy readability.
- N. Interior Equipment: Single tier lockers over 42 inches high shall have a hat/book shelf. Other tiered lockers do not have shelves. All single, double and triple tier lockers shall have one double-prong (single prong in 9 inch width) back hook and two (2) single-prong wall hooks in each compartment. All hooks shall be made of steel. Lockers under 20 inches high are not equipped with hooks.
- O. Locks: Each locker shall have an integrated combination lock.
- P. Door Frames: Shall be 16 gauge.
- Q. Doors: Shall be 14 gauge, formed with a full channel shape on the lock side to fully conceal the lock bar, channel formation on the hinge side, and right angle formations across the top and bottom. Door material/frame shall be continuous wrap from front to sides and to back minimum of one (1) inch on back of door (leaving no open edge of door frame material on back side of door – particularly so at hinge side of door at top and bottom). Standard locker doors shall have louvers near the top and bottom of each door.

- R. Latching: Shall be a one-piece, pre-lubricated spring steel latch, completely contained within the lock bar under tension to provide rattle-free operation. There shall be three (3) latching points for lockers over 48 inches in height and two (2) latching points on for all tiered lockers 20 to 36 inches and under in height. 12" box lockers to have one latch.
- S. Finish: Powder coated to match color of locker.
- T. Latch Bar: Full-height latch bar constructed of 1/2 inch (13 mm) HDPE plastic secured to locker with stainless steel tamper-resistant screws.
- U. Color: As selected by Architect from manufacturer's full range.
- V. Accessories:
 - 1. Coat Hooks: Black polycarbonate double hook.
- W. End Panels: 1/2 inch (13mm) thick, with color and finish matching locker body.
- X. Filler Panels: 1/2 inch (13 mm) HDPE filler panel, with color and finish matching locker body, attached with 3/8 inch (10 mm) thick HDPE solid plastic angle bracket.
- Y. Wall Hooks: Black powder coated, cast zinc hook two per locker.
- Z. Number Plate: White acrylic with black film coating, laser etched with number specified. Provide one per locker. Numbering shall be confirmed by owner during submittal phase.
- AA. Coat Rod: Schedule 40 PVC with plastic pole sockets and stainless steel tamper-resistant screws.

2.2 LOCKER ROOM BENCHES:

- A. CMU bases with 1" thick HDPE black paisley tops. Refer to drawings for additional details.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Assemble lockers in accordance with the manufacturer's written instructions. Lockers shall have no sharp metal edges. Install lockers in the locations shown on the drawings.
- B. Install number plates in order as directed by the Architect.
- C. Install doors to close smoothly and completely without binding. Ensure hinges do not bind.
- D. Adjust hardware latches for smooth operation and positive latching and automatic locking.
- E. Standard locker design shall have all welded fronts and doors and have interiors and backs assembled with nuts and lock washers. Ventilated locker design to be all welded construction.

END OF SECTION

SECTION 10 56 13
INDUSTRIAL METAL SHELVING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal storage shelving.
- B. Shelving accessories.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Blocking and reinforcement in walls for anchoring shelving units.

1.03 REFERENCE STANDARDS

- A. ANSI MH28.1 - American National Standard for the Design, Testing, Utilization and Application of Industrial Grade Steel Shelving - Specifications

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Rated uniform shelf loads.
 - 2. Details of shelving assemblies, including reinforcement.
 - 3. Accessories.
- C. Test Reports: Provide independent agency test reports documenting compliance with specified structural requirements.
- D. Shop Drawings: Indicate location, type, and layout of shelving, including lengths, heights, and aisle layout, and relationship to adjacent construction.
 - 1. Indicate methods of achieving specified anchoring requirements.
- E. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and finishes.
- F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Shelves: Two of each size, with shelf brackets.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Inspect for dents, scratches, or other damage. Replace damaged units.
- B. Store in manufacturer's unopened packaging until ready for installation.
- C. Store under cover and elevated above grade.

1.07 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide one year manufacturer warranty covering defects of manufacturing and workmanship and rust and corrosion.

PART 2 PRODUCTS

2.01 SHELVING - GENERAL

- A. Shelving: Provide products tested to comply with ANSI MH28.1 for design criteria, lateral stability, shelf connections, and shelf capacity.
- B. Anchors: Provide anchoring hardware to secure each shelving unit to floor and wall.
 - 1. Provide hardware of type recommended by manufacturer for substrate.

- C. Single line installation against walls shall be braced to walls using threaded anchors (block walls) or bolted to wall/in wall blocking (drywall wall). HAMMER DRIVE ANCHORS ARE NOT ALLOWED. Back to back installations shall be braced together.
- D. Provide adjustable 18 gauge heavy duty open shelves with a shelf capacity of 400 lbs. (minimum uniformly distributed load). The edge is made from full box flange construction at front and rear. The shelves are 84 inches high x 16 inches deep and 36 inches wide. At Art room, custodial and book room depth shall be 24”.
- E. Shelf Unit Components include seven shelves, two pairs of side sway braces per unit and one pair of back sway braces per unit.
- F. Shelves to be in standard factory applied paint in color to be selected by Architect.

2.02 MANUFACTURERS

- A. Dixie Shelving Company, Houston, TX
- B. List Industries, Inc.; Deerfield Beach, FL
- C. Lyon Metal Products, Inc., Aurora, IL
- D. Montel, Inc., Melbourne, FL
- E. Penco Products, Inc., Oaks, PA
- F. Republic Storage Systems Co., Inc., Canton, OH
- G. Inco Metal Products

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate is level and that clearances are as specified.
- B. Verify that walls are suitable for shelving attachment.
- C. Do not begin installation until substrates have been properly prepared.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 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.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install shelving with shelf surfaces level and vertical supports plumb; adjust feet and bases as required.
- C. Install shelving units secure to walls in accordance with manufacturer's instructions at locations shown on drawings.

END OF SECTION

SECTION 10 73 13
AWNINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum framing and fittings.
- B. Exterior walkway covers and canopies
- C. Covering material.

1.02 RELATED REQUIREMENTS

- A. Section 09 90 00 - Painting and Coating: Paint finish on framing members.

1.03 REFERENCE STANDARDS

- A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2013.
- B. ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube; 2010.
- C. ASTM B483/B483M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Tubes and Pipe For General Purpose Applications; 2013.

1.04 INSTALLER QUALIFICATIONS

- A. Company with minimum 5 year experience in installation of aluminum canopies of the type specified for this Project and approved by steel canopy manufacturer to install their canopies in accordance with their instructions.

1.05 DESIGN REQUIREMENTS

- A. 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 design 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.
- B. 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.
- C. Coordinate dimensional requirements prior to fabrication.
- D. Canopy erection drawings to be furnished at time of shipment. Piece marks included for field identification of all major parts.
- E. Product shall be designed shop drawings prepared and sealed by licensed Registered Texas Structural Professional Engineer.
 - a. System shall be designed in accordance with FM Global I-90 wind uplift requirements and any other applicable building codes.
 - b. System shall also be designed to comply with Underwriters Laboratories Class 'A' Fire Rating requirements.
- F. Erect canopy after all concrete and masonry in vicinity is complete and washed down.
- G. Install rain caps over draining sections of the deck.

- H. Downspouts columns shall be filled with grout to the discharge level to prevent standing water.
- I. Downspout deflectors shall be installed after grouting.
- J. Bird blockers shall be installed at all upper ribs of deck above C-Channel beams.

1.06 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on awning covering, color fastness, stitching and seaming methods, attachment devices to framing system.
- C. Samples, Covering: Submit 12 x 12 inch (300 x 300 mm) sample of covering with representative hem stitch detail, seam with reinforcement, and attachment devices to framing system.
- D. Design calculations or letter indicating design certification sealed by a registered professional engineer licensed in the state in which the job is located.

1.07 WARRANTY

- A. One year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
 - 1. Defects shall include loose or missing parts, delamination or deterioration of finish and scratched, dented or damaged surfaces.

1.08 REGULATORY REQUIREMENTS

- A. Conform to applicable code for fire resistance ratings for awning covering.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Aluminum Walkway Cover:
 - 1. Basis of Design: Avadeck Walkway Cover Systems & Canopies, Houston, Texas
 - a. Other approved manufacturers are: Aluminium Technologies, American Walkway Covers LLC, Childers Carports & Structures, Dittmer Architectural Aluminium, Mapes Industries, inc, Peachtree Protective Covers, Inc, Perfection Architectural Systems, Inc, Superior Metal Product Co.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ALUMINUM FRAMING SYSTEM

- A. All aluminum shapes shall be sized and connections designed to meet or exceed specific project design load requirements, and as indicated in the drawings.
- B. Aluminum components shall be 6063-T6 Alloy Extruded aluminum.
- C. Structure shall be designed by the manufacturer to withstand walking on top, heavy hail, and winds to comply with all local codes.
- D. Provide concealed drainage from deck into columns.
- E. Flashing shall be 0.040 inch aluminum fabricated to prevent leakage of water between canopy and adjacent structures, where applicable.
- F. The Roof Deck shall be of size and depth recommended by the manufacturer to suite application, intended use, requirements of building code authorities having jurisdiction, and shall interlock in a homogeneous structural unit, with joint designed and fabricated into a structurally rigid shape which is self flashing.
- G. Provide expansion joints as required. Expansion joints shall have no metal to metal contact.

- H. 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.
- I. Finish to be Super Dynapon 2 Coat system selected from manufacturer's full range of colors.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that wall substrate anchors are acceptable and are ready to receive work.

3.02 INSTALLATION - FRAMING

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects.
- C. Erect canopy after all concrete and masonry in vicinity is complete and washed down.
- D. Columns sleeves shall be furnished by the manufacturer and installed by the Contractor to elevations and dimensions on approved shop drawings.
- E. Install all columns and beams straight and true. Protect columns with heavy plastic sheeting.
- F. Install raincaps over draining sections of the deck. Downspouts columns shall be filled with grout to the discharge level to prevent standing water. Downspouts deflectors shall be installed after grouting.
- G. Install all flashing required at the juncture of deck sections.

3.03 INSTALLATION - COVERING

- A. Install covering over framing members, stretched taut without creases or folds.
- B. Attach covering and fasten securely.

END OF SECTION

SECTION 11 31 00
RESIDENTIAL APPLIANCES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Kitchen appliances.

1.02 RELATED REQUIREMENTS

- A. Section 22 11 16 & 22 13 16 for Plumbing Piping
- B. Section 26 27 73- Line voltage wiring.

1.03 REFERENCE STANDARDS

- A. UL (EAUED) - Electrical Appliance and Utilization Equipment Directory; Underwriters Laboratories Inc.; current edition.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data indicating dimensions, capacity, and operating features of each piece of residential equipment specified.
- C. Copies of Warranties: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Electric Appliances: Listed and labeled by UL and complying with NEMA standards.
- C. Gas Appliances: Bearing design certification seal of AGA.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five (5) year manufacturer warranty on refrigeration system of refrigerators.
- C. Provide ten (10) year manufacturer warranty on tub and door liner of dishwashers.

PART 2 PRODUCTS

2.01 APPLIANCES

- A. All Equipment Eligible for Energy Star Rating: Energy Star Rated.
- B. Ice Makers (casework under counter)
 - 1. Manufacturer: Hoshizaki preferred AM-50BAE-AD (ADA Compliant)
 - 2. Size: Coordinate with casework
 - 3. Self venting with drain to floor sink
 - 4. Accessibility for service/repair and movability of equipment
- C. Dishwasher:
 - 1. Manufacturer: Whirlpool WDF550SAHW- stainless steel
 - 2. Coordinate with casework.
- D. Disposal:
 - 1. Manufacturer: Equal to Insinkarator Evolution Pro 880LT
 - 2. Motor: 7/8 horsepower min.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify utility rough-ins are present and correctly located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Anchor built-in equipment in place

3.03 ADJUSTING

- A. Adjust operating equipment to efficient operation.

3.04 CLEANING

- A. Remove packing materials from equipment.
- B. Wash and clean equipment.

END OF SECTION

SECTION 11 57 00

SHOP 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 SECTION INCLUDES

- A. Provide fully operational shop equipment with accessories as specified to complete work as shown on drawings or required.
- B. Furnish, install, hook-up and start-up the following shop equipment:
 - a. Saw, Table 10 Inch (SW1).
 - b. Saw, Panel (SW2).
 - c. Sander, Disc 12 Inch. (DS)
 - d. Miter Band Saw (MBS)
 - e. Multi Process Welder (MPW)
 - f. Drill Press 20" (DP1)
 - g. ARC Welding Station (WS)
 - h. Cabinet, Flammable Cabinet (CAB1). (FSC)
 - i. Cabinet, Shop Tool (CAB2).
 - j. Jointer, 6 Inch (JT1).
 - k. Planer, 15 Inch (PL1).
 - l. Router (RT2).
 - m. Gooseneck Tip Tube.
 - n. Oxygen Cylinders.
 - o. Oxygen Regulator.
 - p. Acetylene Cylinder.
 - q. LP Gas Regulator Only.
 - r. Positive Pressure "E" Type Mixer.
 - s. Hose.
 - t. Torch Handle.
 - u. Twin Tip Tube.
 - v. Tip.
 - w. Wheelbarrow Mixer (WB1).
 - x. Brazing Table with Vises (Welding Metal Table) (BT)
 - y. Bench Grinder w Stand (BG)
 - z. Plasma Table (PT)
 - aa. Cutting Track (CT)
 - bb. Hydraulic Press (HP)
 - cc. Miter Band Saw (MBS)
 - dd. Multi Process Welder (MPW)

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.
 - 3. Manufacturer's operation and maintenance instructions.
 - 4. Spreadsheet of all powered equipment submitted with required voltage and phasing,

including voltage and phasing provided by electrical plans.

1.3 QUALITY ASSURANCE

- A. Provide set-up and assembly of specified equipment by qualified manufacturer's installer.
- B. Equipment requires operational sign-off by Owner whether indicated or not.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in protective wrapping, store inside building protected from weather, moisture and soiling.

1.5 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13 – Project Coordination and 01 31 19 Project Meetings.

1.6 WARRANTY

- A. Provide warranties as indicated, and where not indicated provide manufacturers standard warranties.
- B. Warrant the work specified herein for one (1) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

PART 2 - PRODUCTS

3.1 SHOP EQUIPMENT AND MANUFACTURERS – WELDING

- A. Cabinet, Flammable Storage:
 - 1. Designation on Drawings: **FSC**
 - 2. Number/Location: One (1) as shown on drawings.
 - 3. Power Requirements: None.
 - 4. Features:
 - a. Wall mounted.
 - b. 65 inches H by 43 inches W by 18 inches D.
 - c. Yellow powder coat paint finish.
 - d. 45 gallon capacity.
 - 5. Mounting height: Operable handle max 48" AFF.
 - 6. Brand/Model: SKU M439233 TS-12, Model BM45YP as manufactured by Jamco Flammable Cabinet as manufactured by Jamco and distributed by Grainger.
- B. Torch Handle:
 - 1. Number/Locations: Eight (8)
 - 2. Automatic on/off gas control.
 - 3. Adjustable pilot light.
 - 4. Equipped with Flash Guard check valves.
 - 5. Gas Service: Propane, propylene, natural gas/methane.
 - 6. Capacity: Cuts 3 inch, welds to 1/2 inch.
 - 7. Length: 8 inch.
 - 8. Brand/Model: Model 50-10 Torch Handle as manufactured by Harris Welding Supplies.
- C. Positive Pressure "E" Type Mixer :
 - 1. Number/Locations: Eight (8)
 - 2. Brand/Model : H-16-E as manufactured by Harris Products Group.

- D. Twin Tip Tube:
 - 1. Number/Locations: Eight (8)
 - 2. Brand/Model : TH-50-2 as manufactured by Harris Products Group.

- E. Gooseneck Tip Tube:
 - 1. Number/Locations: Eight (8)
 - 2. Brand/Model : Model 9100379 as manufactured by Harris Products Group.

- F. Tip:
 - 1. Number/Locations: Eight (8)
 - 2. Brand/Model : Model 13950 5N as manufactured by Harris Products Group.

- G. Oxygen Regulator:
 - 1. Number/Locations: Eight (8)
 - 2. Brand/Model : Model 3000795 as manufactured by Harris Products Group.

- H. LP Gas Regulator:
 - 1. Number/Locations: Eight (8)
 - 2. Brand/Model : Model 3000713 as manufactured by Harris Products Group.

- I. Hose:
 - 1. Number/Locations: Eight (8)
 - 2. Style: T.
 - 3. Size: ¼ inch 12-1/2 inch B to B fittings.
 - 4. Brand/Model : Model 4300583 as manufactured by Harris Products Group.

- J. Brazing Table with Vises (Welding Metal Table): BT
 - 1. Number/Locations: Eight (8)
 - 2. Size: 38 inches by 47 inches.
 - 3. Brand/Model : As manufactured by Grainger.

- K. Oxygen Cylinders:
 - 1. Number//Locations: Eight (8)
 - 2. Brand/Model: As manufactured by Alltex.

- L. Acetylene Cylinder:
 - 1. Number//Locations: Eight (8)
 - 2. Brand/Model: As manufactured by Alltex.

- M. ARC Welding Stations: (WS)
 - 1. Quantity: 24.
 - 2. All welded construction of heavy 11 gauge steel with 26 inches x 30 inches fire resistant non-asbestos fiber back shield.
 - 3. Overall Size: 30 inches W x 25 inches D x 64 inches H.
 - 4. Work Surface Height: 34 inches.
 - 5. One piece, replaceable steel grate top measures 29 inches W x 24 inches D.
 - 6. Drawer: 4 inches H x 12 inches W x 18 inches D.
 - 7. Removable and adjustable hanger for 2 fire resistant, transparent curtains.
 - 8. Curtain: Smoke Gray.
 - 9. Include floor anchor pads and slag pan.
 - 10. Brand/ Model: Grainger.

- N. Bench Grinder with Stand: (BG)
 - 1. Quantity: 3.
 - 2. Max Wheel Diameter: 8 inches.
 - 3. Grinding Wheel: Grit 36/60.
 - 4. Arbor Size: 5/8 inch.

5. Dust Management included.
 6. Application: Grinding.
 7. Bearing Type: Ball Bearing.
 8. Current: 10/5A
 9. Dust Collection Port Size: 2-1/2 inch.
 10. Duty: Heavy Duty.
 11. Frequency: 60 Hz
 12. Horsepower: 1.
 13. Includes:
 - a. (2) Grinding Wheels
 - b. (3) Tool Rests.
 - c. (2) standard Flat Top and V-Grooved Top for Drill Bit Sharpening.
 - d. Wheel Dresser Max.
 14. Wheel Speed: 3,600 RPM.
 15. Overall Height: 12-1/2 inch.
 16. Overall Length: 18 in.
 17. Phase- Single
 18. Voltage: 115/230V.
 19. Wheel Distance: 16-1/2 inch.
 20. Manufacturer: Dayton.
- O. Plasma Table: (PT)
1. Quantity: 1.
 2. Positional Accuracy: .007.
 3. Repeatability: .002.
 4. Rapid Speeds: 800 IPM.
 5. Cutting Speeds: Over 500 IPM.
 6. 15 mm linear ball bearing profile rails
 7. Precision machine ground railways.
 8. Rack and Pinion X/Y axis.
 9. Precision Ball screw Z axis.
 10. 5-15 hp Spindle Applications.
 11. Model/ Manufacturer: Scorpion 4x8.
- P. Cutting Track: (CT)
1. Quantity: 1
 2. Basis of Design: Victor VCM 201 HT Portable Cutting Machine.
- Q. Hydraulic Press: (HP)
1. Quantity: 1
 2. Pump Type: Manual.
 3. Frame Type: H-Frame.
 4. Frame Capacity: 10 Ton.
 5. Stroke: 16 inc.
 6. Material Machining: Steel.
 7. Overall Height: 36 inches.
 8. Overall Width: 48 inches.
 9. Pressure: 10 Tons.
 10. Basis of Design: Baileigh Industrial Hydraulic Press as manufactured by Grainger.
- R. Miter Band Saw: (MBS)
1. Quantity: 1
 2. Band Saw Type: Combination Horizontal/ Vertical
 3. Band Saw Operation: Semi-Automatic.
 4. Voltage: 115V AC.
 5. Hz: 60.

6. HP: 1
7. Max Blade Length: 120 in.
8. Phase 1.
9. Overall Dimensions: 72 inches D x 46 inches D x 34-1/2 inches W.
10. Basis of Design: Jet Band Saw – 53ZC59 as manufactured by Grainger.

S. Multi Process Welder: (MPW)

1. Quantity: (4)
2. Basis of Design: 6-pack Rack Flextex 500 Multi-process Welder – K4099-1 manufactured by Lincoln Electric.

3.2 SHOP EQUIPMENT AND MANUFACTURERS – HVAC TRAINING

A. Saw, Table 10 Inch:

1. Designation on Drawings: **SW1**
2. Number/Location: One (1) as shown on drawings.
3. Power Requirement: 1 phase, 220 V, 13 Amp.
4. Motor: 3 HP.
5. Dust Collection Port: 4 inches.
6. Features:
 - a. 44” w x 34” d x 34” h, 85 1/4” w x 36 1/2” d x 34” h (w/ optional fence & 52” rails).
 - b. 3 HP Motor.
 - c. Cabinet footprint: 19-3/8” w x 19-3/8” d, Cast iron table: 20” w x 27” d, 44” w x 27” d (w/ extension wings).
 - d. Extension wing: 12” w x 27” d.
 - e. Blade: 40-tooth, professional grade, 5/8” arbor, Blade diameter: 10”, Blade tilt: Left, Blade kerf: 3mm, Blade plate thickness: 2mm.
7. Brand/Model: SKU M771543 PCS31230-PFA30 Professional Cabinet Saw as manufactured by SawStop and distributed by Midwest Technology Products.
8. distributed by Midwest Technology Products.

B. Saw, Panel:

1. Designation on Drawings: **SW2**.
2. Number/Location: One (1) as shown on drawings.
3. Power Requirement: 120 volt, 15 amp.
4. Dust Collection Port: 1.5 inch.
5. Features:
 - a. 3.25 HP motor.
 - b. Horizontal and Vertical Cutting.
 - c. 8” Saw Blade.
 - d. 120” frame length.
6. Include:
 - a. 3 Pack of Saw Blades (Wood, Plastics, Aluminum).
 - b. Frame stand.
 - c. Dust collection kit.
 - d. Hold Down Bar.
7. Brand/Model: Safety Speed Manufacturing H-5.

C. Jointer, 6 Inch:

1. Designation on Drawings: **JT1**.
2. Number/Location: One (1) as shown on drawings.
3. Power Requirement: 230v, 1 phase, 20 amps.
4. Dust Collection Port: 4 inch.

5. Features:
 - a. Type of Cutterhead: Helical.
 - b. Number of Knives: 40 Four-sided carbide helical inserts.
 - c. Cutterhead Diameter: 2-1/2 inch.
 - d. Cutterhead Speed: 6,000 rpm.
 - e. Cutting Capacity: 6 inch W x 1/2 inch D.
 - f. Table Size: 66 inch L x 7-1/4 inch W.
 - g. Table Height from Floor: 31-1/2 inch.
 - h. Infeed Table Length: 32-1/2 inch.
 - i. Outfeed Table Length: 32-1/2 inch.
 - j. Fence Size: 38 inch L x 4-3/4 inch H.
 - k. Fence Tilt: 45 degree forward, 45 degree backward.
 - l. Fence Positive Stop: 45 degrees, 90 degrees, -45 degrees.
 - m. Dust Collection Minimum CFM Required: 600.
 - n. Dust Port Outside Diameter: 4 inch.
 - o. Motor Power: 1 HP.
 - p. Motor Phase: 1.
 - q. Motor Voltage: 115/230.
 - r. Rewired Voltage: 115.
 - s. Motor Current: 13/6.5 amps.
 - t. Recommended Circuit Size: 20/10 amps.
 6. Brand/Model: SKU M656669 1791317K 6 inch Jointer Helical Cutterhead as manufactured by Powermatic and distributed by Midwest Technology Products.
- D. Planer, 15 Inch:
1. Designation on Drawings: **PL1**.
 2. Number/Location: One (1) as shown on drawings.
 3. Power Requirement: 230/460V, 3-phase.
 4. Dust Collection Port: 4 inches OD.
 5. Features:
 - a. Motor: 3 HP.
 - b. Cutterhead: 2-7/8 inch diameter 4,500 rpm.
 - c. Helical 74 carbide 4-sided knife inserts.
 - d. Capacity: 14-7/8 inch W x 6 inch thick.
 - e. Depth of cut 1/8 inch to 1/4 inch.
 - f. Unbutted stock 8 inch min.
 - g. Feed rate 16 & 20 rpm.
 - h. Digital readout inch/metric.
 - i. Table size: 48 inch L (w/ extensions) x 15 inch W.
 - j. Tool Size: 28 inch L x 48 inch W x 43-1/2 inch H.
 6. Brand/Model: Deluxe Floor Model Planer (SKU M656603 1791213) as manufactured by Powermatic and distributed by Midwest Technology Products.
- E. Router:
1. Designation on Drawings: **RT1**.
 2. Number/Location: One (1) as shown on drawings.
 3. X Travel: 16 inch.
 4. Y Travel: 12 inch.
 5. Z Travel: 7 inch.
 6. Bridge Clearance: 6 inch.
 7. Repeatability: 0.007 inch.
 8. Positioning Accuracy: (+/-) 0.002.
 9. T-Slot Table: X= 22 inch. Y=16 inch.
 10. Microsoft Windows XP Operating System.
 11. 1.3 GHZ Intel Processor.

12. 17 inch TFT SVGA High Resolution Color.
 13. Flat Panel Display.
 14. Min. 2 Gig of RAM.
 15. Emergency Stop Button.
 16. Brand/Model: EZ Router EZ Square Deluxe.
- F. Sander, Disc 12 Inch:
1. Designation on Drawings: **SS1**
 2. Number/Location: One (1) as shown on drawings.
 3. Features:
 - a. Disc Diameter: 12 inch.
 - b. Disc Speed: 2,375 RPM.
 - c. Disc Table Tilt: 15 degree Up, 45 degree Down.
 - d. Disc Table Size: 17-1/4 inch L x 9 inch W.
 - e. Sanding Belt Size: 6 inch L x 48 inch W.
 - f. Belt Speed: 2,410 RPM.
 - g. Belt Table Tilt: 45 degree Down.
 - h. Belt Table Size: 13-1/4 inch L x 7-1/2 inch W.
 - i. Standing Arm Locking Positions: 0/45/90.
 - j. Dust Collection Minimum CFM Required: 400 CFM.
 - k. Dust Port Outside Diameter: 4 inch.
 - l. Motor Power: 2 HP.
 - m. Motor Phase: 3.
 - n. Motor Voltage: 230/460.
 - o. Prewired Voltage: 230.
 - p. Wiring Remarks: Push Button Switch.
 - q. Motor Current: 7/3.5 Amps.
 4. Brand/Model: SKU M656657 1791292K as manufactured by Powermatic and distributed by Midwest Technology Products.
- G. Wheelbarrow Mixer:
1. Designation on Drawings: **WBM**.
 2. Number/Location: One (1) as shown on drawings.
 3. Features:
 - a. 3.5 cu. ft.
 - b. Power requirements: 115V, 3/4 HP.
 - c. Drum Material: Polyethylene.
 - d. Drum Gauge: 5/16 inch.
 - e. Drum Diameter: 22 inch.
 - f. Drum Opening: 17 inch.
 - g. Frame: Heavy Gauge Steel.
 - h. Handles: Telescoping.
 - i. Locking System: Pin.
 - j. Overall Height: 42 inch.
 - k. Overall Length: 53 inch.
 - l. Overall Width: 25 inch.
 - m. Axle Type: Rigid.
 - n. Wheels: Flat Free Rubber.
 - o. Wheel Diameter: 13-1/4 inch.
 - p. Wheel Width: 3 inch.
 4. Brand/Model: UNSPSC# 33101901, Manufacturer Model #350DD as manufactured by Kushlan Products and distributed by Grainger.

3.3 EQUIPMENT AND MANUFACTURERS – MISCELLANEOUS EQUIPMENT

- A. Cabinet, Shop Tool:
1. Designation on Drawings: **CAB2.**
 2. Number/Location: One (1) as shown on drawings.
 3. Material: Extra Heavy Duty maple full-framing with mortise and tenon joints and birch paneling.
 4. Finish: Natural.
 5. Features:
 - a. Thick doors (1/8 inch T) with heavy-duty brass continuous hinges.
 - b. Upper cabinet are lined with dedicated tool holders.
 - c. Lower cabinet with 1 fixed and 2 adjustable 1 inch veneer core plywood shelves.
 6. Overall Size: 60 inch W x 22 inch D x 84 inch H.
 7. Brand/Model: Item #9PAFO as manufactured by Hann and distributed by Midwest Technology Products.
- B. Cabinet, Flammable Storage:
1. Designation on Drawings: **CAB1.**
 2. Number/Location: One (1) as shown on drawings.
 3. Power Requirements: None.
 4. Features:
 - a. Wall mounted.
 - b. 65 inches H by 43 inches W by 18 inches D.
 - c. Yellow powder coat paint finish.
 - d. 45 gallon capacity.
 5. Mounting height: Operable handle max 48" AFF.
 6. Brand/Model: SKU M439233 TS-12, Model BM45YP as manufactured by Jamco Flammable Cabinet as manufactured by Jamco and distributed by Grainger.
- C. Drill Press, 20 inch:
1. Designation on Drawings: **DP1.**
 2. Number: One (1) as shown on drawings.
 3. Power Requirement: 115/230 volt, single phase.
 4. Features:
 - a. 1-1/2HP motor.
 - b. 12 speeds form 150 to 4,200 RPM.
 - c. Chuck Size: 3/4 inch.
 - d. Taper MT-3.
 - e. Column: 3-3/8 inch diameter.
 - f. Spindle Travel: 4-5/8 inch.
 - g. Table work surface: 18-1/2 inch x 16 inch. Tilt 45 degree R&L.
 - h. Tool Size: 18-1/2 inch x 33-1/2 inch, 67 inch H.
 - i. Ball bearing spindle.
 - j. Built-in worklight.
 - k. Adjustable tension spindle return spring.
 - l. 1/2 inch diameter external positive depth stop with 3-nut locking feature for quick adjustment.
 - m. Upfront on/off switch on drill press head.
 5. Brand/Model: SKU M486005 as manufactured by JET and distributed by Midwest Technology Products.

- D. Bench Drill Press:
1. Designation on Drawings: **DP2**.
 2. Number/Location: One (1) as shown on drawings.
 3. Motor: 115 V, 3/4 HP, 1 phase, 3.0 Amps, 60 Hz.
 4. Swing: 15 inch.
 5. Laser System: Class II.
 6. Type: Bench Top.
 7. Chuck Size: 5/8 inch.
 8. Spindle Travel: 3-1/8 inch.
 9. Table Tilt: 45 degree left and right.
 10. Spindle Taper: MT2/JT3.
 11. Column Diameter: 2-3/4 inch.
 12. Number of Spindle Speeds: 16.
 13. Range of Spindle Speeds: 210-3,500 RPM.
 14. Overall Size: 36.5 inch x 33.2 inch x 12.8 inch.
 15. Table Size: 17 inch W x 12-1/2 inch L.
 16. Base Size: 18 inch L x 11-3/8 inch W x 2-1/4 inch H.
 17. Brand/Model: SKU: M486055 JDP-15B.
18. Axis Drive Motors:
- a. Motor Type: Stepper.
 - b. X Axis: 1.35 N-m.
 - c. Y Axis: 1.35 N-m.
 - d. Z Axis: 2.2 N-m.
 - e. Rapid feed rate: 2000 mm/min 79 ipm.
 - f. Feed rate: 1000 mm/min 40 ipm.
19. Brand/Model: Benchturn 7X00 CNC Turning Center as distributed by Intelitek.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where equipment is to be installed to ensure areas are ready to receive equipment installation.
- B. Ensure that proper utilities are in place. Confirm all power supplies are adequate for final equipment selections. Contractor responsible for all power supply changes needed to support final equipment selections.

3.2 INSTALLATION

- A. Install, hook-up, and start-up all equipment in accordance with manufacturer's instructions.

3.3 ADJUSTING, DEMONSTRATING AND CLEANING

- A. Adjust equipment for proper operation.
- B. Instruct Owner's personnel on proper operation, care, and maintenance of items.
- C. Clean equipment of dirt, dust, fingerprints and markings detrimental to good appearance.

END OF SECTION 11 57 00

SECTION 11 61 00
THEATRICAL LIGHTING SYSTEM

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Construction Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.
- B. TL series Drawings.

1.02 REFERENCES

- A. National Fire Protection Association (NFPA)
- B. National Electrical Code (NEC)
- C. American National Safety Institute (ANSI)
- D. Entertainment Services and Technology Association (ESTA)
- E. National Electrical Manufacturers Association (NEMA).
- F. TX State and City of Houston Building Code.

1.03 RESPONSIBILITY AND RELATED WORK

- A. The written specification and TL series drawings shall be collectively referred to herein as the Contract Documents.
- B. Contractor shall provide, based on the Contract Documents, a complete, turnkey system, tested and ready for acceptance testing. The Contract Documents are developed to the extent required to properly convey design intent and system infrastructure. It is understood by the contractor that they are to supply additional equipment, as required, to provide a complete and working system.
- C. System features or devices which are mentioned in one part of the Contract Documents may not be shown in the other. In case of conflict between the written specifications and the drawings, Contractor must seek clarification from the Consultant. If the Contractor fails to obtain such clarification, the interpretation of the Consultant will prevail.
- D. Contractor shall obtain all licenses and permits necessary for the execution of any work pertaining to the installation within this scope of work.
- E. Refer to TL0.00 for division of responsibilities related to the theatrical lighting system.

1.04 DEFINITION OF TERMS & ABBREVIATIONS:

- A. Provide: to supply and install.
- B. Furnish: to supply to another contractor for installation.
- C. Supply: to supply but not install.
- D. Install: to install but not supply.
- E. OFE: Owner furnished (supplied) equipment. Equipment will be provided to contractor for installation.
- F. NIC: Not In Contract. Refers to items that are not included in the scope of work outlined in this section but may be shown for coordination purposes or reference.
- G. Future: Equipment that will be provided by owner later. Accommodations shall be provided for future equipment as shown on the drawings.

1.05 SYSTEM DESCRIPTION

- A. The theatrical lighting system will use LED-based lighting fixtures where to reduce the operating cost and maintenance effort required to keep the system running.
- B. **LIGHTING POWER AND CONTROLS**
 - 1. Fixtures with integrated dimming capabilities will be used. No dimmer rack or portable dimmer packs will be provided. Non-dimmed power circuits will be distributed to the lighting positions that will accommodate these fixtures (LED or automated lights) as well as providing the opportunity for temporary portable dimmer packs to be used with conventional light fixtures if desired.
 - 2. Controls for the theatrical lighting system will include:
 - a. A lighting control console with at least 2 DMX Universes (expandable to at least 4), sACN (lighting) network connectivity, and the ability to support a minimum of 1 touch screen monitors.
 - b. A stage manager's panel, with a touchscreen that can control basic theatrical lighting presets.
- C. **LIGHTING INSTRUMENTS**
 - 1. The lighting instrument package will include:
 - a. LED Ellipsoidals (beam angles TBD)
 - b. LED PARs
- D. **LOOSE EQUIPMENT**
 - 1. The loose equipment package will consist of:
 - a. DMX cables
 - b. Cat5e Ethernet cables with Ethercon connectors
 - c. 20A Powercon extension cables
 - d. Powercon to SPG adapters

1.06 PRE-BID SUBMITTALS

- A. Comply with all requirements of Division 1.
- B. Bid Clarifications. Contractor is responsible for reading and understanding all information presented in these specifications and related documents outlined in Section 1. Discrepancies between drawings and specifications or other errors or omissions should be brought to the Consultant's attention a minimum of 5 days prior to bid date. Failure to do so does not relieve the contractor from the requirement to provide a fully operational and turnkey system. In this event, the Contractor agrees to abide by the decision of the Consultant for resolution.
- C. Contractor Qualifications. Contractors will be considered by the Owner and Consultant upon receipt of qualifications as outlined in Bid Submittals section below.

1.07 BID SUBMITTALS

- A. Comply with all requirements of Division 1.
- B. Submit according to conditions of the Construction Contract and Project Manual.
- C. Bidders that have not been pre-qualified shall submit the following information:
 - 1. Company profile including history, number of employees, facility size and completed projects.
 - 2. Installer shall have previously installed at least three jobs of similar magnitude, completed within the last five years. A resume shall be provided for these projects including project name, scope of services, year completed, and contact information for a reference. Provide at least one such completed job for inspection by the Architect and/or consultant.

3. Installer shall have five years of experience with equipment and systems of the types specified, shall maintain a fully staffed and equipped service facility, and shall be a franchised dealer and authorized service facility for the major brands specified, and shall be properly licensed to work in Houston, TX
 4. Resume of key personnel to be used on this project, including but not limited to: Project Manager; Lead Engineer; Job-Site Superintendent.
 5. A sample set of shop drawings or as-built documents that confirm the Contractor's capabilities to provide engineering and documentation for the project.
 6. A line sheet listing all manufacturers the Contractor is a dealer and/or authorized service center for.
 7. A description of the Contractor's abilities for in-shop assembly, fabrication, and testing.
- D. The Bidder shall disclose in the bid whether any portions of the project work will be subcontracted out. All terms of this contract, including bidding and qualification statements, shall apply to the subcontractor. Provide the following information for each subcontractor to be used:
1. Name of the proposed subcontractor.
 2. A statement of qualifications for each subcontractor.
 3. A scope of work outlining what portions of the project for which the subcontractor will be responsible.
- E. Include the following information with the bid submittal:
1. The total contract price.
 2. The total price for any add or deduct alternates.
 3. The price for contractor tests and adjustments as outlined in Section 3.3.
 4. An itemized equipment list.
 5. Unit pricing for all equipment listed above.
 6. A breakdown of the number of labor hours for each of the following:
 - a. Engineering and documentation.
 - b. On site coordination meetings and supervision.
 - c. In shop fabrication and assembly.
 - d. On site fabrication, assembly, and installation.
 - e. On site verification and testing.
- F. Substitutions. Contractor shall note all substitutions at the time of bid. Any proposed substitutions must meet all specifications of the specified equipment. No product substitution will be accepted without the written approval of the Consultant or Owner. Consultant and owner retain the right to reject any proposed substitution.
- G. Contractor to obtain all licenses and permits necessary for the execution of any work pertaining to the installation, or any operation by the Owner.

1.08 PROJECT SUBMITTALS

- A. Comply with all requirements of Division 1.
- B. Submit according to conditions of the Construction Contract and Project Manual.
- C. Make each specified submittal as a coordinated package complete with all information. Uncoordinated sets will be returned without review.
- D. Product Data: Submit within 30 days of contract award. Submit manufacturer's product data sheets for each item of equipment that will be provided as part of this contract. Submit electronically as a single PDF. All equipment cut sheets will be arranged per specification section number. Provide a table of contents and a bookmark at the start of every product sheet.
- E. Shop Drawings

1. Submit within 60 days of contract award.
 - a. Failure to submit shop drawings with ample time for evaluation shall not entitle the contractor to an extension of contract time.
 - b. There will be no work authorized on site without the prior submittal (and subsequent approval) of a complete set of shop drawings. Any exceptions to this must be in writing and approved by the Consultant.
 - c. Review of shop drawings is for general conformance with the design intent and general compliance with the contract documents of the project. Corrections, comments or markings made do not relieve the Contractor from compliance with the Contract Documents nor allow departure there from. Contractor remains responsible for detailing and accuracy, confirming and correlating quantities and dimensions, selecting fabrication processing and techniques of construction, coordinating work with that of other trades, and performing work in a safe a satisfactory manner.
2. Submitted as a multi-sheet PDF document with:
 - a. Minimum 11" x 17" sheets
 - b. Table of Contents.
 - c. Bookmarks for every sheet with Sheet Name and Number
3. Drawings shall be a standalone package containing all information required for system installation. The package shall include:
 - a. A legend of all symbols and abbreviations used in the drawing package
 - b. Plan View Drawings showing:
 - 1) Locations of all equipment and devices
 - 2) Locations of junction boxes, with associated conduits and cable fill
 - 3) Coordinated layouts of:
 - a) Equipment Rooms
 - b) Control Booths
 - c) Follow Spot Booths
4. Section and Elevation Drawings including but not limited to:
 - a. Lighting fixture hang positions
5. Equipment Rack Elevations including:
 - a. Location of all equipment within the rack
 - b. Heat loads for each equipment rack and calculations showing how numbers were derived
6. AC Power Requirements
 - a. For each equipment rack show:
 - 1) Power requirements and calculations showing how numbers were derived
 - 2) Power distribution details within each rack
7. Rigging Detail Drawings
 - a. Details will be submitted with licensed engineer stamp licensed in the state in which the project resides.
 - b. Drawings will include:
 - 1) Structural attachment details
 - 2) Welding calculations
 - 3) Types of hardware to be used
8. Wiring Schematics
 - a. Complete and detailed wiring schematic for all systems including:
 - 1) Cable types
 - 2) Identification by number and color codes
 - 3) Detailed wiring of connections to equipment and between equipment racks

9. Schematic drawings of any custom circuitry or equipment modifications, including connector pin-outs and component lists.
- F. Schedules showing:
1. Cable Types
 - a. Type Identifier matching Contract Documents
 - b. Manufacturer
 - c. Part Number
 - d. Signal Group
 - e. Nominal Outside Diameter
 2. Junction Boxes
 - a. Box Name
 - b. Drawing Reference
 - c. Location
 - d. Dimensions
 - e. Mounting Height
 3. Pull Schedule
 - a. Pull Length
 - b. Source and Destination
 - c. Wire Number
 4. Custom Color and Finishes for:
 - a. Fixtures
 - b. Custom Panels
 - c. Exposed Cabling
 5. Conduit riser diagram showing interconnect of all systems
 6. Terminal strip layouts for all terminal strips to be used in junction boxes or equipment racks
 7. Connector wiring details including connector model numbers
 8. Network schematic showing:
 - a. Logical Connections of all devices
 - b. IP address scheme
 - c. VLAN Scheme
 9. Custom Panel Details including:
 - a. Materials
 - b. Finishes
 - c. Dimensions
 - d. Connector Layout
 - e. Connector Labeling
 10. Lighting patch bay layouts and labeling scheme
 11. Mounting and orientation details for:
 - a. Access points
 - b. Wireless antenna
 12. Relay panel physical and electrical details
 13. Control systems physical and electrical details
 14. Distribution devices physical and electrical details
- G. Final Inspection Notification Report- Two copies of a computer-generated checkout report for the entire system will be prepared and submitted two weeks prior to system commissioning. It will include:

1. A complete listing of every piece of equipment including serial number, the date it was tested and by whom, the results and (if failure occurred during any previous tests) the date retested
2. The final report will indicate that every device tested successfully.
3. A performance test report indicating that the system meets all of the Contractor testing requirements in Section 3.3 and 3.5.
4. A copy of the Final Inspection Report shall be included in the Project Manual.

1.09 CONTRACT CLOSEOUT SUBMITTALS

- A. Comply with all requirements of Division 1.
 1. Submit all contract closeout documentation within 30 days after substantial completion, unless otherwise noted. Documents should be contained on a single USB Drive.
- B. Contractor shall work from approved shop drawings only. Note changes made during installation on a single set of drawings. This set of marked up drawings will not leave the jobsite until after the final system commissioning. Submit one corrected set of reproducible drawings showing work as installed. All “as-built” drawings to be provided in electronic form (ACAD 2010 or later and PDF).
- C. Contractor to provide a Project Manual prior to acceptance testing. Provide one electronic copy (PDF). This manual shall contain the following information:
 1. Table of Contents.
 2. A legend of acronyms and abbreviations must accompany all documentation.
 3. Contractor’s contact information for warranty and or service.
 4. A complete list of equipment, both installed and loose gear. Include manufacturer, model number, and serial number for all devices. Include settings (software or hardware settings) for any devices that required modification or adjustment during the acceptance testing.
 5. Operating manuals for each device.
 6. Service manuals for each device.
 7. Documentation of all testing results as outlined in Section 3.3 and 3.5
 8. Replacement parts lists of major items of equipment.
 9. Suggested schedule of routine maintenance. Schedule should include dates such as of replacement of all batteries, cleaning of air filters etc.
 10. System Operation and Instructions- Prepare a complete and typical procedure for the operation of the equipment as a system, organized by subsystem or activity. This procedure should describe the operation of all system capabilities. Assume the intended reader of the manual to be unfamiliar with both the equipment and this facility.
 11. A list of all equipment, indicating manufacturer, model, serial number, and equipment location (i.e. panel/rack/room number). Update following acceptance testing, if changed.
 12. As-Built drawings to include the following:
 - a. Updated lighting hang plot with circuit numbering and control addressing.
 - b. Lighting distribution plot.
 - c. Updated instrument schedule and hook up sheets.
- D. Software Licensing and Manuals. Provide backup computer discs, all software manuals and license certificates for all software loaded on all PC’s. Include all original software installed, or downloaded, to devices in the system as part of the USB Drive.
- E. Asbestos and PCB Certification: After completion of installation, but prior to Substantial Completion, Contractor will certify in writing that products and materials installed, and processes used, do not contain asbestos or polychlorinated biphenyls (PCB).

1.10 DELIVERY, HANDLING, STORAGE

- A. Comply with Division 1 General Conditions.

1.11 CODE COMPLIANCE

- A. All work and materials shall comply with all applicable codes and regulations to meet or exceed Federal, State, City, and Local Building Codes and Regulations. Advise the Architect if anything in the Plans or Specifications is out of compliance with codes and/or laws prior to bidding.

1.12 PROJECT CONDITIONS

- A. Verify conditions on the job site applicable to this work. Notify the General Contractor in writing of discrepancies, conflicts, or omissions promptly upon discovery.
- B. The drawings diagrammatically show cabling, conduit, wiring, and arrangements of equipment fitting the space available without interference. If conditions exist which make it impossible to install work as shown, recommend solutions and/or submit drawings to the Consultant for approval, showing how the work may be installed.

1.13 WARRANTY

- A. Installer shall warrant equipment to be free of defects in materials and workmanship for not less than one year after date of Substantial Completion. Defects occurring in labor or materials within one-year warranty shall be rectified by replacement or repair. Within the warranty period, provide answer to service calls and requests for information within a 24-hour period, and repair or replace any faulty item within a 72-hour period without charge, including parts and labor.
- B. This warranty shall not include any consumable items (eg. patterns).
- C. This warranty shall not void specific warranties issued by manufacturers for greater periods of time. Nor shall it void any rights guaranteed to the Owner by law.
- D. Theatrical Lighting Contractor to provide Owner with exact beginning and ending dates of the warranty period. Include the name of the person to call for service and telephone number. This information to be part of Project Record Drawings.

PART 2 PRODUCTS

2.01 UNAUTHORISED MATERIALS

- A. Materials and products required for work of this section shall not contain asbestos, polychlorinated biphenyls (PCB) or other hazardous materials identified by the General Contractor or Owner.
- B. All devices shall have applicable approvals from a Nationally Recognized Testing Laboratory and meet all applicable local codes and requirements. Should any equipment lack proper approval the Contractor will arrange for onsite inspections and certification at no additional expense to the Owner.

2.02 ACCEPTABLE MANUFACTURERS

- A. Model numbers and manufacturers included in this specification are listed as a standard of quality.
- B. Consultant will consider other qualified manufacturers subject to review. Submit according to conditions of the Construction Contract and Project Manual.
- C. Proposed substitutions must meet all specifications of the specified equipment. The Contractor will supply complete technical data specifications at the time of proposed substitution.

- D. The Contractor will arrange for product demo at the request of the Consultant or Owner Representative and will pay ground freight shipping to and from site, or to and from Consultant's office.
- E. No product substitution will be accepted without the written approval of the Consultant and Owner. The Owner, General Contractor, and the Consultant reserve the right to accept or refuse any substitution without condition.
- F. Upon acceptance of a substitution, Contractor assumes all responsibility for verification and coordination of all heat, power, rack space and architectural requirements.
- G. If product is discontinued and/or no longer publicly advertised as a part of a manufacturer's current product line-up at time of installation, the project team reserves the right to request a substitution of product for new and currently offered product of like function fulfilling the design intent. Substitution value will be based on fair market value of original product at time of bid.

2.03 GENERAL

- A. Equipment and materials shall be new, meet the latest published specifications of that product, and conform to applicable regulatory provisions. Take care during installation to prevent scratches, dents, chips, etc.
- B. Theatrical Lighting Contractor shall verify all site conditions prior to fabrication and installation of all equipment. Notify Consultant of any discrepancies in site conditions or design documents as soon as identified.
- C. Wiring of power distribution cable shall be in accordance with the electrical engineer's specification.
- D. Wiring of control distribution cable shall be in accordance with the manufacturer's specification.
- E. Installation of theatrical lighting support pipes shall be in accordance with the structural engineer's specification.
- F. All products and materials to be handled and shipped in accordance with manufacturer's recommendation.
- G. Provide protective covering on equipment and furniture during construction to prevent damage or entrance of foreign matter.
- H. Replace at no expense to Owner, product damaged during delivery, storage, handling or construction.

2.04 LAKES HS AUDITORIUM - THEATRICAL LIGHTING SYSTEM

- A. Lighting Control Console (Quantity: 1)
 - 1. ETC Ion Xe 20 with 12,288 outputs
 - 2. Provide two (2) 27" Touchscreen Monitor with Black Bezel and minimum 1920 x 1080 resolution.
 - 3. Provide one (1) appropriately sized Desktop UPS device (No cooling fans).
 - 4. Provide one (1) 15' Cat 5e Network Patch Cable
- B. DMX Rack Mount 4-Port Node (Quantity: 6)
 - 1. ETC Response Mk2 4-Port-Terminal
 - 2. Provide with Gateway Rack Mount Kit.
 - 3. Provide with all necessary patch cables to interface with lighting network.
 - 4. Units shall be mounted in racks A.LER.01 and A.LER.02.
- C. DMX Portable Two Port Node (Quantity:6)
 - 1. ETC Response Mk2 RSN-DMX2-0-P

2. Provide node mounted in back box with clamp for portable hanging.
 3. Provide node with 7.5 foot Network patch cable.
 4. Portable node shall be powered via Ethernet.
 5. Color to be Black.
- D. Network Patch Panel (Quantity: 4)
1. Provide Bittree or approved equivalent.
 2. Provide appropriately sized network patch panel.
 3. Provide as standard rack mountable unit.
 4. Patch panels shall be located in racks A.LER.01 and A.LER.02.
- E. Single Space Brush Panel (Quantity: 6)
1. Provide Middle Atlantic BR1 or approved equivalent.
- F. Network POE Switch (Quantity: 2)
1. CISCO CBS350-24P or approved equivalent
 2. Provide as standard rack mountable unit.
 3. Switches shall be located in racks A.LER.01 and A.LER.02.
- G. Wall Mounted Network Switch (Quantity: 1)
1. ETC Simple Network Box SNB8FP or approved equivalent.
 2. Box is labelled as A.LER.03.
- H. Lighting Console Interface Panel NET/NET/NET (Quantity: 2)
1. ETC or approved equivalent.
 2. Panel labeled as A.LWP.01 & 02.
 3. Provide these as flush wall plates w/Ethercon receptacles mountable in existing backbox locations.
- I. NET Plug In Ethercon Panel (Quantity: 7)
1. ETC or approved equivalent.
 2. Provide this as a flush wall plate w/Ethercon receptacle mountable in either existing or new backbox locations.
 3. Panels labelled as A.LWP.03 thru 09.
- J. NET Plug In Pipe Mount Ethercon Box (Quantity: 4)
1. ETC or approved equivalent.
 2. Provide this as single receptacle u-bolt pipe mount box w/Ethercon receptacle.
 3. Panels labelled as A.LPB.04 thru 07.
- K. Dimmer Rack Renovation (Quantity: 2)
1. Provide ETC Sensor SR48 Rack Power Package upgrade w/5 year warranty.
- L. Dimmer Rack Renovation (Quantity: 1)
1. Provide ETC Sensor SR12 Rack Power Package upgrade w/5 year warranty.
- M. Theatrical Lighting DMX/NET Relay Rack, 24 space (Quantity: 1)
1. ETC ECHO Pass through
 2. Provide with twenty-four (24) 20A single pole relays.
- N. Ellipsoidal Theatrical Lighting Instrument (Quantity: 66)
1. ETC ColorSource Spot V w/shutter assembly or approved equivalent.
 - a. 19° - 28
 - b. 26° - 14
 - c. 36° - 20
 - d. 50° - 4
 2. Provide complete with c-clamp, gel frame, safety cable and 3' lead terminated to a L5-20 plug.

3. Refer to Theatrical Lighting Plan for hang and focus details.
- O. Fresnel Theatrical Lighting Instrument (Quantity: 27)
 1. ETC ColorSource Fresnel V or approved equivalent.
 2. Provide complete with c-clamp, gel frame, safety cable and 3' lead terminated to a L5-20 plug.
 3. Refer to Theatrical Lighting Plan for hang and focus details.
- P. Cyc Theatrical Lighting Instrument (Quantity: 18)
 1. ETC ColorSource Cyc or approved equivalent.
 2. Provide complete with c-clamp, gel frame, safety cable and 3' lead terminated to a L5-20 plug.
 3. Refer to Theatrical Lighting Plan for hang and focus details.
- Q. PARnel Theatrical Lighting Instrument (Quantity: 22)
 1. ETC Source4WRD II retrofit kit and Source4WRD PARnel fixture body or approved equivalent.
 2. Provide complete with c-clamp, gel frame, safety cable and 3' lead terminated to a L5-20 plug.
 3. Refer to Theatrical Lighting Plan for hang and focus details.
- R. Linear Theatrical Lighting Instrument (Quantity: 5)
 1. ETC ColorSource Linear 2 or approved equivalent.
 2. Provide complete with c-clamp, floor trunion, gel frame, safety cable and 3' lead terminated to a L5-20 plug.
 3. Refer to Theatrical Lighting Plan for hang and focus details.
- S. LED Followspot (Quantity: 2)
 1. Canto Aurora X1 Short or approved equivalent.
 2. Provide complete with floor stand and 15' power cord terminated to a NEMA 5-15P.
- T. DMX Extension Cable (Quantity: 150)
 1. 5' – 5
 2. 10' – 5
 3. 15' – 140
 4. Cables shall be labeled for length using appropriately sized self-adhesive numbers 3" from both connector ends covered by clear heat shrink tubing.
 5. Cables shall be supplied with one (1) appropriately sized Velcro cable tie.
 6. Cables shall be black.
 7. Cable shall be constructed according to USITT DMX512/1990 standard.
 8. Cables shall be constructed with one (1) 5 pin XLR Male connector and one (1) 5 pin XLR Female connector.
- U. 20A PowerCon TRUE1 Extension Cable (Quantity: 150)
 1. 5' – 5
 2. 10' – 5
 3. 15' – 140
 4. Cables shall be labeled for length using appropriately sized self-adhesive numbers 3" from both connector ends covered by clear heat shrink tubing.
 5. Cables shall be supplied with one (1) appropriately sized Velcro cable tie.
 6. Cables shall be black.
 7. Cable shall be constructed using 12/3 SJOO-W cable.
 8. Cables shall be constructed with PowerCon TRUE1 connectors rated for 120vac @ 20amp loads.
- V. RJ45 to 5-Pin Female Connector (Quantity: 12)

- W. 3' Molded Cat6 Patch Cable (Quantity: 64)
- X. Color Media:
 - 1. Provide a color media allowance for 12 – 20” x 24” sheets of R119.

2.05 LAKES HS AUDITORIUM - ARCHITECTURAL LIGHTING CONTROL SYSTEM

- A. Architectural Control Rack (Quantity: 1)
 - 1. ETC Unison ERn2-RM
 - 2. Provide with one (1) P-ACP architectural control processor.
 - 3. Provide with one (1) P-SPM-E Station Power Module.
 - 4. Unit shall be mounted in rack A.LER.01.
- B. Architectural LCD Touchscreen Station (Quantity: 1)
 - 1. ETC Unison P-TS7-PE
 - 2. Provide with portable desktop stand 95622.
 - 3. Provide Station with 25' cable.
 - 4. Confirm color with architect.
- C. Architectural LCD Rack Mount Touchscreen Station (Quantity: 1)
 - 1. ETC Unison P-TS7-PE
 - 2. Provide with rack mount plate.
 - 3. Color to be black.
- D. Architectural Entry Station (Quantity: 2)
 - 1. ETC Unison UH10001-_1F.
 - 2. Confirm color with architect.
- E. Architectural Entry Station (Quantity: 2)
 - 1. ETC Unison UH10002-_1F
 - 2. Confirm color with architect.
- F. Architectural Entry Station (Quantity: 2)
 - 1. ETC Unison UH10003-_1F
 - 2. Confirm color with architect.
- G. Architectural Entry Station (Quantity: 2)
 - 1. ETC Unison UH10002-_1F with custom coverplate for existing back boxes.
 - 2. Confirm color with architect.
 - 3. A.LWP.19 & 20
- H. Architectural Entry Station (Quantity: 3)
 - 1. ETC Unison UH40604-_1P with custom coverplate for existing back boxes.
 - 2. Confirm color with architect.
 - 3. A.LWP.16 thru 18
- I. Emergency Bypass Detection Kit (Quantity: 1)
 - 1. ETC Emergency Bypass Detection Kit EBDK
- J. Emergency Bypass DMX Controller (Quantity: 1)
 - 1. ETC DMX Emergency Bypass Controller DEBC-6

2.06 LAKES HS BLACK BOX – THEATRICAL LIGHTING SYSTEM

- A. Lighting Control Console (Quantity: 1)
 - 1. ETC Ion Xe 20 with 2,048 outputs
 - 2. Provide two (2) 27” Touchscreen Monitor with Black Bezel and minimum 1920 x 1080 resolution.
 - 3. Provide one (1) appropriately sized Desktop UPS device (No cooling fans).
 - 4. Provide one (1) 15’ Cat 5e Network Patch Cable

- B. Equipment Racks Wall Mounted (Quantity: 1)
 - 1. MIDDLE ATLANTIC DWR series 22" Deep Racks
 - 2. Provide appropriately sized rack for equipment listed in this spec as being located within the rack.
 - 3. Provide rack with sufficient horizontal cable managers to separate all switches and patch bays with one cable manager each. PANDUIT WMPF1E or approved equivalent.
 - 4. Provide rack with appropriately sized blank filler panels to close all unused rack spaces.
 - 5. Provide rack with sufficient and appropriately sized hook and loop fastener cable ties to neatly dress all patch cables for the lighting network.
 - 6. Provide rack with appropriately sized rack mount UPS to power all equipment located in the rack.
 - 7. Rack is labelled as BB.LER.01
- C. DMX Rack Mount 4-Port Node (Quantity: 1)
 - 1. ETC Response Mk2 4-Port-Terminal
 - 2. Provide with Gateway Rack Mount Kit.
 - 3. Provide with all necessary patch cables to interface with lighting network.
 - 4. Unit shall be mounted in rack BB.LER.01.
- D. Network Patch Panel (Quantity: 2)
 - 1. Provide Bittree or approved equivalent.
 - 2. Provide appropriately sized network patch panel.
 - 3. Provide as standard rack mountable unit.
 - 4. Patch panels shall be located in racks BB.LER.01.
- E. Single Space Brush Panel (Quantity: 3)
 - 1. Provide Middle Atlantic BR1 or approved equivalent.
- F. Network POE Switch (Quantity: 1)
 - 1. CISCO CBS350-24P or approved equivalent
 - 2. Provide as standard rack mountable unit.
 - 3. Switch shall be located in rack BB.LER.01.
- G. DMX Two Port Node (Quantity:8)
 - 1. ETC Response Mk2 RSN-DMX2-0-P or approved equivalent.
 - 2. Provide node mounted in back box with clamp for portable hanging.
 - 3. Provide node with 15' Network patch cable.
 - 4. Portable node shall be powered via Ethernet.
 - 5. Color to be black.
- H. Theatrical Lighting DMX/NET Relay Rack, 24 space (Quantity: 1)
 - 1. ETC ECHO Mains Feed
 - 2. Provide with twenty-four (24) 20A single pole relays.
- I. Lighting Pipe Mount Box (Quantity: 30)
 - 1. ETC 9800 Series with offset brackets or approved equivalent
 - 2. Pipe boxes of the following configurations:
 - a. BB.LPB.01, 03, 04, 06, 08, 11, 13, 15, 16, 18, 20, 23, 25, 27, 28 and 30:
 - 1) 1 - 120V util ckts to 1 – L5-20 flush receptacle and 1 – Ethercon network control receptacle.
 - b. BB.LPB.02, 05, 07, 09, 10, 12, 14, 17, 19, 21, 22, 24, 26 and 29:
 - 1) 1 - 120V util ckt to 1 – L5-20 flush receptacle.
 - 3. Pipe mount boxes shall be mounted to 1 ½" Schedule 40 pipe in locations as shown on the drawings.

4. Pipe mount boxes shall include labeling indicating what source(s) they are fed from located on the faceplate of the box. It is the responsibility of the theatrical lighting contractor to request this information.
 5. All low voltage control wiring shall be integral to the box and shall be isolated from the high voltage wiring by a low voltage barrier.
 6. All network connectors to be uniquely labeled using LTIE.XX. Label to contain the run length of the network cable and the maximum length of extension cable allowed between the network jack and any device connected to the jack.
 7. Relay panel circuits shall be labeled indicating what source(s) they are fed from located adjacent to the utility circuit receptacle. It is the responsibility of the theatrical lighting contractor to request this information.
 8. Relay panel circuits and numbering shall be located as noted on drawings
- J. Network/AC Plug In Panel (Quantity: 5)
1. ETC or approved equivalent.
 - a. BB.LWP.01:
 - 1) 1 - 120V util ckt to 1 – 5-20 flush duplex receptacle and 1 – Ethercon network control receptacle.
 - b. BB.LWP.02 thru 05:
 - 1) 1 - 120V util ckt to 1 – L5-20 flush receptacle and 1 – Ethercon network control receptacle.
 2. Provide this as a flush wall plate mountable in a standard 2 Gang (Deep) backbox supplied by others.
 3. Panel labelling TBD.
- K. Ellipsoidal Theatrical Lighting Instrument (Quantity: 20)
1. ETC ColorSource Spot V w/shutter assembly or approved equivalent.
 - a. 19° - 0
 - b. 26° - 20
 - c. 36° - 10
 - d. 50° - 0
 2. Provide complete with c-clamp, gel frame, safety cable and 3' lead terminated to a L5-20 plug.
 3. Refer to Theatrical Lighting Plan for hang and focus details.
- L. Fresnel Theatrical Lighting Instrument (Quantity: 20)
1. ETC ColorSource Fresnel V or approved equivalent.
 2. Provide complete with c-clamp, gel frame, safety cable and 3' lead terminated to a L5-20 plug.
 3. Refer to Theatrical Lighting Plan for hang and focus details.
- M. DMX Extension Cable (Quantity: 52)
1. 15' – 40
 2. 25' – 12
 3. Cables shall be labeled for length using appropriately sized self-adhesive numbers 3" from both connector ends covered by clear heat shrink tubing.
 4. Cables shall be supplied with one (1) appropriately sized Velcro cable tie.
 5. Cables shall be black.
 6. Cable shall be constructed according to USITT DMX512/1990 standard.
 7. Cables shall be constructed with one (1) 5 pin XLR Male connector and one (1) 5 pin XLR Female connector.
- N. 20A PowerCon TRUE1 Extension Cable (Quantity: 52)
1. 15' – 40

2. 25' – 12
 3. Cables shall be labeled for length using appropriately sized self-adhesive numbers 3" from both connector ends covered by clear heat shrink tubing.
 4. Cables shall be supplied with one (1) appropriately sized Velcro cable tie.
 5. Cables shall be black.
 6. Cable shall be constructed using 12/3 SJOO-W cable.
 7. Cables shall be constructed with PowerCon TRUE1 connectors rated for 120vac @ 20amp loads.
- O. 3' Molded Cat6 Patch Cable (Quantity: 24)
- P. Gobo Holder (Quantity: 12)
1. ETC 400PH-A or approved equivalent.
- Q. Steel Gobo, A size (Quantity: 24)
1. Patterns TBD.
- R. Color Media:
1. Provide a color media allowance for 4 – 20" x 24" sheets of R119.

2.07 LAKES HS BLACK BOX - ARCHITECTURAL LIGHTING CONTROL SYSTEM

- A. Vacancy Sensor (Quantity: 4)
1. ETC EVAC-SR-4 small room vacancy sensor or approved equivalent
 2. Color to be black.
- B. Touch Screen / Controller (Quantity: 1)
1. ETC ETS-4 EchoTouch MK2 controller or approved equivalent
- C. Architectural Entry Station (Quantity: 2)
1. ETC E10002-4 2 button Inspire or approved equivalent
 2. Color to be black.
- D. Interface Station (Quantity: 1)
1. ETC EACC-4 Echo Access Interface or approved equivalent
 2. Color to be black.
- E. Architectural Power Module (Quantity: 1)
1. ETC E-SPM-A Unison Drd Echo Station Power Module with Auxilliary Station Power or approved equivalent
- F. Emergency Bypass Detection Kit (Quantity: 1)
1. ETC Emergency Bypass Detection Kit EBDK
- G. Emergency Bypass DMX Controller (Quantity: 1)
1. ETC DMX Emergency Bypass Controller DEBC-1

PART 3 EXECUTION

3.01 GENERAL

- A. Coordinate work with other trades to avoid causing delays in construction schedule.
- B. Mount equipment and enclosures plumb and square. Permanently installed equipment shall be firmly and safely held in place.
- C. Cover edges of cable pass-through holes in chassis, racks, boxes, etc., with rubber grommets or Brady GRNY nylon grommeting.
- D. Mount equipment in racks and consoles and fully wire and test before delivery to job site. If field conditions prevent prior assembly of racks, notify Consultant in writing that racks will be fabricated on site and the reasons for the change.

3.02 CONTRACTOR/THEATRICAL LIGHTING CONTRACTOR INSTALLATION

- A. Confirm by site visit and by report from electrical contractor all field conditions, which may affect manufacture and installation of the Theatrical and Architectural Lighting Systems equipment prior to fabrication. Provide any additional hardware, panels and backboxes to accommodate field conditions. Submit all changes to equipment and mounting details to Consultant for review prior to fabrication.
- B. Supply specific, detailed direction to electrical contractor as required for proper installation of all Theatrical and Architectural Lighting System equipment, coordinated with actual site conditions.
- C. The Theatrical Lighting Contractor shall furnish all items required to properly install and secure Theatrical and Architectural Lighting System equipment in place.
- D. The electrical contractor shall place, install, and connect all Theatrical Lighting System equipment with the following exceptions:
 - 1. Theatrical and architectural control wire terminations.
 - 2. Theatrical fixtures set up, hang, and focus.
 - 3. Theatrical control console set up and programming.
 - 4. Architectural control station install, setup, and programming.
- E. If any panel, distribution box, or other device requires relocation or change of mounting detail, and this fact is not known until after shipment due to sequence of work, modify equipment or provide new equipment to fit revised location or mounting detail. Notify Consultant of any such changes and submit all changes to Consultant for review prior to fabrication.
- F. The Theatrical Lighting Contractor shall terminate all control wire in dimmer banks and all control panels.
- G. All control cables within the system shall be labeled with a unique identifying number at each end of the cable. Use only pre-printed labels. Cover labels with clear heat shrink tubing. Self-adhesive labels will not be allowed without prior approval of Consultant.
- H. Provide a service loop for all control cables and harness in place where applicable. No splices shall be allowed inside of control panels or racks. Provide terminal strips secured to panel or rack frame for all connections.
- I. Supply GC with all paint and supplies to correct minor cosmetic damage to equipment. Ensure that all equipment is clean and in perfect condition at time of Completion Checkout.
- J. Repair or replace any equipment, which has suffered non-cosmetic damage prior to time of Completion Checkout. Claims arising from repair or replacement of such damage shall be considered only after final acceptance of system by Owner.
- K. The contractor shall clean all racks, panels, and boxes of dirt, dust and debris, re-assemble all equipment, and replace all panels, covers and screws prior to time of Completion Checkout.
- L. Contractor shall not use any control equipment intended for installation for purpose of checking out wiring or circuitry prior an on-site factory trained technician testing the system (as specified above). Equipment may be used for such testing only in specific areas where proper conditions exist.
- M. Any existing equipment that is not required for the renovation to be salvaged by contractor/electrical contractor/theatrical lighting contractor and coordinated with owner as to whether it should be turned over or disposed of properly.

3.03 THEATRICAL LIGHTING CONTRACTOR TESTS AND ADJUSTMENTS

- A. Lamp all fixtures with the specified lamps and where applicable bench focus fixtures to a flat, even field.

- B. Hang, focus and color all lighting fixtures according to the Theatrical Fixture Layout drawing.
- C. Set up lighting control console and all related peripheral devices to include soft patching the console according to supplied paperwork.
- D. Set up and programming of architectural lighting control system and all related peripheral devices.
- E. Prior to energizing Production Lighting control systems, perform complete system checkout to verify that all items are correctly installed and shall safely operate as specified herein.
- F. Perform all tests and adjustments specified below upon Completion of installation of Production Lighting System.

3.04 TEST EQUIPMENT

- A. The following equipment shall be available for field-testing. Submit for approval, as a portion of the tender, list of test equipment.
 - 1. Ethernet Network cable and termination Qualifier
 - 2. DMX512 Protocol Tester.
 - 3. True RMS Multimeter, and clamp on ammeter.
 - 4. Circuit tester with adapters for all power receptacles provided in this section.
 - 5. Appropriate loads to test 100% of Theatre Lighting Circuits.
 - 6. Theatrical Lighting Contractor shall provide all appropriate adapters, extension cables and connectors necessary to interconnect test equipment to Theatrical Lighting system, and to perform all tests described below.
 - 7. Theatrical Lighting Contractor shall provide sufficient field service personnel (minimum of 2) to perform all tests specified below. Coordinate with the Division 26 contractor and to assist in all tests specified below. The contractor shall provide ladders and other devices, including 4 walkie-talkies, to allow access to all devices to be tested and communication between parties.

3.05 TEST PROCEDURES

- A. Perform all following tests & provide a written test report to the consultant:
 - 1. Test all low voltage DMX/Architectural/Network circuits for proper wiring/termination, cable length, cable faults, Power Over Ethernet (POE) quality, and inducted voltage. Qualify Network circuits for Full Duplex 100BASE-TX operation. All Network tests to be executed after all Building Systems have been energized and are operating. Provide a written report of all test results organized by box/location.
 - 2. Inspect all device labels to ensure that devices are correctly and clearly labeled as specified and shown in specifying consultant approved submittal drawings.
 - 3. Test all line voltage circuits for proper wiring, polarity, connection to proper dimmer, and inspect for correct labeling.
 - 4. Test all power receptacles provided in this section.
 - 5. Test all Control Console operations.
 - 6. Test all control panels for all functions.
 - 7. Test all functions of all remote devices and all control plug-in points. When remote devices are NIC, but accommodations for these devices are included, provide identical devices for testing purposes.
 - 8. Test Control Console video systems for clear screen and high resolution of characters.
 - 9. Test all extension cables, adapters, etc.
 - 10. Perform visual testing of LED fixture dimming curves and consistency of dimming across all fixtures.
- B. Repair or replace any equipment that fails to conform to specification, and schedule second set of tests and adjustments. Provide test equipment and personnel specified above.

- C. Repeat testing and repair or replacement as required ensuring that the entire Theatrical Lighting System conforms to specification.
- D. Upon completion of testing, furnish Owner and Consultant a complete report on all field-testing and adjustment, certifying that system conforms to specification and that installation is complete and ready for inspection.

3.06 ACCEPTANCE

- A. Schedule inspection by Owner and Consultant no earlier than their receipt of above specified report.
- B. Provide all test equipment and personnel specified in "Field Testing and Adjustment" above.
- C. Coordinate with GC to ensure that no other work shall be scheduled in audience chamber or stage areas, and that all temporary bracing and scaffolding has been removed to permit full operation of and access to all equipment.
- D. At request of Consultant, repeat any and all test specified in "Field Testing and Adjustment" above in presence of Owner and Consultant.
- E. Should Owner or Consultant judge that any equipment fails to conform to specification, repair or replace that equipment within 30 days, and schedule second inspection. Should the Owner or Consultant judge that any work inspected is not substantially complete at time of Completion Checkout, schedule second inspection. Provide all equipment and personnel specified above.
- F. Schedule additional checkouts as required until Owner and Consultant judge entire Theatrical Lighting System to conform to specification.

3.07 INSTRUCTION OF OWNER PERSONNEL

- A. Provide four hours instruction to Owner designated personnel on the use and operation of the System, scheduled as one session, by an instructor fully knowledgeable and qualified in system operation. This instruction should include familiarization with all system components and basic operation of the lighting control console and architectural control system. The owner may record the instruction session at their cost. The System Reference Manuals shall be complete and on site at the time of this instruction.
- B. The lead technician for the project installation shall be present at the first two formal uses of the system.

END OF SECTION

SECTION 11 61 33
RIGGING SYSTEMS AND CONTROLS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Construction Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.
- B. Theatrical rigging system drawings (TE series).

1.02 SCOPE

- A. Intent: This specification covers the fabrication, furnishing, delivery, and installation of the Theatrical rigging system. The form of contract, general conditions, and the project drawings are considered to be parts of these specifications.
- B. Complete System: The Rigging Contractor shall provide all items necessary for a complete, safe, fully functional system as described herein, including all tools, scaffolding, labor, and supervision, even though they may not be specifically enumerated. Any errors, omissions or ambiguities do not relieve the Contractor of this responsibility but shall be brought to the attention of the Architect for clarification.
- C. Work Included: The work of this section shall include, but not necessarily be limited to the following:
 - 1. Theatrical Curtains, Tracks and Accessories
 - 2. Theatrical Lighting Pipe Grid
- D. Related Work: Related work which is not included in this section:
 - 1. Gridiron, head and loft block beams, and all other structural steel and miscellaneous metals not specifically called out as part of this section.
 - 2. Galleries, ladders and catwalks.
 - 3. Stage flooring.
 - 4. Theatrical lighting.
 - 5. Electrical connections, conduit, boxes and wiring of any type.

1.03 GENERAL REQUIREMENTS

- A. Field Conditions: All bidders shall fully inform themselves of the conditions under which the work is to be performed. No additional compensation shall be allowed for any labor or item the bidder could have been fully informed of prior to the bid date.
- B. Safety: The systems shall conform to all applicable code requirements and shall be in conformance with industry standards of operation and practices. All materials, arrangements, and procedures shall comply with applicable code requirements, allowing the users to arrange and operate a safe assembly and working environment for audience and user personnel.
- C. Insurance: In the absence of more stringent requirements, the Rigging Contractor shall maintain injury and property liability insurance coverage throughout the project's scheduled timetable, including workmen's compensation coverage for Contractor's employees.

1.04 RESPONSIBILITY AND RELATED WORK

- A. The Theatrical Rigging Contractor shall be responsible for the following:
 - 1. Coordinate with the project Structural Engineer and verify the load capacities of the building structure where it interfaces with the rigging system.
 - 2. Provide all miscellaneous steel required for support of the Theatrical rigging system.

3. Perform regular site visits (minimum of one monthly) after steel erection is completed to provide coordination with all other trades that may conflict with the installation and operation of the rigging system.
 4. Provide regular reports of all site visits to the Architect, Client, and Consultant that document all coordination issues and their resolutions in regards to the rigging system.
 5. Provide and install all rigging system components.
 6. Terminate all control distribution cable, which shall be done in accordance with the manufacturer's specification.
 7. Furnish to the Electrical Contractor for installation all line level components and their housings.
 8. Provide a factory trained technician for system commissioning, including inspection, testing, and programming for the complete project.
 9. Provide shop drawings, As-built drawings, owner training, and operation manuals.
 10. Provide accessories and minor equipment items needed for a complete system, even if not specifically mentioned herein or in the drawings, without claim for additional payment.
 11. Assume responsibility for all engineering of systems described herein, including modification of and addition to any details as required in order to fulfill the design intent of the theatrical rigging system contract documents.
 12. Furnish sufficient workmen to operate all equipment and to assist in all tests specified. Provide ladders and other access devices, including 4 walkie-talkies, to allow access to all devices to be tested and communication between parties.
 13. Contractor shall obtain all licenses and permits necessary for the execution of any work pertaining to the installation within this scope of work.
- B. The Electrical contractor shall be responsible for the following:
1. Provide, install, and terminate all high voltage feeder circuits for the theatrical rigging system.
 2. Provide and install all low voltage control cabling.
 3. Provide and install all conduit, junction boxes, electrical wireways, and cable trays required for the rigging power and control systems.
 4. Pull all high voltage and low voltage cable in conduit.
 5. Provide sufficient workmen to assist Theatrical Rigging Contractor with system troubleshooting at first system energization.
 6. Clean all racks, panels, and boxes of dirt, dust and debris, re-assemble all equipment, and replace all panels, covers and screws prior to time of Completion Checkout.

1.05 REFERENCES

- A. International Building Code
- B. Underwriters Laboratories (U.L.)
- C. Occupational Safety and Health Administration (O.S.H.A.)
- D. National Fire Protection Association (N.F.P.A.).
- E. National Electrical Code (N.E.C.).
- F. American National Safety Institute (A.N.S.I.).
- G. Electronics Industries Association (E.I.A).
- H. TX State and City of Houston Building Code.
- I. National Electrical Manufacturers Association. (N.E.M.A.)
- J. Entertainment Services and Technology Technical Standards (E.S.T.A.)

1.06 SUBMITTALS

- A. **Product Data:** Submit manufacturer's product data sheets for each item of equipment in accordance with Division 1 of the project manuals. Data submittals shall be highlighted, alphabetized and tabbed. The Theatrical Rigging Contractor shall also provide a table of contents and quantities for all equipment.
- B. **Shop Drawings:** Indicate complete details and dimensions of work to be performed and indicate types and locations of equipment, fabricated equipment, and other details to completely describe work to be performed. Provide one PDF electronic file of submittal drawings for review. Keep a complete set of approved shop drawings on the job at all times. Non-approved shop drawings will not be allowed on the job site. Note any changes made during installation on a single set of drawings. This set of marked up drawings will not leave the jobsite until after the final system commissioning. Submit one PDF corrected electronic file set of drawings showing work as installed. All "as-built" drawings to be provided in PDF electronic form (ACAD 2000 or later). Details for both Shop/Submittal and As-Built drawings to include the following:
1. System control riser diagram
 2. Control wiring charts
 3. Wire numbers on all schematics/riser diagrams
 4. Rigging Equipment physical and electrical details
 5. Control systems physical and electrical details
 6. Other details or schematics required for systems operation
 7. All Rigging Submittals to be stamped by a licensed engineer licensed in the state of TX.
 8. Note: Consultant will supply AutoCAD files of system design, if requested.
- C. **Contract Closeout Submittals:**
1. Prepare and submit 3 copies of the System Reference Manual prior to Owner training in 3 ring binders, sized to hold the material plus 50% excess, with clear vinyl pockets on cover and spine for project title. Provide tabular dividers with permanent legends for the following sections:
 2. System Operation and Instructions- Prepare a complete and typical procedure for the operation of the equipment as a system, organized by subsystem or activity. This procedure should describe the operation of all system capabilities. Assume the intended reader of the manual to be technically inexperienced and unfamiliar with this facility.
 3. A list of all test results performed on the system as outlined in Section 3.
 4. A list of all equipment, indicating manufacturer, model, serial number, and equipment location (i.e. panel/rack/room number). Update following acceptance testing, if changed.
 5. A list of all settings of all semi-fixed controls. Update this document after the final acceptance testing.
 6. Photographically reproduced schematic wiring diagrams of the rigging system, based on the as-built documentation, at a reduced scale easy to handle but fully legible. Blue-line (or similar diazo process) prints are not acceptable.
 7. Manufacturer's Instruction Manuals for all items of equipment, incorporating or followed by manufacturer's warranty statements. For custom circuits or modifications, a description of the purpose, capabilities, and operation of each item.
 8. Manufacturer's Service Manuals and parts list for all equipment. Photocopies are not acceptable. For custom circuits or modifications, complete schematics and parts lists.
 9. Maintenance Instructions, including Contractor's maintenance phone number(s) and hours; maintenance schedule, description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products.
 10. A legend of acronyms and abbreviations must accompany all documentation.
 11. Replacement parts lists of major items of equipment.

12. Provide written report for dates of replacement of all batteries. This is to include UPS, and control systems.
13. Project record drawings “as-builts” to be provided within 4 weeks after system acceptance. Provide in PDF electronic form (ACAD 2000 or later, DWG or DXF files). See paragraph 1.6, item B above for further details.

1.07 QUALITY ASSURANCE

- A. Contractor's Qualifications: Have previously installed at least 4 jobs of similar magnitude, completed within the last five years. Provide name and phone number of reference for each representative project. Identify at least one such completed job available for inspection by Consultant or Owner’s Representative.
- B. Bidder will confirm in writing that Sub-contractor firm has five years’ experience with equipment and systems of the types specified, that the Sub-contracting firm maintains a fully staffed and equipped service facility, and that the firm is a franchised dealer and authorized service facility for the major brands specified, and that the firm is properly licensed to work in Houston, TX. Bidding contractor will identify all Sub-contractors on the Bid Response team and a detailed scope of work for each Sub-contractor.
- C. Provide a summary of experience of the project manager, lead engineer and lead installers assigned to this project. This will include key team members of any Sub Contractor. The on-site lead installer shall be an ETCP Certified Rigger.
- D. DELIVERY, HANDLING, STORAGE
- E. Comply with Division 1 General Conditions - Materials and Equipment section.

1.08 WARRANTY

- A. The Rigging Contractor shall provide a three year written guarantee against defects in materials or workmanship starting from the date of acceptance of equipment by the Owner’s representative. The guarantee shall not cover damage due to normal wear and tear, acts of God, neglect, or improper use of equipment. Any required maintenance or replacement shall be provided by the Rigging Contractor within thirty days of notification by the Owner except for safety related items, which shall be corrected within 48 hours of notification. Subsequent to the expiration of the guarantee period the Rigging Contractor agrees to furnish repair and maintenance service, at the Owner’s expense, within thirty days of request for such service. This warranty shall not void specific warranties issued by manufacturers for greater periods of time. Nor shall it void any rights guaranteed to the Owner by law.
- B. Theatrical Rigging Contractor to provide Owner with exact beginning and ending dates of the warranty period. Include the name of the person to call for service and telephone number. This information to be part of Project Record Drawings.

PART 2 PRODUCTS

2.01 GENERAL

- A. Standards:
 1. Materials shall conform to the following ASTM and ANSI standard specifications:
 - a. ASTM A-36 Specification for structural steel
 - b. ASTM A 47 Specification for malleable iron casting
 - c. ASTM A 48 Specification for gray iron casting
 - d. ASTM A 120 Specification for black and hot dipped zinc coated (galvanized) steel pipe for ordinary use
 - e. ANSI B18.2.1 & 2 Specification for square and hex bolts and nuts
 - f. ANSI E1.4-2009 Entertainment Technology – Manual Counterweight Rigging Systems.

- g. ANSI E1.22 - 2009 Entertainment Technology - Fire Safety Curtain Systems
 2. In order to establish minimum standards of safety, the following factors shall be used:
 - a. Cables and fittings 8:1 Safety Factor
 - b. Cable bending ratio Sheave tread diameter is 26 times cable diameter
 - c. Maximum fleet angle 1 1/2 degrees
 - d. Steel 1/5 of yield
 - e. Bearings Two times required load at full speed for 2000 hours
 - f. Bolts Minimum SAE J429 Grade 5 (ISO R898 Class 8.8), zinc plated
 - g. Motors 1.0 Service Factor
 - h. Gearboxes - 1.25 Mechanical Strength Service Factor
- B. Materials: All materials used in this project shall be new, unused and of the latest design. Re furnished and obsolete materials are not permitted.
- C. Sheaves:
 1. Sheaves shall be one of the following materials:
 - a. ASTM A-48 Class 30 grey iron castings
 - b. Nylatron or Polyamide Nylon (PA6-G)
 - c. Steel
 2. Groove depths shall be sufficient to encompass fully the cables and ropes. Grooves shall have sloped sides (8 degree minimum) and conform to rope and cable manufacturers' standards for groove shape and tolerance.
 3. Sheaves shall be supported by bearings and a machined steel shaft, which shall be keyed to one side plate to prevent rotation. Proper adjustment of the bearing shall be accomplished by means of a fine thread, self-locking nut on the opposite end of the shaft. Each sheave shall run plumb and true without rubbing its side plates when rotated.
- D. Fabrication:
 1. All manufactured equipment that is dependent on field conditions shall have those conditions field verified prior to fabrication and installation of all equipment. Notify Consultant of any discrepancies in site conditions or design documents as soon as identified.
 2. The mechanical fabrication and workmanship shall incorporate best practices for good fit and finish. There shall be no burrs or sharp edges to cause a hazard nor shall there be any sharp corners accessible to personnel.
 3. All moving parts shall have specified tolerances. Sheaves shall run plumb and true and shall not scrape housings.
 4. All equipment shall be built and installed to facilitate future maintenance and replacement.
- E. Finishes:
 1. Paint shall be the manufacturer's standard finish and color except as noted.
 2. All turnbuckles, clips, tracks, chains and other items of incidental hardware shall be furnished plated or painted.
- F. Recommended Working Load: This specification calls for minimum recommended working loads for many hardware items. This is the maximum load which the manufacturer recommends be applied to properly installed, maintained, and operated new equipment. Manufacturer's recommended working loads shall be determined by calculations by a Licensed Professional Engineer and destructive testing by an independent testing laboratory. These calculations and reports shall be available for review.
- G. Materials and products required for work of this section shall not contain asbestos, polychlorinated biphenyls (PCB) or other hazardous materials identified by the Owner.

2.02 ACCEPTABLE MANUFACTURERS

- A. The following manufacturers of Theatrical Rigging equipment shall be considered pre-Qualified to supply Theatrical Rigging equipment.
 - 1. H & H Specialties, Inc
 - 2. Wenger / J.R. Clancy, Inc.
- B. Additional qualified manufacturers will be considered subject to review by the Owner and Consultant. The Contractor will supply complete technical data specifications at the time of proposed substitution. The Contractor will arrange for product demo at the request of the owner and will pay ground freight shipping to and from site, or to and from Consultant's office. The Owner reserves the right to accept or refuse any substitution without condition.
- C. Substitutions: Comply with Division 1 General Conditions – Substitutions section. Any proposed substitutions must meet all specifications of the specified equipment. No product substitution will be accepted without the written approval of the Consultant and Owner.
- D. The manufacturer must have a product testing program, including determination of recommended working loads for products based on destructive testing by an independent laboratory and review by an independent licensed engineer. Approval to bid does not release the manufacturer from meeting this requirement.
- E. Requirements for Approval to bid: Equipment manufacturers seeking approval must submit the following information at least 2 weeks prior to the bid opening date. Failure to submit any of the required information will automatically disqualify the manufacturers from consideration of approval.
 - 1. Evidence that the manufacturer has been in business for a minimum of eight years manufacturing Theatrical equipment.
 - 2. A listing of 8 equivalent installations including:
 - a. Name, address, and telephone number of Owner.
 - b. Name, address, and telephone number of Architect.
 - c. Scope of work.
 - 3. A brief written description of the manufacturer's operation including facilities, financial capabilities, and experience of key personnel.
 - 4. A statement from an insurance company indicating that the manufacturer carries primary product and general liability insurance of \$2,000,000 each, with excess liability coverage of \$10,000,000.
 - 5. A description of their details of their product testing program and methods along with the names and telephone number of the independent test lab and licensed professional engineer performing the product testing and review.
- F. Equipment and materials shall be new, and conform to applicable UL, CSA, or ANSI provisions. Take care during installation to prevent scratches, dents, chips, etc.
- G. The Theatrical Rigging Contractor shall verify all site conditions prior to fabrication and installation of all equipment. Notify Consultant of any discrepancies in site conditions or design documents as soon as identified.
- H. Use only components and items in the theatrical rigging systems that conform to industry practice and acceptable code standards.
- I. Wiring of power distribution cable shall be in accordance with the electrical engineer's specification.
- J. Wiring of control distribution cable shall be in accordance with the manufacturer's specification.

- K. Installation of theatrical rigging support steel shall be in accordance with the structural engineer's specification.

2.03 LAKES HS BLACK BOX

- A. Theatrical Lighting Pipe Grid (Quantity: 1)
1. Provide a Lighting grid and associated mounting hardware for the theatrical lighting instruments to be mounted in the Stage Pipe grid position. The grid shall be ~44'-5" x 45'-4" long. The grid shall be built with a 4' x 4' pipe spacing. See drawings TE3.00 and TE4.10G for detail.
 2. All pipes shall be 1 ½" Schedule 40 black seamless steel/iron pipe, treated to prevent corrosion. Pipe shall have a nominal OD of 1.9".
 3. All pipe crossovers shall be secured using pipe cross clamps.
 4. Co-ordinate all miscellaneous support steel requirements with the General Contractor.
 5. Co-ordinate installation of pipes and mounting hardware with Division 26 Contractor.
 6. Co-ordinate color of pipes and mounting hardware with the Specifying Lighting Consultant and Client.
 7. Co-ordinate location of support pipes and mounting with the Specifying Lighting Consultant and Client.
 8. All dimensions and conditions must be field verified before installation.
 9. Retain the services of a registered professional structural engineer, licensed to practice in Houston, TX to oversee and certify the design, development, fabrication and installation of the support pipes and associated rigging/mounting hardware. This does not include any required miscellaneous steel or structural supports that the support pipes are rigged/mounted to which are the responsibility of the projects structural engineer, architect and contractors other than the theatrical rigging vendor.
- B. Theatrical Curtains and Accessories
1. Walk Along Operated Traveling Curtain Track (Quantity: 4)
 - a. Provide curtain track complete with all necessary accessories for walk along operation located in the plan North, South, East and West wall positions. Tracks to be ~40'-6", ~38'-9", ~39'-6" and ~31'-6" long respectively. Refer to TE series drawings.
 - b. Suspend track with two-piece clamp hanger. Install end stop at each track end. Where lengths exceed 24', connect tracks with minimum 12" long, two-piece splicing clamp.
 - c. Provide single carriers, spaced on 12" centers, constructed of two polyethylene wheels fastened parallel to shielded ball bearing carrier body and supplied with heavy-duty hook, swivel eye and trim chain for attachment of curtain. Black nylon shall be molded around shielded and greased ball bearing to form carrier body. Install round neoprene bumper between each carrier to reduce noise.
 - d. Track shall be finished with a semi-gloss black powder coat. All other steel components shall be black oxide finished.
 - e. Curtains per drapery schedule in paragraph 2.03, B, 2, b.
 2. Stage Drapery and Drops
 - a. Stage Curtain Construction
 - 1) Verify Drapery Measurements in Field before construction.
 - 2) All draperies must be either inherently flame retardant (IFR) or vat dyed and flame retarded (FR) by an immersion process.
 - 3) All fabric cuts must be full length with no splices. Any fabric sections with visible streaking or spotting must be cut from bolt and discarded.
 - 4) All Stage curtains furnished with sewn fullness must be box-pleated on 12-inch centers.

- 5) All top hems must have a heavy-duty jute webbing double stitched at the top with machine set brass grommets one foot on center with tie lines or snap hooks as required.
 - 6) All draperies must have, as a minimum, 50% fullness unless otherwise specified.
 - 7) All hems must be double turned with no visible selvage edges.
 - 8) On-stage and off-stage vertical hems of Main Curtain and Traveler Curtains must have 1/2 bolt width turned back hems. All other vertical hems must be 3 inches.
 - 9) Floor length draperies must have a 6-inch bottom hem with a suspended inner canvas or muslin pocket containing #8 zinc plated chain weights.
 - 10) Bottom hems of border curtains must be 4 inches.
 - 11) All fabrics with pile ends must be sewn with pile running down unless otherwise specified.
 - 12) Lining fabric (if required) shall be attached to the face fabric of the drape using short nylon webbing strips tacked along the bottom and sides of the curtain.
 - 13) All fabrics must be either inherently flame retardant or flame proofed using an immersion process. This process must be in accordance with the requirements of the NFPA 701 Large and Small scale test.
- b. Drapery Schedule
- 1) 12 each - Masking Leg Curtain from 21 oz IFR Polyester Velour, in one section ~14'6" high X 10'0" wide. Provide curtain with snap hooks at top. Color to be black.
 - 2) 3 each - Masking Leg Curtain from 21 oz IFR Polyester Velour, in one section ~14'6" high X 8'0" wide. Provide curtain with snap hooks at top. Color to be black.

PART 3 EXECUTION

3.01 GENERAL

- A. Coordinate work with other trades to avoid causing delays in construction schedule.
- B. Mount equipment and enclosures plumb and square. Permanently installed equipment shall be firmly and safely held in place.

3.02 CONTRACTOR/THEATRICAL RIGGING CONTRACTOR INSTALLATION

- A. Confirm by site visit and by report from general and electrical contractor all field conditions, which may affect manufacture and installation of the Theatrical Rigging Systems equipment prior to fabrication. Provide any additional hardware, panels and back boxes to accommodate field conditions. Submit all changes to equipment and mounting details to Consultant for review prior to fabrication.
- B. The Theatrical Rigging Contractor shall furnish all items required to properly install and secure Rigging System equipment in place.
- C. Repair or replace any equipment, which has suffered non-cosmetic damage prior to time of Completion Checkout. Claims arising from repair or replacement of such damage shall be considered only after final acceptance of system by Owner.
- D. The Theatrical Rigging Contractor in coordination with the Project General Contractor shall clean all pipe grid components of dirt, dust and debris prior to time of Completion Checkout.

3.03 THEATRICAL RIGGING CONTRACTOR TESTS AND ADJUSTMENTS

- A. Verify that all termination hardware is installed to specification.

3.04 TEST EQUIPMENT

- A. The following equipment shall be available for field-testing. Submit for approval, as a portion of the tender, list of test equipment.
1. Torque Wrench
 2. Compression sleeve test gage.

3.05 TEST PROCEDURES

- A. Perform all following tests & provide a test report to the consultant:
1. Measure Torque of all bolted connections to verify if they meet manufacturer's specification.
 2. Measure all Compression sleeve connections to verify if they meet manufacturer's specification.
 3. Repair or replace any equipment that fails to conform to specification, and schedule second set of tests and adjustments. Repeat testing and repair or replacement as required to make the entire Theatrical Rigging System conform to specification.
 4. Upon completion of testing, furnish Owner, Architect and Consultant a complete report on all field-testing and adjustment, certifying that system conforms to specification and that installation is complete and ready for inspection.

3.06 ACCEPTANCE

- A. Schedule inspection by Owner, Architect and Consultant no earlier than upon receipt of above specified report.
- B. Provide all test equipment and personnel specified in "Field Testing and Adjustment" above.
- C. Coordinate with GC to ensure that no other work shall be scheduled in audience chamber or stage areas, and that all temporary bracing and scaffolding has been removed to permit full operation of and access to all equipment.
- D. At request of Consultant, repeat any and all tests specified in "Field Testing and Adjustment" above in presence of Owner, Architect and Consultant.
- E. Should Owner, Architect or Consultant judge that any equipment fails to conform to specification, repair or replace that equipment within 30 days, and schedule second inspection. Should the Owner; Architect or Consultant judge that any work inspected is not substantially complete at time of Completion Checkout, schedule second inspection. Provide all equipment and personnel specified above.
- F. Schedule additional checkouts as required until Owner, Architect and Consultant judge entire Rigging System to conform to specification. After Completion Checkout, compensate Owner for any consulting and transportation costs incurred during subsequent checkouts. Final payment shall be withheld until systems have been thoroughly tested and adjusted and found to be in first class operating condition in every particular.

END OF SECTION

SECTION 12 21 13
HORIZONTAL LOUVER BLINDS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Horizontal slat louver blinds.
- B. Operating hardware.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

1.03 REFERENCE STANDARDS

- A. WCMA A100.1 - Safety of Corded Window Covering Products; Window Covering Manufacturers Association; 2012. (ANSI/WCMA A101.1)

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the placement of concealed blocking to support blinds.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating physical and dimensional characteristics.
- C. Shop Drawings: Indicate opening sizes, tolerances required, method of attachment, clearances, and operation.
- D. Samples: Submit two samples, 12 inch (300 mm) long illustrating slat materials and finish, color, cord type and color.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Slats: 20 of each type and size.
 - 3. Extra Lift Cords, Control Cords, and Wands: One of each type.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.07 WARRANTY

- A. Warrant the work specified herein for lifetime, without charge to the original purchaser, any part found defective in workmanship or material as long as the blind remains in the same window for which it was purchased.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Horizontal Louver Blinds:
 - 1. Hunter Douglas; Product Celebrity: www.hunterdouglas.com.
 - 2. Levolor Contract; Product Riviera: www.levolorcontract.com.
 - 3. Bali; Product Classics Mini Blinds.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 BLINDS AND BLIND COMPONENTS

- A. Blinds: Horizontal slat louvers hung from full-width headrail with full-width bottom rail; manual control of raising and lowering by cord with full range locking; blade angle adjustable by control wand; complying with WCMA A100.1.
- B. Metal Slats: Spring tempered pre-finished aluminum; radiused slat corners, with manufacturing burrs removed.
 - 1. Width: 1 inch (25 mm).
 - 2. Color: As selected.

- C. Slat Support: Woven polypropylene cord, ladder configuration.
- D. Head Rail: Pre-finished, formed steel box, with end caps; internally fitted with hardware, pulleys, and bearings for operation; same depth as width of slats
 - 1. prime coat of vinyl primer and finish coat of polyester baked enamel to match bottom rail and slats.
- E. Bottom Rail: Pre-finished, formed steel with top side shaped to match slat curvature; with end caps.
Color: Same as headrail.
- F. Control Wand: Extruded hollow plastic; hexagonal shape.
 - 1. Length of window opening height less 3 inches (75 mm).
 - 2. Color: As selected.
- G. Headrail Attachment: Ceiling brackets.
- H. Accessory Hardware: Type recommended by blind manufacturer.
- I. Braided Ladders:
 - 1. Distance between end ladder and end of slats shall not exceed 6 inches.
 - 2. Distance between ladders shall not exceed 22 inches.
 - 3. Material shall be polyester yarn. Vertical component shall not be less than 0.045-inch dia. nor greater than 0.066-inch diameter.
 - 4. Cord lock and tilter operation locations: Tilter at left, cord lock at right (standard).
 - 5. Installation brackets: End support, hinged cover brackets. 0.042-inch-thick treated steel with prime coat of epoxy primer and finish coat of polyester baked enamel in color to match headrail. Brackets shall be marked left and right to facilitate installation and shall have a 1-1/4 inch extra-wide top to accommodate power screwdriver.
 - 6. Intermediate support brackets: Brackets shall be furnished for blinds over 60 inches wide. Maximum spacing for intermediate support brackets shall be 48 inches.
 - 7. Install valance brackets and double blade stacked slats at top of all blinds.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that openings are ready to receive the work.
- B. Ensure structural blocking and supports are correctly placed.

3.02 INSTALLATION

- A. Install blinds at all new exterior windows in accordance with manufacturer's instructions.
- B. Secure in place with flush countersunk fasteners.
- C. Install intermediate support brackets and extension brackets as needed to prevent deflection in headrail.
- D. Install blinds with adequate clearance to permit smooth operation and any sash operators. Hold blinds 1/4 inch clear from each side of window opening on inside mount, unless other clearance is indicated.
- E. Set tilt and locking controls.

3.03 INSTALLATION TOLERANCES

- A. Maximum Variation of Gap at Window Opening Perimeter: 1/4 inch (6 mm).
- B. Maximum Offset from Level: 1/8 inch (3 mm).

3.04 ADJUSTING

- A. Adjust blinds for smooth operation.

3.05 CLEANING

- A. Clean blind surfaces just prior to occupancy.

END OF SECTION

SECTION 13 34 13

GREENHOUSE

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. 0

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Greenhouse

1.03 DESIGN

- A. GREENHOUSE SIZE: 25' X 72' X 10' OVERALL SIDEWALL HEIGHT
NOTE: Greenhouse will be built on 30" stem wall, thus actual greenhouse will be 7'6" tall to top of sidewall. Thus, Base Plates are required.
Only systems approved by Owner prior to bid may be used. Requests for substitutions shall be made in writing to the Owner at least seven (7) days prior to bid date.
- A. Note that the greenhouse foundation indicated on the drawings is based upon a single manufacturer's standard recommendations for specific wind and seismic loading required for this project. If an alternate greenhouse system is used, contractor is responsible for verifying any modifications necessary to meet specified loading and including all necessary materials and costs in the bid sum submitted.

1.04 DESIGN CRITERIA

- A. Greenhouse system shall be designed in conformance with current Uniform Building Code (ICBO) or BOCA Code. A structural engineer licensed to practice in the State of Texas shall certify that the total system including structural steel, glazing and foundation shall satisfy the following:
 - 1. Total vertical live load 30 psf, minimum.
 - 2. Total perpendicular wind load 127 mph minimum at "B" exposure.
 - 3. Dead load to include structure and equipment weight.
 - 4. Seismic loading UBC Seismic Zone.
 - 5. Equipment loading 100 lb. at center of any roof span.
 - 6. Maximum Deflection 120th of span.
- B. Greenhouse system shall be designed to resist loads in the following combinations:
 - 1. Dead Load plus Wind Load.
 - 2. Dead Load plus Live Load.
 - 3. Dead Load plus Seismic Load.
 - 4. Dead Load plus Live Load plus Wind Load.
 - 5. Dead Load plus Live Load plus Seismic Load.

1.05 SHOP DRAWINGS

- A. Provide shop drawings including joints, assembly details, accessories, anchorage details and other pertinent items. Include installation instructions.

- B. Provide shop drawings with equipment cut sheets.

1.06 ERECTION

- A. The greenhouse system shall be erected and installed by a qualified contractor authorized and approved by the greenhouse system manufacturer. The contractor shall have had at least five (5) years' experience in building greenhouses of the type specified.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Protect against damage and discoloration. Store off ground and on dunnage. Contractor shall provide for unloading of all material.

1.08 COORDINATION

- A. Coordinate with other trades affecting or affected by work of this section.

1.09 WARRANTY

- A. Warrant for 1 year against leakage, air infiltrations, and faulty operation. Greenhouse system manufacturer shall have a full service repair facility. Spare parts shall be stocked at this service facility and be available for immediate shipment.

PART 2 – PRODUCT

2.1 GREENHOUSE SYSTEM

- A. Manufacturer and Type:
 - 1. Basis of Design: A Gable Select, pre-engineered truss design, free standing, full span greenhouse (no center post) manufactured by Next G3N Greenhouses, LLC, Chino, CA (909) 315-6400 www.nextg3ngreenhouse.com.
 - a. **Roll formed galvanized steel for superior strength**, Gable Select Series, galvanized, extra-strength steel substructure, designed to be installed on a 32" high kneewall, covered in 8mm solar soft (muted) twin wall polycarbonate. **NOTE: ROUND, SQUARE OR RECTANGLE TUBING NOT ALLOWED FOR STRUCTURAL TRUSSES OR PURLINS. ROLL FORMED GALVANIZED STEEL FOR SUPERIOR STRENGTH IS ONLY ALLOWED.**
 - 1. One, full-length, 54" x 72', automated ridge vent, complete with 100NM DC motor and motor control.
 - 2. Front door, 48" x 80" heavy duty steel, ADA approved, with frame, jambs and hardware. Top half is tempered glass. Back side door-- 36" x 80" heavy duty steel, ADA approved, with frame, jambs and hardware. Top half is tempered glass.
 - b. Approximate dimensions: 25' wide x 72' long x 17' high (peak) from finished floor grade. Reference drawings.
 - c. Climate control package including the following system. The design of the flowing equipment is based upon a 45° temperature differential between inside and outside temperatures, 5,000 ft. candles of light and a 7° pad to fan rise in temperature.
 - 1. One Modine PTP 300 gas heater with vent kit. (Or equivalent)
 - 2. One, 5' x 20' x 6" evaporative cooling system with mounting brackets and stainless steel, self contained reservoir.
 - 3. Four Quietaire or equivalent 18" Horizontal Air Flow fans.

4. One, 5' x 20' Endwall rack and pinion lifting vent with 100NM DC motor with motor control.
 - d. **Shading Device:**
 1. One set Shade Fabric Panels (63%) with taped and grommeted edges for easy attachment. (EXTERIOR SHADE)
 - e. **Stationary Benches:**
 1. Provide stationary galvanized steel benches with poly bench tops as indicated on the drawings.
 - f. Installation of greenhouse and accessories included control wiring for the items listed in this proposal, from a panel provided by others.
 - g. Irrigation and mister package. 4 runs of overhead misting and 2 runs of hanging basket irrigation. Includes Fertilizer injector.
2. Other Manufacturers:
- a. (Peak) House greenhouse system as designed by Greenhouse Megastore (217-709-1832).
 - b. Prospiant, Classroom Cultivator, 5513 Vine ST, Cincinnati, OH .
 - c. 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. Greenhouse shall be a steel framed, single glazed, straight sidewall structure with gutters. Provide all structural members, bracing, clips, lugs, fasteners and accessories required to complete the greenhouse system described (and meet the structural design criteria) whether itemized in these specifications and drawings or not.

B. STRUCTURE AND DESIGN

- A. Steel Substructure: consists of columns, roof chords and trussing, purlins and girts as described below in "Framing" galvanized steel. Column spacing is 12'.
- B. One, 5' x 20' Endwall rack and pinion lifting vent with 100NM DC motor with motor control.
- C. One, full-length, 54" x 72', automated ridge vent, complete with 100NM DC motor and motor control.
- D. Front door, 48" x 80" heavy duty steel, ADA approved, with frame, jambs and hardware. Top half is tempered glass. Back side door-- 36" x 80" heavy duty steel, ADA approved, with frame, jambs and hardware. Top half is tempered glass.
- E. Panels: 8mm twin wall rigid polycarbonate panels, secured with Aluminum H Channels for horizontal securing and terminating into J Channel and top and bottom with perforated tape at bottom. Tek screws with rubber washers in accordance with manufacturer's required spacing. Polycarbonate shall be diffused, such as Solar Soft, Solar Lite, etc. **Not Clear twinwall polycarbonate.**

C. MATERIALS

1. **Framing:** All galvanized steel, pre-punched and bolted together design including:
 - a. Heavy -duty 4.0" OD round (or Square) columns 8 gauge on 12' centers – columns set for (concrete filled piers.) (base plates welded onto one end to be bolted to a concrete pad- fasteners not included.) (pins set into a concrete filled pier – columns to slip over pins.)

- b. Two (2) 4.0" round Up-right columns at each exposed end wall.
- c. 3" tall x 1-7/8" wide 18 gauge Roll-formed horizontal framing girts and both exposed end walls and side walls complete with mounting tabs.
- d. *SUPERIOR STRENGTH* 4" tall x 2-1/4" wide 16 gauge Roll-Formed upper chords assemblies on 12' centers.
- e. 3" tall x 1-7/8" wide 16 gauge Roll-Formed flush mounted purlins complete with condensate control channels.
- f. 1-5/8" Bottom chord 16 gauge plus 1-5/8" 16 gauge webbed supports supplied on 12' centers.
- g. Cable wind bracing.
- h. Galvanized steel Roll-Formed gutters 16 gauge with 210 galvanizing finish complete with (1) gutter outlet each (drainpipe and down spout excluded). Conley's recommends structure to be erected on a sloped grade – either sloping from one end to the other or high in the center sloping to both ends.
- i. Aluminum corner trim, aluminum ridge bar and aluminum gutter trim.
- j. Aluminum gable end bar flashing at end walls.
- k. Brackets and fasteners as required to assemble frame.
- l. Base plates are required. Base plates shall be welded, not less than 3/8" thick.
- m. Foundation bolts shall be determined by local authorities; expansion bolts are permissible rather than anchor bolts poured in place.

- n. Glazing: 8mm twin wall rigid polycarbonate panels, secured with Aluminum H Channels for horizontal securing and terminating into J Channel and top and bottom with perforated tape at bottom. Tek screws with rubber washers in accordance with manufacturer's required spacing. Polycarbonate shall be diffused, such as Solar Soft, Solar Lite, etc. **Not Clear twinwall polycarbonate.**
- o. Galvanized steel Benches: (8) 6' wide x 10' long. Bench tops to be Dura Bench or equivalent molded polyethylene structural plastic tops.

2.2 CONSTRUCTION

- A. Provide complete construction of greenhouse including mounting greenhouse frame, covering and mounting the greenhouse equipment. Concrete foundations, concrete sidewalks, installation of all electrical wiring, conduits, gas piping, vent piping, water lines and internet connection to be furnished by other trades.

- B. Site preparation to include grading, cutting or filling to provide level greenhouse pad ready for erection of greenhouse to be provided by owner.

- C. Owner to bring all utilities to site.

2.3 ELECTRICAL

- A. Design, provide and mount complete electrical system in accordance with local codes and NEC (National Electric Code). Included is main panel of raintight design, circuit breakers, emt conduit, conductors and disconnects as required by code. Provide receptacles with

weatherproof covers. All equipment to be rated for damp location.

2.4 GAS PIPING

- A. Design, provide and install complete gas piping and venting system for gas unit heaters.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. General: install polycarbonate panels and related items in accordance with greenhouse manufacturer's instructions.
- B. Framing: erect structural framing true to line, level and plumb, rigid and secure. Level base plates to a true even plane with full bearing to supporting structures.

- C. Equipment: Install as equipment to manufacturer's set standards. This includes, heater, evaporative cooling system, endwall lifting vent, roof vent, exhaust fans, horizontal air flow fans, doors and exterior shade cloth.
- C. Install and secure stationary benches, trim and related items.
- E. Upon completion of installation, test for leaks. Inspect for leaks, repair leaks and re-test sections until all sections are leak-proof.

3.2 CONTROL SYSTEM

A. One (1) Wadsworth Step Up OR Wadsworth Juniper Controller with necessary relays and contactor panel

3.3 INSTALLATION

- A. Install greenhouse in accordance with manufacturer's instructions in location shown on drawings.
- B. Coordinate dimensional requirements prior to fabrication.

3.4 ERECTION

- A. Erection shall be in accordance with manufacturer's recommendations using erectors approved by manufacturer.
- B. Erect greenhouse after all concrete and masonry in vicinity is complete and washed down.
- C. Column sleeves and base plate anchor bolts, if shown or required, shall be furnished by the manufacturer and installed by the General Contractor to elevations and dimensions on approved shop drawings.
- D. Install all columns and beams straight and true.
- E. Install all flashings and closures required.

3.5 CLEANING AND PROTECTION

- B. Care shall be taken to prevent damage or scratching of components. Damaged or scratched components will not be accepted.

END OF SECTION 13 34 13

SECTION 13 34 19
PRE-ENGINEERED BUILDINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to this section.

1.2 SUMMARY

- A. Extent of pre-engineered building work is shown on drawings for Athletic storage buildings.
 - 1. This section includes:
 - a. Structural Steel Framing
 - b. Metal Roof Panels
 - c. Metal Wall Panels
 - d. Metal Soffit Panels
 - e. Interior Liner Panels
 - f. Doors, Frames and Hardware
 - g. Manual Roll-up Doors
 - h. Accessories
- B. Building Type: The pre-engineered building is single span, rigid-frame type metal building of the length, width, eave height and roof pitch indicated. Exterior walls are covered with metal wall panels. Frame and covering may be matched and prepunched to receive fasteners, or the drilling of holes for fasteners may be performed in the field. The completed building shall be free of excessive noise from wind induced vibrations under the ordinary weather conditions to be encountered at the location where the building is erected, and meet all specification design requirements.
- C. All exterior louvers and vents are a part of this section.
- D. Anchor bolts are a part of this section.
- E. Manufacturer's standard components may be used, providing components, accessories, and complete structure conform to architectural design appearance shown and to specified requirements.
- F. Concrete floor and foundations and installation of anchor bolts are specified in Division 3 section. Refer to structural specifications and drawings.

1.3 DEFINITIONS

- A. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in the referenced standards.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of metal building system component. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
1. Structural-steel-framing system.
 2. Metal roof panels.
 3. Metal wall and soffit panels.
 4. Flashing and trim.
 5. Doors and Frames.
 6. Accessories.
- B. Shop Drawings: Shop drawings shall consist of catalog cuts; design and erection drawings; mill certification for structural bolts, framing steel, wall and roof certification for structural bolts, framing steel, wall and roof covering, shop painting and finishing specifications, instruction manuals; and other data as necessary to clearly describe design, materials, sizes layouts, construction details, fasteners and erection. For all rigid frame metal building designs, except those programmed on a computer, the shop drawings shall be accompanied by engineering design calculations for structural and covering components. For computer programmed designs, shop drawings shall be accompanied by stress values and a certificate, stating the design criteria and procedures used and attesting to the adequacy and accuracy of the design. Shop drawings shall show the reactions at the base of all columns and posts. All shop drawings, computations, and certifications shall be sealed and signed with and by the Texas Seal of the Civil Engineer responsible for the design and preparation of shop drawings for the building must carry Professional Liability Insurance. Submit three prints. One print shall be kept by the Architect for record purposes, two prints shall be returned by the Architect after review. Architect shall have a minimum of ten working days to review shop drawings before returning them.
- C. Additional Shop Drawing requirements:
1. Metal Roof and Wall Panel Layout Drawings: Show layouts of metal panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.
 - a. Show wall-mounted items including doors, windows, louvers, and lighting fixtures.
 - b. Show translucent panel locations in roof, if specified.
 2. Accessory Drawings: Include details of the following items, at a scale of not less than **1-1/2 inches per 12 inches (1:8)**:
 - a. Flashing and trim.
 - b. Gutters.
 - c. Downspouts.
 - d. Ridge Vents
 - e. Doors and Frames
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of sizes indicated below:
1. Metal Panels: Nominal **12 inches (300 mm)** long by actual panel width. Include fasteners, closures, and other exposed panel accessories.
 2. Flashing and Trim: Nominal **12 inches (300 mm)** long. Include fasteners and other exposed accessories.
- E. Accessories: One sample of each type of flashing, trim, closure, caps and similar items. Size shall be sufficient to show construction and configuration.

- F. Fasteners: Two samples of each type to be used with statement regarding intended use.
- G. Gaskets and Insulating Compounds: Descriptive data.
- H. Sealant: One sample approximately one pound, and descriptive data.
- I. Louvers, Vents: Descriptive data for each if not fully covered by shop drawings. Refer to mechanical drawings for requirement.
- J. Door Schedule: For doors and frames. Use same designations indicated on Drawings. Include details of reinforcement.
 - 1. Door Hardware Schedule: Include details of fabrication and assembly of door hardware. Organize schedule into door hardware sets indicating complete designations of every item required for each door or opening.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified erector, manufacturer and professional engineer.
- B. Welding certificates.
- C. Metal Building System Certificates: For each type of metal building system, from manufacturer.
 - 1. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:
 - a. Name and location of Project.
 - b. Order number.
 - c. Name of manufacturer.
 - d. Name of Contractor.
 - e. Building dimensions including width, length, height, and roof slope.
 - f. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
 - g. Governing building code and year of edition.
 - h. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).
 - i. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
 - j. Building-Use Category: Indicate category of building use and its effect on load importance factors.
 - k. AISC Certification for Category MB: Include statement that metal building system and components were designed and produced in an AISC-Certified Facility by an AISC-Certified Manufacturer.
- D. Erector Certificates: For each product, from manufacturer.
- E. Manufacturer Certificates: For each product, from manufacturer.
- F. Material Test Reports: For each of the following products:
 - 1. Structural steel including chemical and physical properties.
 - 2. Bolts, nuts, and washers including mechanical properties and chemical analysis.

3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shop primers.
5. Nonshrink grout.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for insulation and vapor-retarder facings. Include reports for thermal resistance, fire-test-response characteristics, water-vapor transmission, and water absorption.

H. Warranties: Sample of special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panel finishes and door hardware to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Design Criteria:

1. General: Except where these specifications are in variance the building shall comply with the following documents (Latest Edition) of the Metal Building Manufacturers Association:
 - a. Recommended Design Practices Manual
 - b. Recommended Guide Specifications
 - c. Metal Building Systems Nonmenclature
 - d. Recommended Code of Standard Practice
2. Structural Framing: Design primary and secondary structural members and exterior covering materials for applicable loads and combinations of loads in accordance with the Metal Building Manufacturers Association's (MBMA) "Design Practices Manual", and the International Building Code (IBC), all latest editions, and this specification, whichever is the most stringent.
3. Structural Steel: For design of structural steel members, comply with requirements of the American Institute of Steel Construction's (AISC) "Manual of Steel Construction", "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" and "Code of Standard Practice."
4. Welded Connections: Comply with requirements of the American Welding Society's (AWS) "Standard Code for Arc and Gas Welding in Building Construction" for welding procedures.

B. Design Loads:

1. Basic design loads include live load, wind load and seismic load, in addition to the dead load.
2. Collateral loads include additional dead loads over and above the weight of the metal building system such as sprinkler systems, mechanical systems, basketball backstops, etc.

C. Design each member to withstand stresses resulting from combinations of loads that produce the maximum allowable stresses in that member as prescribed in MBMA's "Design Practices Manual", , and the International Building Code (IBC), whichever of these specifications is the most stringent.

D. Deflection: Deflection of steel framing and studs resisting wind loads and which support the interior and exterior concrete masonry shall not exceed 1/600th of the span between supports.

E. Manufacturer's Qualifications: Provide pre-engineered metal building as produced by a manufacturer with not less than 5 years successful experience in the fabrication of pre-engineered metal buildings of the type and quality required.

- F. Erector's Qualifications: Pre-engineered building shall be erected by a firm that has not less than 5 years successful experience in the erection of pre-engineered buildings similar to those required for this project, and that has been licensed by the manufacturer of the building system.
 - G. Source Limitations: Obtain metal building system components, including primary and secondary framing and metal panel assemblies, from single source from single manufacturer.
 - H. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.
 - I. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to metal building systems including, but not limited to, the following:
 - a. Condition of foundations and other preparatory work performed by other trades.
 - b. Structural load limitations.
 - c. Construction schedule. Verify availability of materials and erector's personnel, equipment, and facilities needed to make progress and avoid delays.
 - d. Required tests, inspections, and certifications.
 - e. Unfavorable weather and forecasted weather conditions.
 - 2. Review methods and procedures related to metal roof panel assemblies including, but not limited to, the following:
 - a. Compliance with requirements for purlin and rafter conditions, including flatness and attachment to structural members.
 - b. Structural limitations of purlins and rafters during and after roofing.
 - c. Flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
 - d. Temporary protection requirements for metal roof panel assembly during and after installation.
 - e. Roof observation and repair after metal roof panel installation.
 - 3. Review methods and procedures related to metal wall panel assemblies including, but not limited to, the following:
 - a. Compliance with requirements for support conditions, including alignment between and attachment to structural members.
 - b. Structural limitations of girts and columns during and after wall panel installation.
 - c. Flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
 - d. Temporary protection requirements for metal wall panel assembly during and after installation.
 - e. Wall observation and repair after metal wall panel installation.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
 - B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

1.9 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

- A. Coordinate sizes and locations of concrete foundations and casting of anchor-bolt inserts into foundation walls and footings. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."
- B. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

- A. Special Warranty on Metal Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal 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: 10 years from date of Substantial Completion.
- B. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.
 - 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Metal building manufacture: MBCI Metal Roof and Wall Systems, Division of NCI Group, Inc.; Houston TX. Tel: (877) 713-6224; Email: info@mbc.com; Web: www.mbc.com.

1. Approved Manufacturer: McElroy Metal, Inc. 1. Contact: 1500 Hamilton Rd., Bossier City, LA 71111; Telephone: (800) 950-6531; Fax: (318) 747-8099; E-mail: info@mcelroymetal.com; website: www.mcelroymetal.com.
 2. Provide basis of design product, or comparable product approved by Architect prior to bid
- B. Source Limitations: Obtain metal building system components, including primary and secondary framing and metal panel assemblies, from single source from single manufacturer.

2.2 METAL BUILDING SYSTEMS

- A. Description: Provide a complete, integrated set of metal building system manufacturer's standard mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior.
1. Provide metal building system of size and with bay spacings, roof slopes, and spans indicated.
- B. Primary-Frame Type:
1. Rigid Frames: Frames shall be fabricated from hot-rolled structural steel. Provide built-up "I-beam" shape or open web type rigid frames consisting of either tapered or parallel flange beams and tapered columns. Provide frames factory welded and shop painted. Furnish frames complete with attachment plates, bearing plates and splice members. Factory drill frames for bolted field assembly
- C. End-Wall Framing: End walls shall be framed with steel posts placed at the canopy and at 1/3 or 1/4 points of building span. Girts shall span horizontally between posts. Light gage steel studs shall span vertically, supported by the girts, the floor slab, and the end roof frame.
- D. Wind Bracing: Provide adjustable wind bracing using not less than 1/2" diameter threaded steel rods; comply with requirements of ASTM A36 or A572, Grade D.
- E. Secondary-Frame Type: Manufacturer's standard purlins and joists and exterior-framed (bypass) girts.
1. Provide not less than 16-ga. shop painted rolled formed sections for the following secondary framing members:
 - a. Purlins.
 - b. Eave struts.
 - c. Endwall beams.
 - d. Flange bracing.
 - e. Sag bracing.
 - f. Steel studs and components.
 2. Provide not less than 14-ga. cold-formed galvanized steel sections for the following secondary framing members:
 - a. Base channels.
 - b. Sill angles.
 - c. End wall structural members (except columns and beams).
 - d. Purlin spacers.

- F. Bolts: Provide shop painted bolts, except when structural framing components are in direct contact with roofing and siding panels. Provide zinc-plated or cadmium-plated bolts when structural framing components are in direct contact with roofing and siding panels.
- G. Shop Painting: Clean surfaces to be primed of loose mill scale, rust, dirt, oil, grease, and other matter precluding paint bond. Follow procedures of SSPC-SP3 for power tool cleaning, SSPC-SP7 for bush-off blast cleaning, and SSPC-SP1 for solvent cleaning.
- H. Prime structural steel primary and secondary framing members with manufacturer's standard rust-inhibitive primer as per paint and coating materials items of this section.
- I. Eave Height: As Indicated.
- J. Bay Spacing: As Indicated.
- K. Roof Slope: As Indicated.
- L. Roof System: Manufacturer's Standard 3", standing seam roof panel (MBCI, Double-Lok as Basis of Design).
- M. Exterior Wall System: Manufacturer's Standard 1-1/4", exposed fastener, R Panel, with Fluoropolymer Two Coat System (MBCI, Signature 300 Basis of Design).

2.3 METAL BUILDING SYSTEM PERFORMANCE

- A. Delegated Design: Design metal building system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Thermal Movements: 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 joint sealants, failure of connections, and other detrimental effects. Base engineering calculations 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.
- C. Air Infiltration for Metal Roof Panels: Air leakage through assembly of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) of roof area when tested according to ASTM E 1680 at negative test-pressure difference of 1.57 lbf/sq. ft. (75 Pa).
- D. Air Infiltration for Metal Wall Panels: Air leakage through assembly of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) of wall area when tested according to ASTM E 283 at static-air-pressure difference of 1.57 lbf/sq. ft. (75 Pa).
- E. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E 1646 at test-pressure difference of 2.86 lbf/sq. ft. (137 Pa).
- F. Water Penetration for Metal Wall Panels: No water penetration when tested according to ASTM E 331 at a wind-load design pressure of not less than 2.86 lbf/sq. ft. (137 Pa).

2.4 STRUCTURAL STEEL MATERIALS

A. Metals:

1. Hot-Rolled Structural Shapes: Comply with requirements of ASTM A36 or A529.
2. Tubing or Pipe: Comply with requirements of ASTM A500, Grade B, ASTM A501, or A53.
3. Members Fabricated from Plate or Bar Stock: Provide 42,000 psi minimum yield strength. Comply with requirements of ASTM A529, A570, or A572.
4. Members Fabricated by Cold Forming: Comply with requirements of ASTM A607, Grade 50.
5. Bolts for Structural Framing: Comply with requirements of ASTM A307 or A325 as necessary for design loads and connection details.

B. Paint and Coating Materials: Unless otherwise indicated, paint and coating materials shall comply with performance requirements of the federal specifications indicated. Unless specifically indicated otherwise, compliance with compositional requirements of the federal specifications indicated is not required.

C. Primers:

1. Shop Primer for Ferrous Metal: Provide fast-curing, lead free, abrasion resistant, rust-inhibitive primer as selected by the manufacturer for compatibility with substrates, with types of alkyd finish paint systems indicated and for capability to provide a sound foundation for field-applied topcoats despite prolonged exposure. Comply with performance requirements only of FS TT-P-86, Types I, II or III.

2.5 METAL ROOF PANELS

A. Tapered-Rib-Profile, Lap-Seam Metal Roof Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.

1. Material: Zinc-coated (galvanized) steel sheet.
 - a. Exterior Finish: Fluoropolymer.
 - b. Color: As selected by Architect from manufacturer's full range.
2. Major-Rib Spacing: 18"
3. Panel Height: 3"

B. Materials:

1. Metallic-Coated Steel Sheet: Restricted-flatness steel sheet, metallic coated by the hot-dip process and pre-painted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.

C. Finishes:

1. Exposed Coil-Coated Finish:

- a. Two-Coat Fluoropolymer: AAMA 621. 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.

D. Interior Liner Panel:

1. Match exterior wall panels

2.6 METAL WALL PANELS

- A. Tapered-Rib-Profile, Exposed-Fastener Metal Wall Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in the side laps.

1. Material: Zinc-coated (galvanized) steel sheet, in thicknesses to match existing construction.

- a. Exterior Finish: Fluoropolymer.
- b. Color: As selected by Architect from manufacturer's full range.

2. Major-Rib Spacing: 36"
3. Panel Height: As indicated.

B. Materials:

1. Metallic-Coated Steel Sheet: Restricted-flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

- a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.
- b. Surface: finish to match existing.

C. Finishes:

1. Exposed Coil-Coated Finish:

- a. Two-Coat Fluoropolymer: AAMA 621. 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.

D. Interior Liner Panel:

1. Match exterior wall panels

2.7 METAL SOFFIT PANELS

- A. General: Provide factory-formed metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners[and factory-applied sealant] in side laps. Include accessories required for weathertight installation.

- B. Metal Soffit Panels: Match profile and material of metal wall panels.

2.8 DOORS AND FRAMES

- A. Swinging Personnel Doors and Frames: Metal building system manufacturer's standard doors and frames; prepared and reinforced at strike and at hinges to receive factory- and field-applied hardware according to BHMA A156 Series.

1. Steel Doors: 1-3/4 inches (44 mm) thick; fabricated from 0.040-inch (1.02-mm) nominal-thickness, metallic-coated steel face sheets; of seamed or seamless, hollow-metal construction; with 0.064-inch (1.63-mm) nominal-thickness, inverted metallic-coated steel channels welded to face sheets at top and bottom of door.
 - a. Design: As indicated.
 - b. Core: Kraft honeycomb with U-factor rating of at least 0.47 Btu/sq. ft. x h x deg F (2.67 W/sq. m x K).
2. Steel Frames: Fabricate 2-inch- (51-mm-) wide face frames from 0.064-inch (1.63-mm) nominal-thickness, metallic-coated steel sheet.
 - a. Type: Factory welded.
3. Fabricate concealed stiffeners, reinforcement, edge channels, and moldings from either cold- or hot-rolled steel sheet.
4. Hardware:
 - a. Provide hardware for each door leaf, as follows:
 - 1) Hinges: BHMA A156.1. Three plain-bearing, standard-weight, full-mortise, stainless-steel, template-type hinges; 4-1/2 by 4-1/2 inches (114 by 114 mm), with nonremovable pin.
 - 2) Threshold: BHMA A156.21. Extruded aluminum.
 - 3) Silencers: Pneumatic rubber; three silencers on strike jambs of single door frames and two silencers on heads of double door frames.
 - 4) Weather Stripping: Vinyl applied to head and jambs, with vinyl sweep at sill.
 - 5) Refer to Specification **08 71 00 Door Hardware for additional and balance of hardware required.**
5. Anchors and Accessories: Manufacturer's standard units, galvanized according to ASTM A 123/A 123M.
6. Fabrication: Fabricate doors and frames to be rigid; neat in appearance; and free from defects, warp, or buckle. Provide continuous welds on exposed joints; grind, dress, and make welds smooth, flush, and invisible.

- B. Materials:

1. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
2. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

3. 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 designation.

C. Finishes for Personnel Doors and Frames:

1. Factory-Applied Paint Finish: Manufacturer's standard, complying with SDI A250.3 for performance and acceptance criteria.
 - a. Color and Gloss: As selected by Architect from manufacturer's full range.

D. Cylinders and Keying: All locks requiring cylinders shall be factory keyed to the existing patented removable core key system as directed by the owner. Hardware supplier to verify final core manufacturer and keyway requirements prior to ordering cylinders.

E. Keying Conference: Conduct conference to comply with requirements in Division 1 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 system.
4. Installation of permanent keys and cylinder cores.
5. Address and requirements for delivery of keys.

2.9 METAL ROLL-UP DOOR

- A. Refer to specification Section 08 33 23 Overhead Coiling Door
- B. Provide and installation as part of Pre-engineering building requirements.
- C. Steel Frames: Fabricate 2-inch- (51-mm-) wide face frames from 0.064-inch (1.63-mm) nominal-thickness, metallic-coated steel sheet or as required for door installation.
- D. Fabricate concealed stiffeners, reinforcement, edge channels, and moldings from either cold- or hot-rolled steel sheet as required for door installation.

2.10 ACCESSORIES

- A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.
 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.
- B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.
 1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.

2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum **1-inch- (25-mm-)** thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including copings, fasciae, mullions, sills, corner units, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels unless otherwise indicated.
1. Closures: Provide closures at eaves and rakes, fabricated of same material as metal wall panels.
 2. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum **1-inch- (25-mm-)** thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- D. Flashing and Trim: Formed from **0.022-inch (0.56-mm)** nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match adjacent metal panels.
1. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
 2. Opening Trim: Formed from **0.034-inch (0.86-mm)** nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings.
- E. Gutters: Formed from **0.022-inch (0.56-mm)** nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum **96-inch- (2438-mm-)** long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."
1. Gutter Supports: Fabricated from same material and finish as gutters.
 2. Strainers: Bronze, copper, or aluminum wire ball type at outlets.
- F. Downspouts: Formed from **0.022-inch (0.56-mm)** nominal-thickness, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match metal wall panels. Fabricate in minimum **10-foot- (3-m-)** long sections, complete with formed elbows and offsets.
1. Mounting Straps: Fabricated from same material and finish as gutters.
- G. Roof Ventilators: Gravity type, complete with hardware, flashing, closures, and fittings.
1. Continuous or Sectional-Ridge Type: Factory-engineered and -fabricated, continuous unit; fabricated from **0.022-inch (0.56-mm)** nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match metal roof panels. Fabricated in minimum **10-foot- (3-m-)** long sections. Provide throat size and total length indicated, complete with side baffles, ventilator assembly, end caps, splice plates, and reinforcing diaphragms.
 - a. Bird Screening: Galvanized steel, **1/2-inch- (13-mm-)** square mesh, **0.041-inch (1.04-mm)** wire; or aluminum, **1/2-inch- (13-mm-)** square mesh, **0.063-inch (1.6-mm)** wire.

- b. Throat Size: 9 or 12 inches (229 or 305 mm), as standard with manufacturer, and as required to comply with ventilation requirements.

H. Materials:

1. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.
 - a. Fasteners for Metal Roof Panels: Self-drilling, Type 410 stainless-steel or self-tapping, Type 304 stainless-steel or zinc-alloy-steel hex washer head, with EPDM washer under heads of fasteners bearing on weather side of metal panels.
 - b. Fasteners for Metal Wall Panels: Self-drilling, Type 410 stainless-steel or self-tapping, Type 304 stainless-steel or zinc-alloy-steel hex washer head, with EPDM sealing washers bearing on weather side of metal panels.
 - c. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
 - d. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
2. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
3. Metal Panel Sealants:
 - a. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene-compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape of manufacturer's standard size.
 - b. Joint Sealant: ASTM C 920; one-part elastomeric polyurethane or polysulfide; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by metal building system manufacturer.

2.11 FABRICATION

- A. General: Design prefabrication components and necessary field connections required for erection to permit easy assembly.
- B. Clearly and legibly mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams and instruction manuals.
- C. Structural Framing: Shop fabricate structural framing components to the indicated size and section complete with base plates, bearing plates, and other plates required for erection, welded in place. Provide all required holes for anchoring or connections either shop drilled or punched to template dimensions.
- D. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.
 1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.
- E. Shop Connections: Provide power riveted, bolted, or welded shop connections.

- F. Field Connections: Provide bolted field connections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with erection only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.
- B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION OF STRUCTURAL FRAMING

- A. Framing: Erect structural framing true to line, level and plumb, rigid and secure. Level base plates to a true even plane with full bearing to supporting structures.
- B. Purlins and Girts: Provide rake or gale purlins with tight fitting closure channels and fascias. Locate and space wall girts to suit door and window arrangements and heights. Secure purlins and girts to structural framing and hold rigidly to a straight line by sag rods.
- C. Bracing: Provide diagonal rod or angle bracing in both roof and sidewalls as indicated on erection drawings.
- D. Movement resisting frames may be used in lieu of sidewall rod bracing, to suit manufacturer's standards.
- E. Where diaphragm strength of roof or wall covering is adequate to resist wind forces, rod or other forms of bracing will not be required.
- F. Framed Openings: Provide shapes of proper design and size to reinforce opening and to carry loads and vibrations imposed, including equipment furnished under architectural, mechanical or electrical work. Securely attach to building structural frame.

3.4 METAL PANEL INSTALLATION, GENERAL

- A. Examination: Examine primary and secondary framing to verify that structural-panel support members and anchorages have been installed within alignment tolerances required by manufacturer.

1. Examine roughing-in for components and systems penetrating metal panels, to verify actual locations of penetrations relative to seams before metal panel installation.
- B. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.
 - a. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.
 2. Install metal panels perpendicular to structural supports unless otherwise indicated.
 3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 5. Locate metal panel splices over, but not attached to, structural supports with end laps in alignment.
 6. Lap metal flashing over metal panels to allow moisture to run over and off the material.
- C. Lap-Seam Metal Panels: Install screw fasteners using power tools with controlled torque adjusted to compress EPDM washers tightly without damage to washers, screw threads, or metal panels. Install screws in predrilled holes.
1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply metal panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
- D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
- E. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated; or, if not indicated, provide types recommended by metal panel manufacturer.
1. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.
 2. Prepare joints and apply sealants to comply with requirements in Section 079005 "Joint Sealants."

3.5 METAL ROOF PANEL INSTALLATION

- A. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.
1. Install ridge caps as metal roof panel work proceeds.
 2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.
- B. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint, at location and spacing and with fasteners recommended by manufacturer.

1. Install clips to supports with self-drilling or self-tapping fasteners.
 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
 3. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so that clip, metal roof panel, and factory-applied sealant are completely engaged.
 4. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Pre-drill panels for fasteners.
 5. Provide metal closures at rake edges, rake walls, and each side of ridge caps.
- C. Lap-Seam Metal Roof Panels: Fasten metal roof panels to supports with exposed fasteners at each lapped joint, at location and spacing recommended by manufacturer.
1. Provide metal-backed sealing washers under heads of exposed fasteners bearing on weather side of metal roof panels.
 2. Provide sealant tape at lapped joints of metal roof panels and between panels and protruding equipment, vents, and accessories.
 3. Apply a continuous ribbon of sealant tape to weather-side surface of fastenings on end laps and on side laps of nesting-type metal panels, on side laps of ribbed or fluted metal panels, and elsewhere as needed to make metal panels weatherproof to driving rains.
 4. At metal panel splices, nest panels with minimum **6-inch (152-mm)** end lap, sealed with butyl-rubber sealant and fastened together by interlocking clamping plates.
- D. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

3.6 METAL WALL PANEL INSTALLATION

- A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Unless otherwise indicated, begin metal panel installation at corners with center of rib lined up with line of framing.
 2. Shim or otherwise plumb substrates receiving metal wall panels.
 3. When two rows of metal panels are required, lap panels **4 inches (102 mm)** minimum.
 4. When building height requires two rows of metal panels at gable ends, align lap of gable panels over metal wall panels at eave height.
 5. Rigidly fasten base end of metal wall panels and allow eave end free movement due to thermal expansion and contraction. Pre-drill panels.
 6. Flash and seal metal wall panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
 7. Install screw fasteners in predrilled holes.
 8. Install flashing and trim as metal wall panel work proceeds.
 9. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated; or, if not indicated, as necessary for waterproofing.
 10. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws.
 11. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
- B. Metal Wall Panels: Install metal wall panels on exterior side of girts. Attach metal wall panels to supports with fasteners as recommended by manufacturer.

3.7 DOOR AND FRAME INSTALLATION

- A. General: Install doors and frames plumb, rigid, properly aligned, and securely fastened in place according to manufacturers' written instructions. Coordinate installation with wall flashings and other components. Seal perimeter of each door frame with elastomeric sealant used for metal wall panels.
- B. Personnel Doors and Frames: Install doors and frames according to SDI A250.8. Fit non-fire-rated doors accurately in their respective frames, with the following clearances:
 - 1. Between Doors and Frames at Jambs and Head: **1/8 inch (3 mm)**.
 - 2. Between Edges of Pairs of Doors: **1/8 inch (3 mm)**.
 - 3. At Door Sills with Threshold: **3/8 inch (9.5 mm)**.
 - 4. At Door Sills without Threshold: **3/4 inch (19.1 mm)**.
- C. Door Hardware: Mount units at heights indicated in DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 1. Install surface-mounted items after finishes have been completed on substrates involved.
 - 2. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 3. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
 - 4. Set thresholds for exterior doors in full bed of butyl-rubber sealant complying with requirements specified in Section 079200 "Joint Sealants."

3.8 ACCESSORY INSTALLATION

- A. General: 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 roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 - 2. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 - 3. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "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 will be permanently watertight and weather resistant.
 - 1. Install exposed flashing and trim that is without excessive oil-canning, 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 and weather-resistant 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 (600 mm)** of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be

sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than **1 inch (25 mm)** deep, filled with mastic sealant (concealed within joints).

- C. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than **36 inches (914 mm)** o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- D. Downspouts: Join sections with **1-1/2-inch (38-mm)** telescoping joints. Provide fasteners designed to hold downspouts securely **1 inch (25 mm)** away from walls; locate fasteners at top and bottom and at approximately **60 inches (1524 mm)** o.c. in between.
 - 1. Provide elbows at base of downspouts to direct water away from building.
- E. Continuous Roof Ventilators: Set ventilators complete with necessary hardware, anchors, dampers, weather guards, rain caps, and equipment supports. Join sections with splice plates and end-cap skirt assemblies where required to achieve indicated length. Install preformed filler strips at base to seal ventilator to metal roof panels.
- F. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

3.9 ADJUSTING

- A. Doors: After completing installation, test and adjust doors to operate easily, free of warp, twist, or distortion.
- B. Door Hardware: Adjust and check each operating item of door hardware and each door to ensure proper operation and function of every unit. Replace units that cannot be adjusted to operate as intended.
- C. Roof Ventilators: After completing installation, including work by other trades, lubricate, test, and adjust units to operate easily and be free of warp, twist, or distortion as needed to provide fully functioning units.

3.10 CLEANING 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 erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing, bearing plates, and accessories.
 - 1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or by SSPC-SP 3, "Power Tool Cleaning."
 - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
- C. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
 - 1. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

- D. Doors and Frames: Immediately after installation, sand rusted or damaged areas of prime coat until smooth and apply touchup of compatible air-drying primer.
 - 1. Immediately before final inspection, remove protective wrappings from doors and frames.

3.11 FIELD PAINTING

- A. Immediately upon detection, abraded or corroded spots on shop-painted surfaces shall be wire brushed and touched-up with the same material used for the shop coat. Shop-primed surfaces of doors and windows shall be painted with two coats of an approved exterior enamel. Factory color finished surfaces shall be touched-up as necessary with the manufacturer's recommended touch-up paint. Refer to other specification sections for additional field coats of paint.

END OF SECTION 133419

SECTION 21 01 00
FIRE PROTECTION OPERATING AND MAINTENANCE MANUALS

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Compilation product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare operating and maintenance data as specified.
- B. Instruct Owner's personnel in operation and maintenance of equipment and systems.
- C. Submit three copies of complete manual in final form.

1.2 SUBMITTALS

- A. Thirty (30) days after the Contractor has received the final scheduled identified submittals bearing the Architect / Engineer's stamp of acceptance (including resubmittals), submit for review one copy of the first draft of the Operating and Maintenance Manual. This copy shall contain as a minimum:
 - 1. Table of Contents for each element.
 - 2. Contractor information.
 - 3. All submittals, coordination drawings and product data, reviewed by the Architect / Engineer; bearing the Architect / Engineer's stamp of acceptance. (When submittals are returned from Engineer "Correct as Noted", corrected inserts shall be included.)
 - 4. All parts and maintenance manuals for items of equipment.
 - 5. Warranties (without starting dates)
 - 6. Certifications that have been completed. Submit forms and outlines of certifications that have not been completed.
 - 7. Operating and maintenance procedures.
 - 8. Form of Owner's Training Program Syllabus (including times and dates).
 - 9. Control operations/equipment wiring diagrams.
 - 10. Other required operating and maintenance information that are complete.
- B. Copy will be returned to the Contractor within 15 days with comments for corrections.
- C. Submit completed manuals in final electronic form to the Architect / Engineer one day after substantial completion, and prior to Owner's instructions. Include all specified data, test and balance reports, drawings, dated warranties, certificates, reports, along with other materials and information.
- D. The Architect / Engineer will review the manuals for completeness within fifteen (15) days.
- E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Architect / Engineer. The manuals will not be retransmitted.
- F. Completed electronic manuals will be delivered to the Owner.

PART 2 – PRODUCTS

2.1 BINDERS

- A. Commercial quality black three-ring binders with clear overlay plastic covers.
- B. Minimum ring size: 1".
Maximum ring size: 3".
- C. When multiple binders are used, correlate the data into related groupings.
- D. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 – EXECUTION

3.1 OPERATION AND MAINTENANCE MANUAL

- A. Form for 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 flyleaf 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 21.
 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

**SECTION 21 05 00
FIRE PROTECTION GENERAL PROVISIONS**

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions and Supplementary Conditions, applicable provisions of the General Requirements, and other provisions and requirements of the contract documents apply to work of Division 21 Fire Sprinkler Systems.
- B. Applicable provisions of this section apply to all sections of Division 22, Plumbing.

1.2 CODE REQUIREMENTS AND FEES

- A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.
- B. Plumbing work shall comply with applicable inspection services:
 - 1. Underwriters Laboratories
 - 2. National Fire Protection Association
 - 3. State Health Department
 - 4. Local Municipal Building Inspection Department
 - 5. Texas Department of Licensing & Regulations (TDLR)
 - 6. Texas Accessibility Standards (TAS Based on ADA)
- C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.
- D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.
- E. Obtain all permits required.

1.2 CONTRACTOR'S QUALIFICATIONS

- A. 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 has served their Owners satisfactorily for not less than 3 years

1.3 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date bids are received. Requirements in reference specifications and standards are minimum for all equipment, material, and work. In instances where specified capacities, size, or other features of equipment, devices, or materials exceed these minimums, meet specified capacities.

1.4 CONTRACT DRAWINGS

- A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.

1.6 PROJECT RECORD DOCUMENTS

- A. Maintain at the job site a separate set of white prints (blue line or black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various lines, valves, ductwork, traps, equipment, and other pertinent items, as installed. Include flow-line elevation of sewer lines. Record existing and new underground and under slab piping with dimensioned locations and elevations of such piping.
- B. At the conclusion of project, obtain without cost to the Owner, erasable mylars of the original drawings and transfer as-built changes to these. 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 2012 / Revit CAD files on disk (CD Rom).
- C. 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 RECORD DRAWINGS.
 - 4. Clearly indicate: DOCUMENT PRODUCED BY
 - 5. Indicate all changes to construction during construction. Indicate actual routing of all piping, etc. that were deviated from construction drawings.
 - 6. Correct schedules to reflect (actual) equipment furnished and manufacturer.
 - 7. 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.
 - 8. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and plumbing valves.
 - 9. Exact location of all electrical equipment in and outside of the building.
 - 10. Fire Protection System documents revised to indicate exact location of all sprinkler heads and zone valves.
 - 11. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
 - 12. Cloud all changes.

1.7 SPACE REQUIREMENTS

- A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.8 RELATION WITH OTHER TRADES

- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements.
- B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.
- C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.

- D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.
- E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under that Division. Determine from the Contractor for the various trades, the Owner, and by direction from the Architect/Engineer, the exact location of all items.

1.9 CONCEALED AND EXPOSED WORK

- A. When the word "concealed" is used in connection with insulating, painting, piping, ducts and the like, the work is understood to mean hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is understood to mean open to view.

1.10 GUARANTEE

- A. Guarantee work for 1 year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

1.11 MATERIAL AND EQUIPMENT

- A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 NOISE AND VIBRATION

- A. Select equipment to operate with minimum noise and vibration. If objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, rectify such conditions at no additional cost. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.13 ACCEPTABLE MANUFACTURERS

- A. Manufacturers names and catalog number specified under sections of Division 21 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer will be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before bid due date. Submit complete design and performance data to the Engineer.

1.14 OPERATING TESTS

- A. After all plumbing 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.

1.15 WARRANTIES

- A. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.16 BUILDING CONSTRUCTION

- A. It shall be the responsibility of each sub-contractor to consult the Architectural and Engineering drawings, details, and specifications and thoroughly familiarize himself with the project and all job related requirements. Each sub-contractor shall cooperate with the General Contractor to verify that all piping and other items are placed in the walls, furred spaces, chases, etc., so there will be no delays in the job.

PART 2 - PRODUCTS – NOT USED

PART 3 – EXECUTION

3.1 OPENINGS

- A. Framed, cast or masonry openings for ductwork, equipment or piping are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.2 HOUSEKEEPING PADS

- A. Provide equipment housekeeping pads under all floor mounted and ground mounted plumbing equipment, and as shown on the drawings.
- B. Concrete work as specified in Division 3.
- C. Concrete pads:
 - 1. 4" high, rounded edges, minimum 2500 psi unless otherwise indicated on the drawings
 - 2. Chamfer strips at edges and corner of forms.
 - 3. Smooth steel trowel finish.
 - 4. Doweled to existing slab
- D. Install concrete curbs around multiple pipe penetrations.

3.3 VANDAL RESISTANT DEVICES

- A. Provide a handle for each loose keyed operated valve and hose bibb on the project.
- B. Where vandal resistant screws or bolts are employed on the project, deliver to the Owner 2 suitable tools for use with each type of fastener used.
- C. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.4 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 plumbing 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 plumbing systems and with the project.
- B. Time to be allocated for instructions.
 - 1. Minimum of 4 hours dedicated instructor time.
 - 2. 2 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 Operating and Maintenance Manual.

3.5 EQUIPMENT IDENTIFICATION

- A. Provide a laminated engraved plastic nameplate on each piece of equipment and starter.
 - 1. Designation approved by Architect/Engineer.
 - 2. Equipment includes, but is not limited to, water heaters, pumps, boilers and utility controllers.
 - 3. Submit schedule of equipment to be included and designations.
- B. Provide nameplates with 1/2" high letters and fastened with epoxy or screws.

3.6 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
 - 1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
 - 2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
- B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.7 PROTECTION

- A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.

END OF SECTION

**SECTION 21 05 10
FIRE PROTECTION CONTRACT QUALITY CONTROL**

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Contract quality control including workmanship, manufacturer's instructions and demonstrations.

1.2 QUALITY CONTROL PROGRAM

- A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work in accordance with contract documents.

1.3 WORKMANSHIP

- A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform work by persons qualified to produce workmanship of specified quality.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.
- D. Provide finishes to match approved samples. All exposed finishes shall be approved by the Architect. Submit color samples as required.

1.4 MANUFACTURER'S INSTRUCTIONS

- A. Comply with instructions in full detail, including each step in sequence.
- B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.5 MANUFACTURER'S CERTIFICATES

- A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.6 MANUFACTURER'S FIELD SERVICES

- . When required in individual Specification Sections, manufacturer shall provide qualified personnel to observe:
 - 1. Field conditions.
 - 2. Condition of installation.
 - 3. Quality of workmanship.
 - 4. Start-up of equipment.
 - 5. Testing, adjusting, and balancing of equipment.
- B. Representative shall make written report of observations and recommendations to Architect / Engineer.

PART 2 – PRODUCTS

2.1 REFERENCE APPLICABLE SPECIFICATION SECTIONS.

PART 3 – EXECUTION

3.1 PROTECTION OF EQUIPMENT

- A. 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 a like kind at no additional cost to the Owner.

- B. Adequately protect equipment from damage after delivery to the project. Cover with heavy tarpaulins, drop cloths or other protective coverings as required to protect from plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion.

END OF SECTION

SECTION 21 05 12
FIRE PROTECTION SHOP DRAWINGS, COORDINATION DRAWINGS & PRODUCT DATA

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Prepare submittals as required by Division 1.
- B. The term submittal, as used herein, refers to all:
 - 1. Shop Drawings
 - 2. Coordination Drawings
 - 3. Product data
- C. Submittals shall be prepared and produced for:
 - 1. Distribution as specified
 - 2. Inclusion in the Operating and Maintenance Manual, as specified, in the related section

1.2 SHOP DRAWINGS

- A. Present drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.
- B. Show all dimensions of each item of equipment on a single composite Shop Drawing. Do not submit a series of drawings of components.
- C. Identify field dimensions; show relationship to adjacent features, critical features, work, or products.
- D. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.

1.3 COORDINATION DRAWINGS

- A. Present in a clear and thorough manner. Title each drawing with project name. Identify each element of drawings by reference to sheet number and detail, or room number of contract documents. Minimum drawing scale: $\frac{1}{4}'' = 1'-0''$.
- B. Prepare coordination drawings to coordinate installations for efficient use of available space, for proper sequence of installation, and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.
- C. For each mechanical room and for each outside equipment pad where equipment is located, submit plan and elevation drawings. Show:
 - 1. Actual mechanical equipment and components to be furnished
 - 2. Service clearance
 - 3. Relationship to other equipment and components
 - 4. Roof drains and leader piping
 - 5. Fire protection piping and equipment
- D. Identify field dimensions. Show relation to adjacent or critical features of work or products.
- E. Related requirements:
 - 1. Ductwork shop drawings
 - 2. Coordination drawing specified in Division 26
- F. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.
- G. Gas piping sketch indicating proposed location of piping prior to proceeding with the installation.

1.4 PRODUCT DATA AND INSTALLATION INSTRUCTION

- A. Submit only pages which are pertinent to the project. All options which are indicated on the product data shall become part of the contract and shall be required whether specified are not.
- B. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number.
- C. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.
- D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.
- E. Mark up a copy of the specifications for the product. Indicate in the margin of each paragraph the following: "Comply," "Do Not Comply", or "Not Applicable". Explain all "Do Not Comply" statements.
- F. Provide a separate transmittal for each submittal item. Transmittals shall indicate product by specification section name and number. Separate all submittals into appropriate specification section number. Do not combine specification sections.

1.5 MANUFACTURERS INSTRUCTIONS

- A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, calibrating, balancing and finishing.

1.6 CONTRACTOR RESPONSIBILITIES

- A. Review submittals prior to transmittal.
- B. Determine and verify:
 - 1. Field measurements
 - 2. Field construction criteria
 - 3. Manufacturer's catalog numbers
 - 4. Conformance with requirements of Contract Documents
- C. Coordinate submittals with requirements of the work and of the Contract Documents.
- D. Notify the Architect / Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.
- E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect / Engineer's acceptance.
- F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect / Engineer reviews submittals or not.
- G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect / Engineer reviews submittals or not, unless Architect / Engineer gives written acceptance of the specific deviations on reviewed documents.
- H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
 - 1. Proper sizes and capacities
 - 2. That the item will fit in the available space in a manner that will allow proper service
 - 3. Construction methods, materials and finishes
- I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

1.7 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor.
- B. Number of submittals required:
 - 1. Shop Drawings and Coordination Drawings: Submit one reproducible transparency and three opaque reproductions.
 - 2. Product Data: Submit the number of copies which the contractor requires, plus those which will be retained by the Architect / Engineer.
- C. Accompany submittals with transmittal letter, in duplicate, containing:
 - 1. Date
 - 2. Project title and number
 - 3. Contractor's name and address
 - 4. The number of each Shop Drawing, Project Datum and Sample submitted
 - 5. Other pertinent data
- D. Submittals shall include:
 - 1. The date of submission
 - 2. The project title and number
 - 3. Contract Identification
 - 4. The names of:
 - a. Contractor
 - b. Subcontractor
 - c. Supplier
 - d. Manufacturer
 - 5. Identification of the product
 - 6. Field dimensions, clearly identified as such
 - 7. Relation to adjacent or critical features of the work or materials
 - 8. Applicable standards, such as ASTM or federal specifications numbers
 - 9. Identification of deviations from contract documents
 - 10. Suitable blank space for General Contractor and Architect / Engineer stamps
 - 11. Contractor's signed and dated Stamp of Approval
- E. Coordinate submittals into logical groupings to facilitate interrelation of the several items:
 - 1. Finishes which involve Architect / Engineer selection of colors, textures or patterns
 - 2. Associated items which require correlation for efficient function or for installation

1.8 SUBMITTAL SPECIFICATION INFORMATION

- A. Every submittal document shall bear the following information as used in the project manual:
 - 1. The related specification section number
 - 2. The exact specification section title
- B. Submittals delivered to the Architect / Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.9 RESUBMISSION REQUIREMENTS

- A. Make re-submittals under procedures specified for initial submittals.
 - 1. Indicate that the document or sample is a re-submittal
 - 2. Identify changes made since previous submittals

- B. Indicate any changes which have been made, other than those requested by the Architect / Engineer.

1.10 CONTRACTOR'S STAMP OF APPROVAL

- A. Contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
- B. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect / Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.
- C. Do not deliver any submittals to the Architect / Engineer that do not bear the Contractor's stamp of approval and signature.
- D. Submittals delivered to the Architect / Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.11 ARCHITECT / ENGINEER REVIEW OF IDENTIFIED SUBMITTALS

- A. The Architect / Engineer will:
 - 1. Review identified submittals with reasonable promptness and in accordance with schedule
 - 2. Affix stamp and initials or signature, and indicate requirements for re-submittal or approval of submittal
 - 3. Return submittals to Contractor for distribution or for resubmission
- B. Review and approval of submittals will not extend to design data reflected in submittals which is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.
- C. Architect / Engineer's review and approval is only for conformance with the design concept of the project and for compliance with the information given in the contract.
 - 1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
 - 2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes or coordination with the work of other trades.
- D. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.12 SUBSTITUTIONS

- A. Do not make requests for substitution employing the procedures of this Section.
- B. The procedure for making a formal request for substitution is specified in Div. 1.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 21 05 13
ELECTRICAL PROVISIONS OF FIRE PROTECTION WORK

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Electrical provisions to be provided as fire protection work are indicated in other Division 21 sections, on drawings, and as specified.
- B. Types of work, normally recognized as electrical but provided as fire protection, specified or partially specified in this Section, include but are not necessarily limited to the following:
 - 1. Motors for fire protection equipment.
 - 2. Starters for motors of fire protection equipment, but only where specifically indicated to be furnished integrally with equipment.
 - 3. Wiring from motors to disconnect switches or junction boxes for motors of fire protection equipment, but only where specifically indicated to be furnished integrally with equipment.
 - 4. Wiring of field-mounted float control switches, flow control switches, and similar fire protection-electrical devices provided for fire protection systems, to equipment control panels.
 - 5. Pipe heat tracing.
- C. Refer to Division 21 sections for specific individual fire protection equipment electrical requirements.
- D. Refer to Division 26 sections for motor starters and controls not furnished integrally with fire protection equipment.
- E. Refer to Division 26 sections for junction boxes and disconnect switches required for motors and other electrical units of fire protection equipment.

1.2 RELATED WORK

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to work of this Section.

1.3 QUALITY ASSURANCE

- A. Wherever possible, match elements of electrical provisions of fire protection work with similar elements of electrical work specified in Division 26 sections for electrical work not otherwise specified.
- B. For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards for definitions of terminology. Comply with National Electrical Code (NFPA 70) for workmanship and installation requirements.

1.4 SUBMITTALS

- A. Include in listing of motors, voltage, notation of whether motor starter is furnished or installed integrally with motor or equipment containing motors.

PART 2 – PRODUCTS

2.1 MOTORS

- A. Provide motors for fire protection equipment manufactured by one of the following:
 - 1. Baldor Electric Company.
 - 2. Century Electric Div., Inc.
 - 3. General Electric Co.
 - 4. Louis Allis Div.; Litton Industrial Products, Inc.
 - 5. Lincoln Electric

6. Marathon Electric Mfg. Corp.
 7. Reliance Electric Co.
 8. Westinghouse Electric Corp.
- B. Motor Characteristics. Except where more stringent requirements are indicated, and except where required items of fire protection equipment cannot be obtained with fully complying motors, comply with the following requirements for motors of fire protection work:
- C. Temperature Rating. Rated for 40°C environment with maximum 50°C temperature rise for continuous duty at full load (Class A Insulation).
- D. Provide each motor capable of making starts as frequently as indicated by automatic control system, and not less than 5 starts per hour for manually controlled motors.
- E. Phases and Current Characteristics. Provide squirrel-cage induction polyphase motors for 3/4hp and larger, and provide capacitor-start single-phase motors for 1/2hp and smaller, except 1/6hp and smaller may, at equipment manufacturer's option, be split-phase type. Coordinate current characteristics with power specified in Division 26 sections, and with individual equipment requirements specified in other Division 21 requirements. For 2-speed motors provide 2 separate windings on polyphase motors. Do not purchase motors until power characteristics available at locations of motors have been confirmed, and until rotation directions have been confirmed.
- F. Service Factor. 1.15 for polyphase motors and 1.35 for single-phase motors.
- G. Motor Construction. Provide general purpose, continuous duty motors, Design "B" except "C" where required for high starting torque.
1. Frames. NEMA #56.
 2. Bearings are to be ball or roller bearings with inner and outer shaft seals, regreasable except permanently sealed where motor is inaccessible for regular maintenance. Where belt drives and other drives produce lateral or axial thrust in motor, provide bearings designed to resist thrust loading. Refer to individual section of Division 21 for fractional-hp light-duty motors where sleeve-type bearings are permitted.
 3. Except as indicated, provide open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation, and provide guarded drip-proof motors where exposed to contact by employees or building occupants. Provide weather-protected Type I for outdoor use, Type II where not housed. Refer to individual sections of Division 21 for other enclosure requirements.
 4. Provide built-in thermal overload protection and, where indicated, provide internal sensing device suitable for signaling and stopping motor at starter.
 5. Noise Rating: Provide "Quiet" rating on motors.
- H. All motors shall be premium efficiency.

2.2 EQUIPMENT FABRICATION

- A. Fabricate fire protection equipment for secure mounting of motors and other electrical items included in work. Provide either permanent alignment of motors with equipment, or adjustable mountings as applicable for belt drives, gear drives, special couplings and similar indirect coupling of equipment. Provide safe, secure, durable, and removable guards for motor drives. Arrange for lubrication and similar running-maintenance without removal of guards.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, anchored to resist torque, drive thrusts, and other external forces inherent in

fire protection work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.

- B. Verify voltage with Electrical Plans.

END OF SECTION

**SECTION 22 01 00
PLUMBING OPERATING AND MAINTENANCE MANUALS**

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Compilation product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare operating and maintenance data as specified.
- B. Instruct Owner's personnel in operation and maintenance of equipment and systems.
- C. Submit three copies of complete manual in final form.

1.2 SUBMITTALS

- A. Thirty (30) days after the Contractor has received the final scheduled identified submittals bearing the Architect/Engineer's stamp of acceptance (including resubmittals), submit for review one copy of the first draft of the Operating and Maintenance Manual. This copy shall contain as a minimum:
 - 1. Table of Contents for each element.
 - 2. Contractor information.
 - 3. All submittals, coordination drawings and product data, reviewed by the Architect/Engineer; bearing the Architect/Engineer's stamp of acceptance. (When submittals are returned from Engineer "Correct as Noted", corrected inserts shall be included.)
 - 4. All parts and maintenance manuals for items of equipment.
 - 5. Warranties (without starting dates)
 - 6. Certifications that have been completed. Submit forms and outlines of certifications that have not been completed.
 - 7. Operating and maintenance procedures.
 - 8. Form of Owner's Training Program Syllabus (including times and dates).
 - 9. Control operations/equipment wiring diagrams.
 - 10. Other required operating and maintenance information that are complete.
- B. Copy will be returned to the Contractor within 15 days with comments for corrections.
- C. Submit completed manuals in final electronic form to the Architect/Engineer one day after substantial completion, and prior to Owner's instructions. Include all specified data, test and balance reports, drawings, dated warranties, certificates, reports, along with other materials and information.
- D. The Architect/Engineer will review the manuals for completeness within fifteen (15) days.
- E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Architect / Engineer. The manuals will not be retransmitted.
- F. Completed electronic manuals will be delivered to the Owner.

PART 2 – PRODUCTS

2.1 BINDERS

- A. Commercial quality black three-ring binders with clear overlay plastic covers.
- B. Minimum ring size: 1".
Maximum ring size: 3".
- C. When multiple binders are used, correlate the data into related groupings.
- D. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 – EXECUTION

3.1 OPERATION AND MAINTENANCE MANUAL

- A. Form for 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 flyleaf 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 reports.

END OF SECTION

**SECTION 22 05 00
PLUMBING GENERAL PROVISIONS**

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of the General Requirements, and other provisions and requirements of the contract documents apply to work of Division 22 Plumbing
- B. Applicable provisions of this section apply to all sections of Division 22, Plumbing.

1.2 CODE REQUIREMENTS AND FEES

- A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.
- B. Plumbing work shall comply with applicable inspection services:
 - 1. Underwriters Laboratories
 - 2. National Fire Protection Association
 - 3. State Health Department
 - 4. Local Municipal Building Inspection Department
 - 5. Texas Department of Licensing & Regulations (TDLR)
 - 6. Texas Accessibility Standards (TAS Based on ADA)
- C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.
- D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.
- E. Obtain all permits required.

1.3 CONTRACTOR'S QUALIFICATIONS

- A. 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 has served their Owners satisfactorily for not less than 3 years

1.4 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date bids are received. Requirements in reference specifications and standards are minimum for all equipment, material, and work. In instances where specified capacities, size, or other features of equipment, devices, or materials exceed these minimums, meet specified capacities.

1.5 CONTRACT DRAWINGS

- A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.

1.6 PROJECT RECORD DOCUMENTS

- A. Maintain at the job site a separate set of white prints (blue line or black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is at variance with the contract drawings. Mark

the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various lines, valves, ductwork, traps, equipment, and other pertinent items, as installed. Include flow-line elevation of sewer lines. Record existing and new underground and under slab piping with dimensioned locations and elevations of such piping.

- B. At the conclusion of project, obtain without cost to the Owner, erasable mylars of the original drawings and transfer as-built changes to these. 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 2012 / Revit CAD files on disk (CD Rom).
- C. 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 RECORD 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 elevation.
 - 7. Indicate exact location of all underground plumbing piping and elevation.
 - 8. Indicate exact location of all underground electrical raceways and elevations.
 - 9. Correct schedules 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 plumbing 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.

1.7 SPACE REQUIREMENTS

- A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.8 RELATION WITH OTHER TRADES

- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements
- B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.
- C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them
- D. Locate and size openings required for installation of work specified in this Division in

sufficient time to prevent delay in the work.

- E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under that Division. Determine from the Contractor for the various trades, the Owner, and by direction from the Architect/Engineer, the exact location of all items.

1.9 CONCEALED AND EXPOSED WORK

- A. When the word "concealed" is used in connection with insulating, painting, piping, ducts and the like, the work is understood to mean hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is understood to mean open to view.

1.10 GUARANTEE

- A. Guarantee work for 1 year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

1.11 MATERIAL AND EQUIPMENT

- A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 NOISE AND VIBRATION

- A. Select equipment to operate with minimum noise and vibration. If objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, rectify such conditions at no additional cost. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.13 ACCEPTABLE MANUFACTURERS

- A. Manufacturers names and catalog number specified under sections of Division 22 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer will be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before bid due date. Submit complete design and performance data to the Engineer.

1.14 OPERATING TESTS

- A. After all plumbing 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.

1.15 WARRANTIES

- A. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.16 BUILDING CONSTRUCTION

- A. It shall be the responsibility of each sub-contractor to consult the Architectural and Engineering drawings, details, and specifications and thoroughly familiarize himself with the project and all job related requirements. Each sub-contractor shall cooperate with the General Contractor to verify that all piping and other items are placed in the walls, furred spaces, chases, etc., so there will be no delays in the job.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 OPENINGS

- A. Framed, cast or masonry openings for ductwork, equipment or piping are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.2 HOUSEKEEPING PADS

- A. Provide equipment housekeeping pads under all floor mounted and ground mounted plumbing equipment, and as shown on the drawings.
- B. Concrete work as specified in Division 3.
- C. Concrete pads:
 - 1. 4" high, rounded edges, minimum 2500 psi unless otherwise indicated on the drawings
 - 2. Chamfer strips at edges and corner of forms.
 - 3. Smooth steel trowel finish.
 - 4. Doweled to existing slab
- D. Install concrete curbs around multiple pipe penetrations.

3.3 VANDAL RESISTANT DEVICES

- A. Provide a handle for each loose keyed operated valve and hose bibb on the project.
- B. Do not use vandal resistant screws or bolts on the project.
- C. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.4 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 plumbing 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 plumbing 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 Operating and Maintenance Manual.

3.5 EQUIPMENT IDENTIFICATION

- A. Provide a laminated engraved plastic nameplate on each piece of equipment and starter.
 - 1. Designation approved by Architect/Engineer.
 - 2. Equipment includes, but is not limited to, water heaters, pumps, boilers and utility controllers.
 - 3. Submit schedule of equipment to be included and designations.
- B. Provide nameplates with 1/2" high letters and fastened with epoxy or screws.

3.6 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
 - 1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
 - 2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
- B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.7 PROTECTION

- A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.

END OF SECTION

**SECTION 22 05 10
PLUMBING CONTRACT QUALITY CONTROL**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Contract quality control including workmanship, manufacturer's instructions and demonstrations.

1.2 QUALITY CONTROL PROGRAM

- A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work in accordance with contract documents.

1.3 WORKMANSHIP

- A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform work by persons qualified to produce workmanship of specified quality.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.
- D. Provide finishes to match approved samples. All exposed finishes shall be approved by the Architect. Submit color samples as required.

1.4 MANUFACTURER'S INSTRUCTIONS

- A. Comply with instructions in full detail, including each step in sequence.
- B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.5 MANUFACTURER'S CERTIFICATES

- A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.6 MANUFACTURER'S FIELD SERVICES

- A. When required in individual Specification Sections, manufacturer shall provide qualified personnel to observe:
 - 1. Field conditions.
 - 2. Condition of installation.
 - 3. Quality of workmanship.
 - 4. Start-up of equipment.
 - 5. Testing, adjusting, and balancing of equipment.
- B. Representative shall make written report of observations and recommendations to Architect / Engineer.

PART 2 – PRODUCTS

2.1 REFERENCE APPLICABLE SPECIFICATION SECTIONS.

PART 3 – EXECUTION

3.1 PROTECTION OF EQUIPMENT

- A. 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 a like kind at no additional cost to the Owner.

- B. Adequately protect equipment from damage after delivery to the project. Cover with heavy tarpaulins, drop cloths or other protective coverings as required to protect from plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion.

END OF SECTION

SECTION 22 05 12
PLUMBING SHOP DRAWINGS, COORDINATION DRAWINGS & PRODUCT DATA

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Prepare submittals as required by Division 1.
- B. The term submittal, as used herein, refers to all:
 - 1. Shop Drawings
 - 2. Coordination Drawings
 - 3. Product data
- C. Submittals shall be prepared and produced for:
 - 1. Distribution as specified
 - 2. Inclusion in the Operating and Maintenance Manual, as specified, in the related section

1.2 SHOP DRAWINGS

- A. Present drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.
- B. Show all dimensions of each item of equipment on a single composite Shop Drawing. Do not submit a series of drawings of components.
- C. Identify field dimensions; show relationship to adjacent features, critical features, work, or products.
- D. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.

1.3 COORDINATION DRAWINGS

- A. Present in a clear and thorough manner. Title each drawing with project name. Identify each element of drawings by reference to sheet number and detail, or room number of contract documents. Minimum drawing scale: $\frac{1}{4}'' = 1'-0''$.
- B. Prepare coordination drawings to coordinate installations for efficient use of available space, for proper sequence of installation, and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.
- C. For each mechanical room and for each outside equipment pad where equipment is located, submit plan and elevation drawings. Show:
 - 1. Actual mechanical equipment and components to be furnished
 - 2. Service clearance
 - 3. Relationship to other equipment and components
 - 4. Roof drains and leader piping
 - 5. Fire protection piping and equipment
- D. Identify field dimensions. Show relation to adjacent or critical features of work or products.
- E. Related requirements:
 - 1. Ductwork shop drawings
 - 2. Coordination drawing specified in Division 26
- F. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.
- G. Gas piping sketch indicating proposed location of piping prior to proceeding with the installation.

1.4 PRODUCT DATA AND INSTALLATION INSTRUCTION

- A. Submit only pages which are pertinent to the project. All options which are indicated on the product data shall become part of the contract and shall be required whether specified are not.
- B. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number.
- C. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.
- D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.
- E. Mark up a copy of the specifications for the product. Indicate in the margin of each paragraph the following: "Comply, "Do Not Comply", or "Not Applicable". Explain all "Do Not Comply" statements.
- F. Provide a separate transmittal for each submittal item. Transmittals shall indicate product by specification section name and number. Separate all submittals into appropriate specification section number. Do not combine specification sections.

1.5 MANUFACTURERS INSTRUCTIONS

- A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, calibrating, balancing and finishing.

1.6 CONTRACTOR RESPONSIBILITIES

- A. Review submittals prior to transmittal.
- B. Determine and verify:
 - 1. Field measurements
 - 2. Field construction criteria
 - 3. Manufacturer's catalog numbers
 - 4. Conformance with requirements of Contract Documents
- C. Coordinate submittals with requirements of the work and of the Contract Documents.
- D. Notify the Architect/Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.
- E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect/Engineer's acceptance.
- F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect/Engineer reviews submittals or not.
- G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect/Engineer reviews submittals or not, unless Architect/engineer gives written acceptance of the specific deviations on reviewed documents.
- H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
 - 1. Proper sizes and capacities
 - 2. That the item will fit in the available space in a manner that will allow proper service
 - 3. Construction methods, materials and finishes
- I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

1.7 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor.
- B. Number of submittals required:
 - 1. Shop Drawings and Coordination Drawings: Submit one reproducible transparency and three opaque reproductions.
 - 2. Product Data: Submit the number of copies which the contractor requires, plus those which will be retained by the Architect/Engineer.
- C. Accompany submittals with transmittal letter, in duplicate, containing:
 - 1. Date
 - 2. Project title and number
 - 3. Contractor's name and address
 - 4. The number of each Shop Drawing, Project Datum and Sample submitted
 - 5. Other pertinent data
- D. Submittals shall include:
 - 1. The date of submission
 - 2. The project title and number
 - 3. Contract Identification
 - 4. The names of:
 - a. Contractor
 - b. Subcontractor
 - c. Supplier
 - d. Manufacturer
 - 5. Identification of the product
 - 6. Field dimensions, clearly identified as such
 - 7. Relation to adjacent or critical features of the work or materials
 - 8. Applicable standards, such as ASTM or federal specifications numbers
 - 9. Identification of deviations from contract documents
 - 10. Suitable blank space for General Contractor and Architect/Engineer stamps
 - 11. Contractor's signed and dated Stamp of Approval
- E. Coordinate submittals into logical groupings to facilitate interrelation of the several items:
 - 1. Finishes which involve Architect/Engineer selection of colors, textures or patterns
 - 2. Associated items which require correlation for efficient function or for installation

1.8 SUBMITTAL SPECIFICATION INFORMATION

- A. Every submittal document shall bear the following information as used in the project manual:
 - 1. The related specification section number
 - 2. The exact specification section title
- B. Submittals delivered to the Architect/Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.9 RESUBMISSION REQUIREMENTS

- A. Make re-submittals under procedures specified for initial submittals.
 - 1. Indicate that the document or sample is a re-submittal
 - 2. Identify changes made since previous submittals
- B. Indicate any changes which have been made, other than those requested by the Architect / Engineer.

1.10 CONTRACTOR'S STAMP OF APPROVAL

- A. Contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
- B. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect/Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.
- C. Do not deliver any submittals to the Architect/Engineer that do not bear the Contractor's stamp of approval and signature.
- D. Submittals delivered to the Architect/Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.11 ARCHITECT/ENGINEER REVIEW OF IDENTIFIED SUBMITTALS

- A. The Architect/Engineer will:
 - 1. Review identified submittals with reasonable promptness and in accordance with schedule
 - 2. Affix stamp and initials or signature, and indicate requirements for re-submittal or approval of submittal
 - 3. Return submittals to Contractor for distribution or for resubmission
- B. Review and approval of submittals will not extend to design data reflected in submittals which is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor
- C. Architect/Engineer's review and approval is only for conformance with the design concept of the project and for compliance with the information given in the contract.
 - 1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
 - 2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes or coordination with the work of other trades.
- D. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.12 SUBSTITUTIONS

- A. Do not make requests for substitution employing the procedures of this Section.
- B. The procedure for making a formal request for substitution is specified in Div. 1.

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 22 05 13
ELECTRICAL PROVISIONS OF PLUMBING WORK

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Electrical provisions to be provided as plumbing work are indicated in other Division 22 sections, on drawings, and as specified.
- B. Types of work, normally recognized as electrical but provided as plumbing, specified or partially specified in this Section, include but are not necessarily limited to the following:
 - 1. Motors for plumbing equipment.
 - 2. Starters for motors of plumbing equipment, but only where specifically indicated to be furnished integrally with equipment.
 - 3. Wiring from motors to disconnect switches or junction boxes for motors of plumbing equipment, but only where specifically indicated to be furnished integrally with equipment.
 - 4. Wiring of field-mounted float control switches, flow control switches, and similar plumbing-electrical devices provided for plumbing systems, to equipment control panels.
 - 5. Pipe heat tracing.
- C. Refer to Division 22 sections for specific individual plumbing equipment electrical requirements.
- D. Refer to Division 26 sections for motor starters and controls not furnished integrally with plumbing equipment.
- E. Refer to Division 26 sections for junction boxes and disconnect switches required for motors and other electrical units of plumbing equipment.

1.2 RELATED WORK

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to work of this Section.

1.3 QUALITY ASSURANCE

- A. Wherever possible, match elements of electrical provisions of plumbing work with similar elements of electrical work specified in Division 26 sections for electrical work not otherwise specified.
- B. For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards for definitions of terminology. Comply with National Electrical Code (NFPA 70) for workmanship and installation requirements.

1.4 SUBMITTALS

- A. Include in listing of motors, voltage, notation of whether motor starter is furnished or installed integrally with motor or equipment containing motors.

PART 2 – PRODUCTS

2.1 MOTORS

- A. Provide motors for plumbing equipment manufactured by one of the following:
 - 1. Baldor Electric Company.
 - 2. Century Electric Div., Inc.
 - 3. General Electric Co.
 - 4. Louis Allis Div.; Litton Industrial Products, Inc.
 - 5. Lincoln Electric
 - 6. Marathon Electric Mfg. Corp.

7. Reliance Electric Co.
8. Westinghouse Electric Corp.
- B. Motor Characteristics. Except where more stringent requirements are indicated, and except where required items of plumbing equipment cannot be obtained with fully complying motors, comply with the following requirements for motors of plumbing work:
 - C. Temperature Rating. Rated for 40°C environment with maximum 50°C temperature rise for continuous duty at full load (Class A Insulation).
 - D. Provide each motor capable of making starts as frequently as indicated by automatic control system, and not less than 5 starts per hour for manually controlled motors.
 - E. Phases and Current Characteristics. Provide squirrel-cage induction polyphase motors for 3/4hp and larger, and provide capacitor-start single-phase motors for 1/2hp and smaller, except 1/6hp and smaller may, at equipment manufacturer's option, be split-phase type. Coordinate current characteristics with power specified in Division 26 sections, and with individual equipment requirements specified in other Division 22 requirements. For 2-speed motors provide 2 separate windings on polyphase motors. Do not purchase motors until power characteristics available at locations of motors have been confirmed, and until rotation directions have been confirmed.
 - F. Service Factor. 1.15 for polyphase motors and 1.35 for single-phase motors.
 - G. Motor Construction. Provide general purpose, continuous duty motors, Design "B" except "C" where required for high starting torque.
 1. Frames. NEMA #56.
 2. Bearings are to be ball or roller bearings with inner and outer shaft seals, regreasable except permanently sealed where motor is inaccessible for regular maintenance. Where belt drives and other drives produce lateral or axial thrust in motor, provide bearings designed to resist thrust loading. Refer to individual section of Division 22 for fractional-hp light-duty motors where sleeve-type bearings are permitted.
 3. Except as indicated, provide open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation, and provide guarded drip-proof motors where exposed to contact by employees or building occupants. Provide weather-protected Type I for outdoor use, Type II where not housed. Refer to individual sections of Division 22 for other enclosure requirements.
 4. Provide built-in thermal overload protection and, where indicated, provide internal sensing device suitable for signaling and stopping motor at starter.
 5. Noise Rating: Provide "Quiet" rating on motors.
 - H. All motors shall be premium efficiency.

2.2 EQUIPMENT FABRICATION

- A. Fabricate plumbing equipment for secure mounting of motors and other electrical items included in work. Provide either permanent alignment of motors with equipment, or adjustable mountings as applicable for belt drives, gear drives, special couplings and similar indirect coupling of equipment. Provide safe, secure, durable, and removable guards for motor drives. Arrange for lubrication and similar running-maintenance without removal of guards.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, anchored to resist torque, drive thrusts, and other external forces inherent in plumbing work. Secure sheaves and other drive units to motor shafts with keys and Allen

set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.

- B. Verify voltage with Electrical Plans.

END OF SECTION

**SECTION 22 05 14
PLUMBING ALTERATIONS PROJECT PROCEDURES**

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Inspect and service existing equipment and materials that are to remain or to be reused.
- B. Disposal of equipment, materials, or housekeeping pads to be abandoned. Prior to disposal, the Contractor shall verify with the Owner what is to be salvaged by the Owner and what is to become the property of the Contractor.
- C. Handling of equipment and materials to be removed.

1.2 QUALITY ASSURANCE

- A. Coordination with the Owner prior to the disconnection or shutdown of existing equipment, or to the modification of existing operational systems.

1.3 CONTRACT DRAWINGS

- A. There is the possibility that existing conditions and devices are affected by the work indicated on the drawings and called for in the specifications (project manual) that do not appear on the drawings. It is the Contractor's responsibility to visit the site and determine all of the existing conditions and to consider these existing conditions when making and presenting a proposal, to have a complete proposal.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Material used to upgrade and repair existing equipment shall conform to that specified.
- B. Material used to upgrade and repair existing equipment shall not void existing warranties or listings of the equipment to be upgraded or repaired.
- C. Material used to upgrade and repair existing equipment shall be new and shall be of the same manufacturer of the existing equipment, shall be acquired through the existing original equipment manufacturer's approved distribution channels, shall have manufacturer's warranties for the new material being used, and shall be listed for the use intended.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Existing materials and equipment indicated on the drawings or in the specifications to be reused shall be inspected for damaged or missing parts. Contractor shall notify the Architect/Engineer, in writing, accordingly.
- B. If using materials specified or shown on the drawing voids or diminishes the warranty or operation of remaining equipment or systems, the Contractor shall notify the Architect/Engineer, in writing.
- C. Verify field measurements, above and underground piping connections and flows.
- D. Demolition Drawings are based on casual field observation, and when available, existing record documents. Report discrepancies to Architect before disturbing existing installation, and immediately after such discrepancies are discovered.
- E. Field verify existing conditions and actual utility uses prior to final connections. Existing drawings may not have been available for all required information. Use pipe inspection camera system to field verify existing sanitary / grease waste connections. Verify flow direction and depth prior to connection to existing plumbing systems.

3.2 APPLICATION

- A. Existing materials and equipment indicated on the drawings or in the specifications to be reused shall be cleaned and reconditioned, including cleaning of piping systems prior to installation and reuse.
- B. Material and equipment removed that is not to be salvaged for Owner's use or for reuse on the project shall become the property of the Contractor and be removed from the site.
- C. Material or equipment salvaged for Owner's use shall be carefully handled and stored where directed by the Owner or the Architect / Engineer. Relocate material and / or equipment as directed by Owner.
- D. Materials and equipment not indicated to be removed or abandoned shall be reconnected to the new system.
- E. Materials, equipment and housekeeping pads not to be reused or reconnected shall be removed for Owner's review and salvaged by Contractor.
- F. Prior to start of construction, Contractor shall walk areas to be renovated with Owner to identify and document items to be salvaged for Owner's use.
- G. Clean and repair existing materials and equipment that remain or are to be reused.
- H. Contractor shall utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

3.3 SEQUENCE AND SCHEDULE

- A. Coordinate utility service outages with Utility Company, Architect and Owner.
- B. Provide additional or temporary valves, piping and connections to maintain existing systems in service during construction.
- C. Existing Plumbing Service: Refer to drawings for work in remodeled areas. Where facilities in these areas are to remain in service, any related work to keep the facilities in operation is specified in this Division. Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from Owner at least 48 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area. Maintain acceptable temperature and humidity control within existing building during renovation activities.
- D. Remove and replace existing Plumbing systems and appurtenances as occasioned by new or remodeled construction. Re-establish service that may be interrupted by remodeled construction.
- E. Refer to other drawings series for work in remodeled areas. Where facilities in these areas are required to remain in service, any related work required to keep these facilities in operation is specified in this Division.
- F. Remove and replace existing piping coincident with the construction.
- G. Remove or relocate existing piping or housekeeping pads as occasioned by new or remodeled construction. Cap unused domestic piping beyond the new finish line.
- H. Relocate all domestic piping as required to accommodate new work requiring precedence.
- I. Remove concrete housekeeping pad where materials or equipment have been removed.
- J. Remove all known utilities that do not provide service to the buildings that remain.
- K. Remove existing plumbing vent penetrations through roof not to be reused. During demolition, abandoned plumbing vents are to be removed in their entirety. Do not cap the vent pipes below the roof deck and abandon in place. The hole in the roof is to be patched and made water tight.

3.4 DEMOLITION AND EXTENSION OF EXISTING PLUMBING WORK

- 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 materials shall remain the property of the Owner, and shall be delivered to such destination as directed by the Owner's representative unless they are not wanted, then it will be the responsibility of this Contractor to remove such items and properly dispose of them. 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 approval of the Owner's representative substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.

- B. All items 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 relocations and to restore them 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.
- C. When items scheduled for relocation and/or reuse are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner's representative 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's representative, at no additional cost to the Owner.
- D. Plumbing, piping and appurtenances to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner's representative. Piping 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 Construction Inspector. 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 that must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner's representative hereinbefore specified.
- E. Repair adjacent construction and finishes damaged during demolition and extension work.
- F. Maintain access to mechanical installations that remain active. Modify installation or provide access panel as appropriate.
- G. Extend existing installations using materials and methods compatible with existing plumbing installations, or as specified.
- H. Existing plumbing piping and devices found to need additional hangers installed should be added at no additional cost to the Owner.

3.5 PROTECTION OF THE WORK

- A. Provide adequate temporary support and auxiliary structure as necessary to ensure structural value or integrity of affected portion of work.
- B. Provide devices and methods to protect other portions of work from damage.
- C. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.

3.6 IDENTIFICATION OF EQUIPMENT IN RENOVATED AREAS

- A. Identification of Equipment: Provide new identification of all existing equipment to be reused and located within the renovated areas. Do not include the description "existing". Provide new nameplates for all existing plumbing equipment in renovated areas as specified in Section 22 05 00 Plumbing General Provisions.

END OF SECTION

**SECTION 22 05 15
PLUMBING EARTHWORK**

PART 1 – GENERAL

- A. Excavate and backfill for pipe trenches for underground piping, and excavate for structures installed as part of plumbing work.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Excavate trenches for underground piping to the required depth to ensure 2 foot minimum coverage over piping.
- B. Cut the bottom of the trench or excavation to uniform grade.
- C. Should rock be encountered, excavate 6 inches below grade, fill with bedding material and tamp well.
- D. 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.

3.2 BACKFILL

- A. 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.
- B. 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 8 inch maximum layers, loose measure. Compact to not less than 95% of maximum soil density as determined by ASTM D-698 Standard Proctor.
- C. 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.

3.3 DISPOSAL OF EXCESS MATERIAL

- A. 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 the Owner / Architect.

END OF SECTION

SECTION 22 05 16
EXCAVATING, BACKFILLING AND COMPACTING FOR UTILITIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 apply to this section.
- B. Refer to Instructions to Bidders for substitution of materials and products.
- C. Addenda issued during the bidding period that affect this section of the specifications.

1.2 WORK INCLUDED

- A. Coordinating all excavating and backfilling for the underground storm sewer, sanitary sewer, water distribution lines, and all related appurtenances.
- B. The extent of lines, excavation, and backfill shall be in conformance with the locations, lines, elevations and grades shown on the drawings prepared by the MEP Engineer.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Earthwork
- B. Water Distribution
- C. Sanitary Sewer
- D. Plumbing

1.4 REFERENCES

- A. American Society for Testing and Materials (ASTM) Use current edition.
 - 1. ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³)
 - 2. ASTM D1556, Standard Test method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
 - 3. ASTM D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
 - 4. ASTM D4254, Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
- B. City Standards
- C. Local Governing Agencies
- D. Texas Health and Safety Code, Chapter 161, Subchapter Q, as amended by House Bill No. 1927.

1.5 WARRANTY

- A. Provide written warranty against defects in the material and workmanship for the work of this Section for a period of one year from the Date of Substantial Completion of the Project. Refer to Division 1 for Warranty form.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Sand: Clean, local sand
- B. Earth Backfill: Clean local material consistent with the surrounding earth material and free of large clods, roots, rocks or other debris.

PART 3 – EXECUTION

3.1 EXCAVATION

- A. General:

1. All utility trenches shall be constructed in conformance with OSHA trench safety standards.
 2. Sheet piling and shoring shall be accomplished to the extent necessary to maintain the sides of the trench in a vertical position throughout the construction period for trenches five feet in depth or deeper. Where approved, trench sides may be laid back in lieu of shoring to meet OSHA safety standards.
 3. Utilities shall not be constructed or laid in a trench in the presence of water. All water shall be sufficiently removed from the trench prior to the line placing operation to ensure a dry, firm bed on which to place the utility line.
- B. Storm and Sanitary Sewer Trenches:
1. For pipe sizes less than 42 inches in diameter, the minimum trench width shall be outside diameter of pipe plus 18 inches.
 2. Trenches shall be excavated to a depth of at least 6 inches below the barrel of pipe.
- C. Appurtenances:
1. Any overdepth excavation below appurtenances shall be refilled with compacted select fill or bank sand.
- D. Water Line Trenches:
1. Water lines shall be at least two feet in depth from the top of proposed grade to the top of pipe.
 2. Trench width for water lines shall be a minimum of the outside pipe diameter plus 18 inches.
 3. Trenches shall be excavated to a depth of at least 6 inches below the barrel of pipe.

3.2 PIPE BEDDING AND BACKFILL – BELOW BUILDING SLAB

- A. Storm and Sanitary Sewer Trenches:
1. Bedding, sewer pipe, and initial backfill over the pipe must be placed in a single day for any given portion of pipe. Initial backfill consisting of bank sand or select backfill shall be placed to one foot above the top of pipe for standard earth backfill.
 2. Remainder of trench backfill shall be placed the next day or later in 8 inch lifts.
 3. Backfill shall be placed in uniform layers not to exceed 8 inches loose measured depth, and compacted to a minimum of 95% of Standard Maximum Density (ASTM D698).
- B. Water Line Trenches Below Building Slab/Outside Building Slab:
1. Pipe bedding shall consist of 6 inches of clean sand placed before the pipe is laid.
 2. After laying pipe and ensuring that the pipe is properly placed and supported by the sand bedding, clean sand backfill shall be placed to 6 inches above the top of pipe. The sand backfill shall be thoroughly rodded and tamped for compaction.
 3. For water lines to be beneath the building and pavement and to one foot from the outer edge of pavement, the remainder of the trench backfill shall be clean sand placed in 6 inch lifts and compacted to 95% Standard Proctor.
 4. For water lines not beneath the building and pavement or within one foot from the outer edge of pavement the remainder of the trench backfill shall be earth fill placed in uniform layers not to exceed 8" loose depth. Each lift shall be compacted to a minimum of 90% of Standard Density (ASTM D698) at the proper moisture content specified in the soils report for this project. All earth backfill shall be placed the next day or later after the pipe is laid.

5. Backfill, under pavement and to one foot from outer edge, up to one foot below subgrade elevation. Remainder of backfill to subgrade to be as specified in paragraph 4 above.

3.3 PIPE BEDDING AND BACKFILL – OUTSIDE BUILDING SLAB

- A. Storm and Sanitary Sewer Trenches:
 1. Bedding, sewer pipe, and initial backfill over the pipe must be placed in a single day for any given portion of pipe. Initial backfill consisting of bank sand or select backfill shall be placed to one foot above the top of pipe for standard earth backfill.
 2. Remainder of trench backfill shall be placed the next day or later in 8 inch lifts.
 3. Backfill shall be placed in uniform layers not to exceed 8 inches loose measured depth, and compacted to a minimum of 95% of Standard Maximum Density (ASTM D698).
 4. Backfill, under pavement and to one foot from outer edge, up to one foot below subgrade elevation. Remainder of backfill to subgrade to be as specified in paragraph 3 above.

3.4 NATURAL GAS PIPING

- A. Natural Gas Trenches:
 1. Natural gas lines shall not be installed under slabs on grade unless pipes are sleeved and vented as per Section 22 63 11.
 2. Natural gas lines shall not be installed in trenches with other utilities.
- B. Utility Locators:
 1. Provide metallic locator over all non-metallic gas piping utilities. Locator tape shall be a maximum of 12 inches below grade and centered over the utility(s).

END OF SECTION

SECTION 22 05 17
PLUMBING ACCESS DOORS

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Furnish and install access doors in wall or ceiling locations as required or shown for access to valves, controls, regulating devices, water arresters and other equipment requiring maintenance, adjustment or operation.

PART 2 – PRODUCTS

2.1 NON-FIRE RATED ACCESS DOORS

- A. 16-Gauge frames
- B. 14-gauge steel panels
- C. Continuous fully concealed hinges
- D. Flush screwdriver cam lock for Owner selection
- E. Prime coat finish
- F. Brushed satin stainless steel finish for restroom, kitchen or cafeteria installation
- G. Material suitable for wall and/or ceiling mounting

2.2 FIRE RATED ACCESS DOORS

- A. UL listed, 1-1/2 hour Label "B", access doors
- B. 16-Gauge stainless steel
- C. 20-Gauge insulated sandwich-type door panel.
- D. Two inch thick with fire rated insulation
- E. Continuous fully concealed hinge
- F. Automatic closing and latching mechanism
- G. Knurled knob and recessed key operation for Owner selection
- H. Interior latch release slide for opening from inside
- I. Prime coat finish
- J. Material suitable for wall and/or ceiling mounting

2.3 ACCEPTABLE MANUFACTURERS

- A. Milcor
- B. MIFAB
- C. Acudor
- D. Elmdor

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Access doors specified in Division 22 will be installed by other crafts. Not all required access doors are shown. Coordinate with the Contractor to locate access doors for ease of operation and maintenance of concealed equipment.
- B. Installation shall be in accordance with the manufacturer's printed instructions.
- C. Minimum size required:
 - 1. 24" x 24" for plumbing multiple isolation valves and electrical related items in ceilings
 - 2. 8"x8" for plumbing for single isolation valve or shock arrestor

END OF SECTION

SECTION 22 05 19
PRESSURE AND TEMPERATURE INSTRUMENTS

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. This section specifies gauges, thermometers, wells and/or pressure and temperature test stations to be installed as specified.

1.2 RELATED WORK

- A. Division 22, Plumbing
 - 1. Plumbing General Provisions
 - 2. Pipe and Pipe Fittings, General
 - 3. Valves, Strainers and Vents

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - GAUGES AND THERMOMETERS

- A. Trerice
- B. Taylor
- C. Marsh
- D. Weksler
- E. Marshalltown
- F. Weiss
- G. Miljoco

2.2 PRESSURE GAUGES

- A. Case and Ring: 4" type 304 stainless steel; liquid filled case with stainless steel bayonet ring.
- B. Dial: White aluminum with black markings
- C. Window: Clear acrylic
- D. Tube: Phosphor bronze and forged brass socket.
- E. Gauge accuracy: +/- 1% over operating range.
- F. For pulsating service, provide impulse dampers.
- G. Without flange for pipe mounting.

- H. With flange for wall mounting.
- I. Weiss Model: Domestic Water 4CTSLF (Lead Free) 0-100 PSI

2.3 THERMOMETER WELLS

- A. Brass or type 300 stainless steel. Machined bar stock, 1-piece construction (Lead Free).
- B. Where installed in insulated piping or vessels, provide with extension neck to match insulation thickness.
- C. Provide metal-to-metal contact with bulb chamber for maximum sensitivity.
- D. Wells shall be sized to extend a minimum of 50% into pipe.

2.4 THERMOMETERS IN PIPING SYSTEMS OR VESSELS

- A. Die cast aluminum case with baked epoxy finish.
- B. Adjustable angle 9" scale length.
- C. Clear acrylic window.
- D. Brass stem, length to match well.
- E. Red reading organic spirit filled-in magnifying glass column.
- F. White background with black figures and markings.
- G. Brass stems and union connections (Lead Free).

- H Accuracy: +/- 1% of scale range.
- I Range:
 - 1. Hot water lines: 30°F to 240°F.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install in accordance with drawing details and manufacturer's recommendations.
- B. Provide a ball valve at each gauge (Lead Free).
- C. Locate gauges and thermometers to be easily readable from the floor at a 5'-6" eye level. Use adjustable angle or rigid stem as required. Install gauges in upright position.
- D. Install gauges in the following locations: across pumps, storage tanks, heat exchangers.
- E. Install thermometer in the following locations: At storage tanks, across heat exchangers, across boiler, leaving side of water heater, leaving water side of tempered water valves, and hot water supply and return lines.
 - 1. Hot water lines: 30°F to 240°F.
 - 2. Tempered water valves 0°F to 120°F.

END OF SECTION

SECTION 22 05 23
VALVES, STRAINERS AND VENTS

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Plumbing Valves
- B. Pipe strainer and suction diffusers.

PART 2 – PRODUCTS

2.1 VALVES

- A. Pressure Ratings:
 - 1. Unless otherwise indicated, use valves suitable for 125 minimum psig working steam pressure (WSP) and 450°F.
 - 2. The pressure temperature rating of valves shall be not less than the design criteria applicable to components of the system.
 - 3. Use grooved butterfly valves when using grooved piping.
- B. Butterfly Valves
 - 1. Butterfly valves shall conform to MSS-SP67.
 - 2. Valves shall have a full lug type body designed for installation between ANSI standard flanges, and shall be rated at full working pressure with downstream flange removed.
 - 3. All valves for domestic use must be lead free.
 - 4. Do not use Victaulic flanges on butterfly valves.
 - 5. All butterfly valves shall have a stainless steel disc.
- F. Ball Valves
 - 1. Provide ball valves with:
 - a. Blowout proof stem.
 - b. Full size port, 316 stainless steel ball and stem.
 - c. Cast bronze body.
 - d. Threaded ends.
 - 2. Seat, seals, thrust washers and packing shall be suitable for the intended service.
 - 3. Service rating:
 - a. 150 psi saturated steam.
 - b. 600 psi WOG.
 - 4. Where Viega ProPress fittings are used, Viega ProPress ball valves may be used, or as approved.
 - 5. All valves for domestic use must be lead free.
 - 6. Do not use PVC or CPVC ball valves.
- I. Valve Connections
 - 1. Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use pipe size valves. Sweated joints are not allowed.
 - 2. Thread pipe sizes 2" and smaller.
 - 3. Flange pipe sizes 2-1/2" and larger.
 - 4. Use screw to solder adapters for copper tubing.
 - 5. Use grooved body valves with mechanical grooved jointed piping.
 - 6. Use press valves when using copper press systems.
- J. Valve Operators
 - 1. Provide suitable hand-wheels for gate, globe, angle or drain valves and inside hose bibbs.
 - 2. When cocks and valves are furnished with square head stem:
 - a. Provide one wrench for every ten cocks or valves sized 2" and smaller,

- minimum of two.
 - b. Provide each cock or valve size 2-1/2" and larger with a wrench with setscrew.
 - 3. Where butterfly valves are provided:
 - a. Provide gear operators on valves 6" and larger.
 - b. Where valves are located 7' or more above the finished floor in equipment room areas provide chain-operated sheaves. Extend chains to about 5' above floor and hook to clips, arrange to clear walking space.
 - c. Lever lock handle with toothed plate for shut-off service and infinitely adjustable handle with lock and nut and memory stop for throttling service on valves 4" and smaller.
 - d. All butterfly valves shall have a stainless steel disc.
- K. Acceptable Manufacturers (All listed must be lead free);
 - 1. Stockham
 - 2. Dezurik
 - 3. Crane
 - 4. Nibco
 - 5. Keystone
 - 6. Jenkins
 - 7. Kitz
 - 8. Apollo
 - 9. Milwaukee Valve
- L. Check Valves:
 - 1. Bronze body, 2" and smaller, bronze disc (Teflon disc for steam service), regrinding swing check, screw-in cap, threaded connection.
 - 2. Iron body, 2-1/2" and larger, bronze trim, non-slam: stainless steel pins and springs, and bronze plate or bronze mounted, regrind-renew check, bronze seat ring and disc. Provide either wafer or threaded lug.
 - 3. Acceptable Manufacturers (All listed must be lead free):
 - a. Mission Duocheck
 - b. Nibco
 - c. Keystone
 - d. Kitz
 - e. Apollo
- M. Backflow Preventer (All valves for domestic use must be lead free):
 - 1. BFP-1 (2" and smaller) bronze body, reduced pressure zone type with two inline independent check valves with an intermediate relief valve, complete with two full port ball valve shut-offs and ball type test cocks. Bronze strainer on inlet. Provide air gap fitting with full size drain piped to nearest floor drain. Watts 909-QT-S-LF.
 - 2. BFP-2 (2-1/2" and larger) stainless steel reduced pressure zone type with two inline independent check valves with reverse relief valves, two non-rising stem resilient sealed gate valves, cast iron strainer on inlet. Provide air gap fitting piped full size to nearest floor drain. Apollo RP4ALF-YS.
- N. Provide valves of same manufacturer throughout where possible.
- O. Provide valves with manufacturer's name and manufacturing location, duty and pressure rating clearly marked on outside of body.
- P. Where valves are installed in insulated piping, provide with extended neck so valve operator and stop plate clears the full thickness insulation.
- Q. Provide valve, seat and trim materials suitable for the intended service.

2.2 PIPE SYSTEMS STRAINERS

- A. Body:
 - 1. Bronze "Y" pattern or basket as shown on the drawings.
 - 2. Line size.
 - 3. Threaded strainer blow down port.
 - 4. ASTM A #126 Class B Cast Iron Body.
- B. Construction:
 - 1. 2" size and smaller with screw connections rated 400 psi WOG.
 - 2. Over 2" size with flanged connections, rated 125 psi WOG.
- C. Fabricate screens of Monel or type 304 stainless steel:
 - 1. With 20 mesh woven wire in piping systems through 2".
 - 2. With 0.045 perforations in piping systems 2-1/2" and 3".
 - 3. With 0.125 perforations in piping systems 4" and larger.
- D. Start-up:
 - 1. Provide an additional fine mesh disposable screen for use during start-up operations.
 - 2. Remove after 30 days.
 - 3. Attach to piping for Owner's review.
- E. Acceptable Manufacturers (All listed must be lead free):
 - 1. Apollo
 - 2. Crane
 - 3. Keckley
 - 4. Kitz
 - 5. McAlear
 - 6. Mueller
 - 7. Muesco
 - 8. Nibco
 - 9. Zurn

2.4 VALVE SCHEDULE

- A. Domestic Service
 - 1. Gas shut-off service: UL approved for natural gas service.
 - a. Nibco Ball Valve, full port through 1": T-585-70-UL
 - b. Nibco Ball Valve conventional port 1-1/4" through 3": T-580-70-UL
 - c. Resun 2-1/2" and larger: 143 - 1-UL
 - d. DeZurick 2-1/2" and larger: Series 425 or 435
 - e. Locking Type: Rockford 3/4" and 1" PNP-400
Mueller 1-1/4" through 4": Lub-O-seal
 - f. Conbraco Ball Valve, full port through 4": 64-100 Series
 - h. Milwaukee Full Port 1/4"-2" #8303A
 - i. Milwaukee Standard Port 2-1/2" & 3" #8503
 - j. Kitz Full Port 2" =- #68
 - k. Apollo
 - 2. Cold and Hot water service (all listed must be Lead Free):
 - a. Nibco Ball Valve full port through 2": T-585-66-LF
 - b. Nibco Butterfly Valve 2-1/2" and larger: LD-2000 EDPM Gaskets
 - c. Watts Ball Valve 4" and larger: G-4000-FDA
 - d. Viega ProPress Bronze Ball Valves (where Viega ProPress fittings are used)
 - e. Kitz Full Port through 2" - #868M Lead Free

- f. Milwaukee Full Port 1/4"-2" #8303A
 - g. Milwaukee Standard Port 2-1/2" & 3" #8503
 - h. Apollo Full Port to 3-1/2" 77CALF
 - i. Apollo Conventional Port 2-1/2"=3" 7OLF
3. Compressed air system
 - a. Nibco Ball Valve full port through 2": T-585-70-66
 - b. Nibco Ball Valve 2-1/2" and 3" conventional port: T-580-70-66
 - c. Watts Ball Valve 4" and larger: G-4000
 - d. Viega ProPress Bronze Ball Valves (where Viega ProPress fittings are used)
 4. Check Valve (All listed must be Lead Free):
 - a. Nibco Check Valve: T - 413 – Y -LF (Teflon Seats)
 - b. Nibco Check Valve 2-1/2" and larger: F - 918 – Y -LF (Buna-N Disc)
 - c. Nibco Check Valve 2-1/2" and larger: W - 920 -W-LF (Wafer)
 - d. Kitz Y & Check: A-22T
 - e. Kitz 2-1/2" and Larger #778 C.I.
 - f. Kitz Wafer Check 2-1/2" and Larger #7032
 - g. Apollo Check Valve 163 TLF
 - h. Apollo Check Valve 2-1/2" – Larger 910 FLF

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install valves with stems upright or horizontal, not inverted.
- B. Install valves for shut-off and isolating service at each piece of equipment, at vertical risers, and where shown on the drawings.
- C. Use butterfly valves and ball valves in domestic hot water and domestic cold water systems interchangeable in place of gate and globe valves.
- D. Use butterfly valves and ball valves in circulating water systems, for balancing duty.
- E. Provide drain valves at main shut-off valves and low points of piping and apparatus so the systems can be entirely drained.
 1. 1" valve for pipes 6" and larger.
 2. 3/4" valve for pipes smaller than 6".
 3. Terminate with pipe plug.
 4. Drain valves shall be ball valves.
- F. Provide isolation valves in domestic water lines to isolate all equipment, restrooms, hose bibbs, and where shown on the drawings.
- G. Where valves are installed in insulated pipe, valve operator shall have an insert so the lever or handle will not damage the insulation. Install handles so the lever or handles will not damage the insulation.
- H. Provide clearance for installation of insulation and access to valves.
- I. Provide access where valves are not exposed.

3.2 VALVE TAGS

- A. Furnish valves with 1-1/2" diameter brass valve tags with stamped, black or red-filled numbers. Service designations shall be 1/4" letters, and valve numbers shall be 2" letters. Engineer shall approve Service designations. Secure tags to valves by use of brass "S" hooks or brass chain. Secure chain to valve by use of copper or Monel meter seals. Valve tags are not required if the valve is located within 3' of the equipment being served and the service is obvious.
- B. Mount charts and drawings listing functions of each valve and its location in a metal and

glass frame. Place charts and drawings as directed; in addition, on the record drawings mark the symbols and furnish a valve schedule properly identifying the valve number, service, exact location, the material being piped, and the room number of area that the valve services. This schedule shall be furnished on reproducible drafting paper or film suitable for reproduction on an Ozalid machine. The Owner shall approve the size of drafting paper. Provide a copy of the valve chart in the Operating and Maintenance Manuals.

3.3 PIPE SYSTEMS STRAINERS

- A. Provide strainers in supply piping to circulating pumps, thermostatic mixing valves, before solenoid valves and trap primer valves.

END OF SECTION

SECTION 22 07 19 PLUMBING PIPING INSULATION

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Furnish and install piping insulation, jackets, accessories and covering of specified materials. The insulation shall be used for high and low temperature piping applications including domestic hot and cold water, roof and overflow drain sump bodies and rain leaders, horizontal sanitary drain piping which receives condensate, make-up water and pool heating water.

1.2 QUALITY ASSURANCE

- A. The intent of insulation specifications is to obtain superior quality workmanship resulting in an installation that is absolutely satisfactory in both function and appearance. Provide insulation in accordance with the specifications for each type of service and apply as recommended by the manufacturer and as specified.
- B. An approved contractor for this work under this Division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, skill, and the 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.
- C. All piping insulation used on the project inside the building must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50, as determined by test procedures ASTM E 84, NFPA 255 and UL 723. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive. Components such as adhesives, mastics and cements must meet the same individual ratings as the minimum requirements and bear the UL label.
- D. Condensation on any insulated piping system is not acceptable.
- E. Replace insulation damaged by either moisture or other means. Insulation that has been wet, whether dried or not, is considered damaged. Make repairs where condensation is caused by improper installation of insulation. Also repair any damage caused by the condensation.
- F. Where existing insulated piping, or other surfaces are tapped, remove existing insulation back to undamaged sections for hot surfaces or to nearest insulation stop for cold surfaces, and replace with new insulation of the same type and thickness as existing insulation. Apply as specified for insulation of the same service.

1.3 APPROVALS

- A. Submit product data on each insulation type, adhesive, and finish to be used in the work. Make the submittal as specified in Division 1 General Requirements and obtain approval before beginning installation. Include product description, list of materials and thickness for each service and location and the manufacturer's installation instructions for each product.
- B. Make a field application of each type of insulation to display the material, quality and application method. Obtain approval of the sample application before proceeding with installation of the work.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Glass fiber pipe insulation:
 - 1. Johns-Manville Micro-Lok AP-T

2. Owens-Corning ASJ/SSL
3. Knauf ASJ/SSL
- B. Cellular Glass Insulation (Foamglass):
 1. Pittsburg Corning
 2. Cell-U-Foam
- C. Aluminum Jacketing:
 1. Childers
 2. Pabco
 3. RPR
- D. Fiberglass reinforcing cloth mesh:
 1. Perma Glass Mesh
 2. Alpha Glass Mesh
 3. Childers Chil-Glas
 4. Vimasco
- E. Mastics and Adhesives
 1. Childers
 2. Foster
 3. Vimasco
 4. Armstrong 520 Adhesive
- F. Elastomeric Insulation
 1. Armacell
- G. Weather Resistant Coating
 1. WB Armaflex Finish
- H. Glass fiber blanket insulation
 1. Manville R-series Microlite FSKL
 2. Owens-Corning eD75 or ED100 RKF
 3. Knauf 0.75 PCF FSK

2.2 FIBERGLASS PIPE INSULATION

- A. Heavy density, dual temperature fiberglass insulation with factory applied, all service, reinforced vapor barrier jacket having integral laminated vapor barrier. Provide with a factory applied pressure sensitive tape closure system and matching butt strips. Supply in thickness as shown.
 1. Thermal conductivity 0.23 @ 75°F mean (ASTM 335).

2.3 ELASTOMERIC INSULATION

- A. Insulation material shall be flexible, closed-cell elastomeric insulation in tubular or sheet form. Material shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E84, latest revision. Sheet material with a thickness greater than 3/4" shall have a flame spread rating of 25 or less and a smoke developed rating of 100 or less when tested in accordance with ASTM E84, latest revision. In addition, the product, when tested, shall not melt or drip flaming particles, and the flame shall not be progressive. In addition, all materials shall pass simulated end-use fire test. Minimum 3/4" thick.
 1. Thermal conductivity 0.27 at 75°F mean (ASTM C177 or C518)

2.4 CELLULAR GLASS INSULATION

- A. ASTM C552:
 1. "k" value of 0.35 @ 75°F ("ksi" value of 0.047 @ 24°C);
 2. 8.0 lb/cu.ft. (128 kg/cu.m.) density

2.5 INSULATION/SHIELD AT HANGERS

- A. Field fabricated: Use 360° sections of rigid foamglass insulation that will support the bearing area at hangers and supports. Further support insulation at hangers and supports with a shield of galvanized metal covering at least half of the pipe circumference, and conforming to the schedule. Insulation shall extend at least 1" beyond metal shield on each end. When pipe is guided at top and bottom, metal shields shall cover the whole pipe circumference. Adhere metal shield to insulation so that metal will not slide with respect to insulation with ½" aluminum bands (2) per shield.
 - 1. Sections of foam glass insulation may be used of the same outside diameter of the adjoining pipe insulation.
 - 2. Minimum thickness of foam glass insulation shall not be less than 1" thick.
- B. Pipe saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter or more than 22". Provide 18 gauge through 4" pipe and 16-gauge 5" pipe and above.

2.6 SEALANT, ADHESIVE AND FINISH

- A. Lap Adhesive. Provide Childers CP-82 adhesive.
- B. Vapor Barrier Finish:
 - 1. Indoors: Provide as insulation coating Childers CP-35, white.
 - 2. Outdoors: Provide as insulation coating Childers Encacel X.
 - 3. Underground: Provide Childers CP-22/24 for fittings and areas. Pittwrap cannot be used.
- C. Sealant. Provide Childers CP-76 vapor barrier sealant.
- D. Lagging Adhesive. Provide Childers CP-50.
- E. Other products of equal quality will be acceptable only upon approval.

2.7 ALUMINUM JACKETING

- A. Finish insulated piping outdoors with a smooth prefabricated Z-lock aluminum jacket 0.016" thick with factory applied 1 mil polyethylene/40 lb and Fab strap. Kraft moisture barrier. Childers Lock-On or approved equal.
- B. Valves, Fittings and Flanges. For finishing valves, fittings, flanges and similar installations, provide formed aluminum covers, 0.024" thick.
- C. Straps and Seals. Provide ½" x 0.020 stainless steel strapping and seals for jackets and covers according to manufacturer's recommendations.

2.8 GLASS FIBER BLANKET INSULATION

- A. Minimum density of 1.0 PCF, 2" thick, installed R value to be 6.0 or better at 75°F mean, facing of 0.35 mil foil reinforced with glass yarn mesh and laminated to 40 lbs fire resistant kraft.

PART 3 – EXECUTION

3.1 INTERIOR PIPING

- A. Cover all piping with glass fiber, heavy density, dual temperature pipe insulation with a vapor barrier jacket. Apply insulation to clean, dry pipes. Longitudinal seams shall be joined firmly together and sealed with self-sealing lap joints. Butt insulation joints firmly together and seal with a 3" wide ASJ butt strip seal. Longitudinal seams and butt strip laps shall be coated and sealed with CP-35 vapor barrier coating for chilled water piping applications.
- B. Install hanger with protective shield, on the outside of all insulation.
- C. Where domestic water pipes (1/2" & ¾" pipe sizes) are installed on trapeze type hangers,

- provide galvanized sheet metal protection shields at these locations. Place insulation jacket directly on hanger. Incompressible, load bearing insulation segments are not required.
- D. Pipe Saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter. Provide 18-gauge through 4" pipe and 16-gauge for 5" pipe and above.
 - E. Seal ends of pipe for drinking chilled water insulation with vapor barrier mastic at valves, flanges, fittings and every 21' on straight runs of piping. Mastic should extend on top of ASJ jacket, across the glass, down onto the pipe making a complete seal.
 - F. Apply a smooth flood coat of white lagging Foster 8142W over all exposed insulation.
 - G. Piping to be insulated as specified above:
 - 1. Domestic hot water and cold water (cold water piping is to be insulated in outside walls to 5' inside building, and in any location subject to freezing). Maintain insulation for domestic hot and cold water in Mechanical Rooms and Central Plant.
 - 2. Make-up water
 - 3. Horizontal sanitary drain piping that receives condensate
 - 4. Exposed to view storm drainage system including roof and overflow drain bodies, vertical piping from drain body to elbow, all horizontal rain leaders, and first elbow turning down

3.2 PIPING OUTDOORS ABOVE GRADE

- A. Insulate all water piping exterior of building above grade with rigid foam insulation and aluminum jacketing.
- B. Adhere the vapor barrier jacket longitudinal seam with vapor barrier adhesive.
- C. Cover all valves, fittings and flanges with factory made molded or field fabricated segments of pipe insulation of a thickness and material equal to the adjoining insulation. Adhere segments together with no voids, using CP-82 adhesive. Secure fitting insulation covers and segments in place with 1/2" wide glass filament tape.
- D. Apply a tack coat of fitting mastic over the insulation and tape.
- E. Neatly embed with 10 x 10 fiberglass cloth into the tack coat.
- F. Apply mastic over the fiberglass cloth to a thickness where the fabric is not visible after completion.
- G. Seal ends of pipe insulation with vapor barrier mastic at valves, flanges, fittings and every 21' on straight runs of piping. Mastic should extend on top of ASJ jacket, across the foam, down onto the pipe, making a complete seal.
- H. Finish with aluminum jacketing as specified.

3.3 FLANGE, VALVE AND FITTING INSULATION

- A. Cover valves and flanges with fabricated segments, fittings with two-piece factory molded fittings, and both of matching pipe insulation type and thickness equal to that of the adjoining pipe. Fittings and fabricated segments shall be securely held in place.
 - 1. Apply a tack coat of insulating mastic to the insulated fitting to produce a smooth surface.
 - 2. After mastic is dry, apply a second coat of vapor barrier mastic. Neatly embed with 10 x 10 fiberglass cloth into the tack coat.
 - 3. Overlap mastic and fiberglass cloth by 2" on adjoining sections of pipe insulation.
 - 4. Apply a second coat of mastic over the fiberglass cloth to present a smooth surface.
 - 5. Apply mastic to a wet film thickness of 3/64".
 - 6. Fabric shall not be visible after completion.
 - 7. Vapor seal flanges, valves and fittings with Childers CP-35.
- B. PVC fitting covers are not acceptable.

3.4 ALUMINUM JACKETING (Insulated Piping Outdoors Above Grade)

- A. Apply smooth aluminum jacket on piping, valves, fittings and flange covers according to manufacturer's recommendations, using stainless steel strapping and seals, to provide weather tight covering and to shed water.
- B. Aluminum jacketing is not considered as contributing to the vapor barrier or the insulation jacket. The vapor barrier must be sufficient in itself for this function. Lap each adjoining jacket section a minimum of 3" to make a weather tight seal.
- C. Install straps on 9" centers and at each circumferential lap joint.
- D. Cover and seal all exposed surfaces.
- E. The use of screws and rivets is not approved.
- F. Provide isolation (30# felt) between the aluminum jacket and the sheetmetal protection shield at each pipe support point.

3.5 CONCEALED STORM DRAIN PIPING

- A. Provide flexible glass fiber insulation with factory-applied, reinforced UL labeled Foil-Skrim-Kraft (FSK) facing. Install insulation of clean, dry piping.
- B. Insulation shall be wrapped tightly on the piping with all circumferential joints and longitudinal joints overlapped a minimum of 2" with facing to the outside to obtain specified R-value using a maximum of 25% compression.
- C. Provide vapor retarder at penetrations, joints, seams and damage to the facing with staples and FSK foil tape. The facing shall be taped with a minimum 3" wide strip of reinforced foil tape. Pressure-sensitive tape shall be a minimum 3" (76mm) wide and shall be applied with moving pressure using an appropriate sealing tool. Staples shall be outward cinch and placed 6" (152mm) on center.
- D. Mechanical / Electrical rooms and above ceilings are considered concealed spaces.

3.6 MISCELLANEOUS

- A. Install materials after piping has been tested and approved.
- B. Apply insulation on clean, dry surfaces only.
- C. Apply weather protective finish on elastomeric insulation installed in non-conditioned spaces. Provide a minimum of three coats.

3.7 INSULATION THICKNESS

THICKNESS

INSULATED UNIT

	<u>(Inches)</u>
Exposed Roof Drain Bodies and Horizontal Roof Drain Leaders	1
Exposed Roof Overflow Drain Bodies and Horizontal Drain Leaders	1
Domestic Cold Water/Make-Up Water Piping/Drinking Chilled Water	1
Horizontal Sanitary Drain Piping Which Receives Condensate	1
Domestic Hot Water Piping, 1-1/2" Pipe and Smaller	1
Domestic Hot Water Piping, 2" Pipe and Larger	1-1/2

END OF SECTION

SECTION 22 11 16
DOMESTIC WATER PIPING AND APPURTENANCES

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Furnish and install domestic hot and cold water piping.

1.2 RELATED WORK

- A. Division 22 Plumbing
1. Valves, Strainers and Vents
 2. Pipe and Pipe Fittings - General
 3. Plumbing Piping Insulation
 4. Plumbing Fixtures and Fixture Carriers

PART 2 – PRODUCTS

2.1 PIPING AND FITTINGS

- A. Below Slab on Grade Piping for Water Entries:
1. 1-1/2-inch and smaller, provide ASTM B88 Type K (heavy wall) annealed tempered (soft) seamless copper water tube. No joints below slab entries.
 2. 2-inch and larger, provide Watts (Ames) IBR and IBR 2 304 stainless steel one piece in-building riser.
- B. Below Grade Piping Outside Building (beyond 5'-0" of building): Provide PVC water main pipe 4 inch through 12 inch in diameter in conformance with AWWA C900. When using 3" or smaller provide Schedule 80 PVC ASTM D1785 with ASTM D-2466 socket type fittings. Provide fittings in conformance with ASTM 2466. Furnish pipe with a minimum pressure rating of 150 lbs. per square inch. Provide PVC pipe as manufactured by Johns-Manville, CertainTeed, Clow or approved equal.
- C. Below Slab on Grade Piping. Furnish ASTM B 88 and ANSI/NSF Standard 61 annealed tempered (soft), Type K copper water tube. Run continuous with no joints under the floor slab. Provide copper pipe corrosion protection as specified in this Section.
- D. Above Slab Piping. Provide seamless ASTM B 88 and ANSI/NSF Standard 61 drawn tempered (hard) Type L copper water tube with wrought copper or bronze fittings with solder-joints, ANSI B16.22. Solder material shall be 95-5 (lead free) (Tin-Antimony-Grade 95TA) ASTM B 32.
- E. Unions. Provide 150 lb. standard unions with ground joint and bronze seat. Flange joints larger than 2 inches. Provide dielectric isolating unions at junctions or connection between metallic piping of dissimilar metal. Provide pipe threads with standard taper pipe threads ANSI B2.1.
- F. Alternate Method of Joining Copper Pipe and Tubing: Press Fittings: Copper press fitting shall conform to the material and sizing requirements of ASME B16.51. O-rings for copper press fittings shall be EPDM. VIEGA. The system intended for use shall be approved by submittal. Systems from various manufacturers may vary in technology. The field personnel shall carry training credentials from the approved manufacturer for the project. Mixing of

2.2 WATER HAMMER ARRESTORS

- A. Provide piston type hydraulic engineered/manufactured water hammer arrestors in cold and hot water supply lines in chases or walls to each fixture branch or battery of fixtures serving quick closing valves of electrical, pneumatic, spring loaded type, or quick hand closure valves on fixture trim. Provide water hammer arrestors at the end of the branch line between the last two fixtures served. Provide Precision Plumbing Products, Inc., or equal. Size units according to water hammer arrestor's Standard PDI WH-201; refer to schedule on drawings.

- B. Install all water hammer arrestors so as to attain 100% effectiveness according to Plumbing and Drainage Institute PDI-WH201 Table 5, 6 and 6-A for water hammer arrestors.
- C. All water hammer arrestors shall be installed in a vertical position.
- D. All water hammer arrestors shall be accessible and shall have access panels where required. Arrestors located above ceilings in fixture drops will not be acceptable. Refer to sizing and placement data as indicated in PDI Standard PDI-WH-201.

PART 3 – EXECUTION

3.1 DRAINAGE

- A. Install water piping systems with uniform horizontal grade of 1/8 inch per 10 foot, minimum, to low points to provide complete system drainage. Where constant pitch cannot be maintained for long runs, establish intermediate low points and rise to new level. Grade branches to drain to mains or risers. Unless otherwise indicated, terminate low points of risers with drain valve piped to nearest hub or floor drain.

3.2 STERILIZATION

- A. Prior to starting work, verify system is complete, flushed and clean.
- B. Inject chorine disinfectant in liquid, powder, tablet or gas form throughout the system to obtain 50 to 80 Mg/L residual.
- C. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 20% of the outlets.
- D. Retain disinfectant in system for 8 hours (minimum), 24 hours (maximum). During the disinfection process, operate all valves and accessories.
- E. If final disinfectant residual tests less than 25 Mg/L, repeat treatment.
- F. Flush disinfectant from system until chemical and bacteriological tests prove water quality equal to that of the service main.
- G. Take samples no sooner than 24 hours after flushing from at least 10% of the outlets and from the water entry.
 - 1. Obtain a minimum of one water sample flushing from at least 10% of the outlets and from the water entry.
 - 2. Take samples from faucets located at highest point in the building, and farthest point from the main water supply.
- H. After final flushing, remove aerators, clean and replace.
- I. Chemical and bacteriological tests shall be conducted by a state certified laboratory.
- J. The firm performing the disinfection shall have chemical laboratory experience.
- L. Provide a laboratory report to indicate the following information.
 - 1. Name and address of the approved laboratory testing the samples.
 - 2. Name and location of the project and date the samples were obtained.
 - 3. Mg/L chlorine during retention.
 - 4. Mg/L chlorine after flushing.
 - 5. The coliform organism count. (An acceptable test shall show absence of coliform organisms.)
- M. If analysis does not satisfy the specified minimum requirements, repeat the disinfection procedure.
- N. Submit for approval to the Architect/Engineer a copy of the laboratory report and the certification of performance. An approved copy of each document shall be inserted in the Owner's manual.

3.3 UNDERGROUND WATER PIPING SYSTEM PROCEDURES

- A. Lay sewer and water lines in separate trenches, separated by 10 foot of undisturbed or compacted soil.

3.4 TESTING

- A. Test under a cold water hydrostatic pressure of 1-1/2 times operating pressure (150 psig minimum) and carefully check for leaks. Repair leaks and retest system until proven watertight.
- B. Test the domestic water piping system at 150psig hydrostatic pressure, maintained for 6 hours.
- C. Use only potable water for the test.
- D. Perform the test before fixtures, faucets, trim or final connections are made to equipment.
- E. If the system is tested in sections, the entire domestic water piping system shall be submitted to a final test, employing the specified procedure.
- F. Do not insulate or conceal piping systems until tests are satisfactorily complete.
- G. If any leaks or other defects are observed, suspend the test and correct the condition at once. Repeat testing until leaks are eliminated and the full test period is achieved.
- H. The satisfactory completion of testing does not relieve the Contractor of responsibility for ultimate proper and satisfactory operation of piping systems and their accessories.

3.5 COPPER PIPE CORROSION PROTECTION

- A. Corrosion protect copper tube piping systems:
 - 1. In the building slab.
 - 2. Beneath the building slab.
 - 3. Buried.
 - 4. Route plasti-sleeve 0.006 thick material entire length of below slab on grade copper tubing.
- B. Cover copper tubing piping system with:
 - 1. "Tapecoat" TC Primer.
 - 2. "Tapecoat" CT cold applied coating tape.
- C. Install coating system as specified by the manufacturer.
- D. Extend the corrosion protection 2 inches above concrete slab on grade.

3.6 TEST OF PIPE CORROSION PROTECTION SYSTEM

- A. Test the pipe corrosion protection coating with an approved high voltage tester adjusted to provide sufficient voltage to produce a spark through a pinhole in the coating (at least 15 kv AC).
- B. Make repairs to small holes in accordance with the manufacturer's instructions.
- C. Retest the repairs using procedures listed above.
- D. Furnish certificate of compliance with field testing in Owner's manual.

END OF SECTION

SECTION 22 11 19
PIPING AND PIPING APPURTENANCES FOR COLD WATER MAKEUP

PART 1 - WORK INCLUDED

1.1 SCOPE

- A. Furnish and install piping and piping appurtenances for cold water makeup piping.

1.2 RELATED WORK

- A. Division 22 Plumbing
 - 1. Valves, Strainers and Vents
 - 2. Plumbing Pipe and Pipe Fittings
 - 3. Plumbing Piping Insulation

PART 2 – PRODUCTS

2.1 PIPE AND FITTINGS

- A. Provide seamless, hard-drawn, Type L, copper water tube conforming to ASTM B88, and wrought copper fittings.

2.2 BACKFLOW PREVENTER

- A. Watts Series #909 reduced pressure principal backflow preventer, 3/4" through 2".
- B. Apollo RPLF 4A Series reduced pressure backflow preventer 2-1/2" and larger in stainless steel body.
- C. Factory assembled components as follows:
 - 1. Isolating, shutoff, full port ball valves.
 - 2. Incoming bronze strainer.
 - 3. Test cocks.
 - 4. Fixed air gap assembly.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install according to manufacturer's instructions.

3.2 BACKFLOW PREVENTERS

- A. Provide backflow preventers at the following locations.
 - 1. HVAC Systems cold water make-up including chilled water, hot water and condenser water.
 - 2. Pumping systems including water utility service and water softening equipment.
 - 3. Where required by Code.
- B. Installation according to manufacturer's recommendations.
 - 1. Connect drain with fixed air gap assembly.
 - a. Pipe full size discharge from relief valve of RPZ to nearest floor drain or floor sink of proper size. Reference manufacturer's suggested sizing of drains.
 - 2. Provide pipe unions on inlet, outlet and discharge connection of the assembly for complete removal.
 - 3. Provide isolation valve upstream of backflow assembly to allow complete removal of listed assembly.
 - 4. Install backflow preventer assembly horizontally in an accessible location for testing and maintenance at a height not to exceed 60" above finished floor and no lower than 12" from finished floor to air gap outlet.

- C. Provide certified testing of all backflow preventers.
 - 1. Include certificates in O&M Manuals.

END OF SECTION

SECTION 22 11 23 DOMESTIC WATER PUMPS

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. General characteristics for pumps specified in Division 22 - Plumbing.

1.2 RELATED WORK

Requirements for pumps are specified in other sections of Division 22 - Plumbing, including the following:

- A. Division 22 Plumbing - Electrical Provisions of Plumbing Work.

1.3 PUMP SELECTION

- A. Select pumps conservatively for scheduled conditions. Furnish pumps that have reasonably high efficiencies, with peak efficiency at or near rated conditions. Select pumps that will operate stably at 15' suction lift despite substantial reduction in head or substantial increase in delivery.
- B. If the pumps proposed are not considered suitable, submit manufacturer's data on other pumps, for review.
- C. Scheduled design flow, design head, pump efficiency, and motor horsepower are the minimum acceptable.
- D. The pump curve shall rise continuously from maximum flow to cut-off.
- E. Shut-off head approximately 10 percent greater than design head, unless otherwise indicated in pump schedules.
- F. Pump brake horsepower shall not exceed the motor horsepower rating over the entire operating range from shut-off to run-out.
- G. Select the pump for operation at or near peak efficiency.
- H. Cavitation-free at all points on the curve.
- I. Impeller diameter shall not exceed 90 percent of the maximum published diameter.

1.4 PUMP SIZE AND TYPE

- A. Provide motor-driven pumps of the type and speed scheduled. Select pumps that are not overloaded throughout the entire range of pump operation. Provide pump connection sizes as indicated.
- B. Submit copies of manufacturer's performance curves, as shop drawings on each pump. Clearly mark the curves for each pump to indicate the diameter of the impeller and the selection point.

1.5 CERTIFIED DATA

- A. Submit factory certified pump curves showing pump performance characteristics with pump and system operating points plotted. Curves shall include as a minimum, flow (gallons per minute), head (feet of water), all available impeller diameters (inches), efficiency (percent), net positive suction head required (feet of water), brake horsepower, pump size and pump model. Show pump curves with system curve plotted.

PART 2 – PRODUCTS

2.1 DOMESTIC HOT WATER CIRCULATING PUMPS (SMALL) FRACTIONAL HORSEPOWER

- A. Pump Construction:
 - 1. Wet-rotor, in-line, single stage
 - 2. Bronze housings with 1/2" and 3/4" sweat connections

3. Stainless steel housing with union threaded connections
 4. Integrated check valve inside union fitting on a sweat pump housing
 5. Built-in 5-foot, 115 volt AC line cord with NEMA 3 Prong male plug or line cord
 6. Built-in timer
 7. Aquastat thermostatic control
- B. Acceptable manufacturers:
1. Armstrong
 2. Grundfos

2.2 SUBMERSIBLE SUMP PUMPS AND SEWAGE EJECTORS

- A. Pump Construction:
1. Hermetically sealed motor
 2. Positive action air operated diaphragm switch
 - a. High water alarm contact
 - b. Use three-float system with duplex pump set-up with float for lag pump (signals high level alarm)
 3. Housing and base cast iron construction
- B. Provide an alarm terminal cabinet.
1. In the event of a high water alarm, energize a pulsing 2" diameter red signal light with graphic "sump pump high water alarm".
 2. High level alarm must be connected to Cy-Fair Police Department.
- C. Test the sump pump package by operation of the completed system through four cycles of operation.
1. Fill the sump to operational levels
 2. Visually check level controls
 3. Pump operation
 4. Verify absence of piping leaks, sump leaks, excessive noise, and excessive vibration
 5. Verify alarms
 6. Verify pump capacity
- D. Sump pump package capacity shall be as scheduled.
- E. Acceptable Manufacturers:
1. Hydromatic
 2. Little Giant Pump Co.
 3. Weil
 4. Goulds
 5. Grundfos
 6. Crane (Barnes) Air Pumps
 7. Ebara

2.3 FLOW INDICATOR

- A. Flow Indicator
1. Bronze Construction
 2. Rotating wheel
 3. Line Size
 4. Double Window
 5. Ernst Flow Industries Model EFI E-57-3

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install the pumps in accordance with Manufacturer's "Installation, Start-up and Service Instructions".
 - 1. Provide access space around pumps for service.
 - 2. Lubricate pumps prior to start-up.
 - 3. Install hot water circulator horizontally, properly supported to wall, in an accessible location for testing and maintenance at a height not to exceed 60" above finished floor. Install line size Ernst bronze rotating wheel, flow indicator with double window, downstream of circulator.
- B. Provide a line size isolation valve and strainer on the pump suction and a line size silent check valve and balancing valve on the pump discharge.
- C. Support piping adjacent to the pump such that no weight is carried on the pump casing. Decrease from pipe size with eccentric reducer on suction side and concentric increaser on discharge side.
- D. Ensure pumps:
 - 1. Operate at specified system fluid temperatures without vapor binding and cavitation.
 - 2. Are non-overloading in parallel and individual operation.
 - 3. Operate within 25 percent of midpoint of published maximum efficiency curve.
- E. Refer to pump detail on the Contract Drawings for piping accessories to be provided.

3.2 ALIGNMENT FOR BASE MOUNTED PUMPS

- A. Set the pump on a concrete inertia base or concrete housekeeping pad as specified. Anchor, level and grout.
- B. Align the pump and driver in accordance with Hydraulic Institute Standards for centrifugal, rotary and reciprocating pumps.
- C. Realign the pump and driver after initial leveling of pump base before placing the grout and again after the grout has set and the foundation bolts are tightened. Recheck the alignment after the piping has been connected.

3.3 MANUFACTURER START-UP SERVICE ALIGNMENT

- A. After installation, the pumps and motors are to be aligned by the manufacturer or their representative utilizing a dial indicator. After completion, a formal report must be submitted by the Manufacturer to the Engineer prior to final acceptance. This report must include pump serial number, location, beginning and final alignment at a minimum.
 - 1. Technicians, as required, shall be trained and experienced in the work they perform (Contractor start-up / alignment is unacceptable).
- B. Before starting pumps, but after connecting piping:
 - 1. Align shafts and coupling with a precision dial indicator alignment instrument to the minimum tolerances .004 (TIR) per inch of coupling radius or as recommended by the manufacturer, whichever is the greater.
 - 2. Tabulate the actual pump alignment reading with manufacturer's minimum tolerances.
 - 3. Submit readings for approval.
 - 4. Include the approved readings in the Owner's Maintenance Manual.

3.4 FINAL PUMP FLOW CALIBRATION

- A. Based on the results of the final phases of the test and balance sequences, if the flow of the unthrottled pump is more than 10% above the scheduled values:
 - 1. Request detailed instructions from the pump manufacturer for the correct impeller diameter.
 - 2. Trim the impeller to the diameter recommended by the manufacturer, employing

precision machinery.

- B. Enter the information on the final configuration of the pump in the Owner's Manual.
 - 1. Modify the pump nameplate to reflect the correct head and flow data and the impeller diameter.

3.5 SPARE PARTS

- A. Provide the following spare parts and material to the Owner for his use after the warranty period.
 - 1. A mechanical seal for each pump
 - 2. A set of bearings for each pump

END OF SECTION

SECTION 22 15 00
SHOP COMPRESSED AIR SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install compressors, pipe and fittings for compressed air systems.

1.2 RELATED WORK

- A. Division 22 Plumbing
 - 1. Control air compressors and control air piping; Control Section.
 - 2. Pipe and Pipe Fittings.
 - 3. Valves, Strainers and Vents.
 - 4. Vibration Isolation.
- B. Division 26 - Electrical - Motors.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. Provide ASTM B 88, Type K, hard-drawn copper water tube with wrought copper solder fittings, ANSI B16.22.

2.2 UNIONS AND FLANGES

- A. Unions. Provide unions that are 150 lb. standard (300 lb. WOG) galvanized malleable iron, ground joint unions with bronze seat. Use flange joints for pipe larger than 3 inches in diameter.

2.3 VALVES

- A. Pressure Reducing. Provide a spring-loaded valve, with semi-steel body and stainless steel inner valve, disc seat and disc spring, adjusting spring of corrosion-resistant steel and synthetic composition diaphragm.
- B. Pressure Relief. Furnish spring-loaded, bronze body relief valves with enclosed spring. Use seats specially ground for compressed air service, with trip lever.
- C. Gate Valves. 2-1/2 inch & smaller, 150 lb., solid disc, union bonnet, rising stem; 3 inch and larger, 125 lb., OS&Y, IBBM.
- D. Ball Valves. 1/2 inch through 2 inch, 150 lb., full port, bronze body, blow-out proof stem.
- E. Check Valves. 2 inch & smaller, 300 lb. Bronze; 2-1/2 inch & larger, provide nonslam wafer type.

2.4 ACCESSORIES

- A. Moisture Traps. Use float-operated moisture traps rated at 200 psi. Provide unit with 30 inch x 30 inch mesh screen, a full 1/4 inch drain orifice and self-cleaning drain seat. Traps used on air compressor drier, receiver and piping system shall be by same manufacturer. Install traps where shown and at all low points in the system.
- B. Quick Couplings:
 - 1. Transportation Centers: Provide with 1/2-inch male NPT end with locking sleeve 1/2-inch standard hose end.
 - 2. School Shops and Labs: Provide with 1/4-inch male NPT end with 1/4-inch standard hose end.
- C. Filter. Provide 200 psig, clear bowl filter, with reusable felt filtering element capable of removing 5 micron-size particles.

- D. Electronic Drain Valve: Automatic drain valve for moisture removal from receiver tank, 120 vac, Maximum Pressure 200 PSI, Adjustable Drain Cycle 5 min. to 24 hours with non-adjustable purge time 3.5 seconds. Dynaquip Controls AD1B 1/2"; Grainger Item #6W175.

PART 3 - EXECUTION

3.1 DRIP LEGS

- A. Install a capped drip leg 6 inches long at the base of the vertical riser and at the ends of main piping runs with a valved drain. Pipe to the nearest floor or hub drain.

3.2 TESTING

- A. Apply an air pressure 1-1/2 times the operating pressure, 150 psig minimum, to the system and test joints with a soap solution while lines are under pressure. Repair leaks and retest the system until pressure is maintained for four hours minimum.

END OF SECTION

SECTION 22 20 00
PLUMBING PIPE AND PIPE FITTINGS - GENERAL

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Furnish and install pipe and pipe fittings for piping systems specified in Division 22 - Plumbing.

1.2 RELATED WORK

- A. Division 22 Plumbing
 - 1. Earthwork
 - 2. Valves, Strainers and Vents
 - 3. Insulation
 - 4. Other Piping Sections

PART 2 – PRODUCTS

2.1 PIPE AND FITTINGS

- A. The particular type of pipe and fittings for each system is specified in the individual sections.

2.2 JOINTS

- A. Make screwed joints using machine cut USASI taper pipe threads. Apply a suitable joint compound to the male threads only. Ream the pipe to full inside diameter after cutting. All-thread nipples are not permitted.
- B. Dissimilar Metals. Make joints between copper and steel pipe and equipment using insulating unions or couplings such as Crane Company #1259; EPCO as manufactured by EPCO Sales, Inc.; or an approved equal.
- C. Solder joints.
 - 1. Prior to making joints, cut pipe square and ream to full inside diameter. Clean exterior of pipe and socket. Apply a thin coat of suitable fluxing compound to both pipe and socket, and fit parts together immediately.
 - 2. Heat assembled joint only as required to cause the solder to flow. Run the joint full, slightly beaded on the outside, and wipe to remove excess solder.
 - 3. Use silver brazing alloy or Sil-Fos on underground water entry piping. Use lead free solder on all other copper piping.
- D. Make welded joints as recommended by the standards of the American Welding Society. Ensure complete penetration of deposited metal with base metal. Provide filler metal suitable for use with base metal. Keep inside of fittings free from globules of weld metal. The use of mitered joints is not approved.
- E. Flanged.
 - 1. Prior to installation of bolts, center and align flanged joints to prevent mechanical pre-stressing of flanges, pipe or equipment. Align bolt holes to straddle the vertical, horizontal or north-south centerline. Do not exceed 3/64" per foot inclination of the flange face from true alignment.
 - 2. Use flat-face companion flanges only with flat-faced fittings, valves or equipment. Otherwise, use raised-face flanges.
 - 3. Install gaskets suitable for the intended service and factory cut to proper dimensions. Secure with manufacturers recommended gasket cement.
 - 4. Use ANSI nuts and bolts, galvanized or black to match flange material. Use ANSI 316 stainless steel nuts and bolts underground. Tighten bolts progressively to prevent unbalanced stress. Draw bolts tight to ensure proper seating of gaskets.

5. Use carbon steel flanges conforming to ANSI B16.5 with pipe materials conforming to ASTM A 105 Grade II or ASTM A 108, Grade II, ASTM A 53, Grade B. Use slip-on type flanges on pipe only. Use welding neck type flanges on all fittings. Weld slip-on flanges inside and outside.
 6. Keep flange covers on equipment while fabricating piping. Remove when ready to install in system.
- F. No Hub. Hubless joints shall be made with wide body, neoprene sealing sleeve with stainless steel sleeve, coupling joints conforming to ASTM C 1277.
1. 4" pipe size and smaller coupling housing minimum of 3" width; 24 gauge Series 300 stainless steel with hi-torque clamps; neoprene coupling gasket.
 2. 6" through 10" pipe size coupling housing minimum of 4" width.
 3. Tighten clamps to within manufacturer's tolerances using preset torque wrench.
- G. Compression Gasket System. Bell and spigot cast iron pipe 4" and smaller, use flax-base lubricant, Tyler Ty-Seal Lubricant or Charlotte Regular Lubricant. 6" and larger use a neoprene base lubricant, Charlotte Adhesive Lubricant.
- H. Ring-Tite Joints: Furnish joints for installation according to manufacturer's recommendations. Provide adequate concrete thrust blocks at changes in direction, as recommended by manufacturer. JM Eagle pressure rated PVC water pipe. ASTM D2241 pressure rating, ASTM D3219 joints, gaskets ASTM F477.
- I. Press fittings for copper pipe 1/2" to 4": Copper press fittings shall conform to the material and sizing requirements of ASTM B16.18 or ASME B16.22. O-rings for copper press fittings shall be EPDM. Pro-Press System manufactured by VIEGA. The system intended for use shall be approved by submittal. Systems from various manufacturers may vary in technology. The field personnel shall carry training credentials from the approved manufacturer for the project. Mixing of fittings from different manufacturers is strictly prohibited.

2.3 UNIONS

- A. Use 150 lb. standard (300 lb. WOG) malleable iron, ground joint unions with bronze seat. Provide flanged joints on piping 2-1/2" and larger.
1. Where pipe materials of different types join, use a dielectric union. Union shall be threaded, solder or as required for its intended use.

2.4 BRANCH CONNECTIONS

- A. Pipe 2" and Smaller. For threaded piping, use straight size reducing tee. When branch is smaller than header, a nipple and reducing coupling or swagged nipple may be used.
- B. 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.

2.5 GASKETS

- A. High Temperature Piping. Provide 1/16" thick ring gaskets of aramid reinforced SBR such as Garlock #3200 or 3400 or equal by Advanced Products and Systems.
- B. Other Piping. Provide ring rubber gaskets, Garlock #7992 or equal by Advanced Products and Systems. Use 1/8" thick cloth reinforced neoprene gaskets. For smaller than 6", use 1/16" thick gasket.

2.6 FLOORS AND CEILING PLATES

- A. 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.

2.7 DOMESTIC MANUFACTURE

- A. All piping material, pipe and pipe fittings shall be manufactured in the United States of America unless specifically named in these specifications.

PART 3 – EXECUTION

3.1 PIPE FABRICATION AND INSTALLATION

- A. Make piping layout and installation in the most advantageous manner possible with respect to headroom, valve access, opening and equipment clearance, and clearance for other work. Give particular attention to piping in the vicinity of equipment. Preserve the required minimum access clearances to various equipment parts, as recommended by the equipment manufacturer, for maintenance.
- B. Cut all pipes to measurement determined at the site. After cutting pipe, remove burrs by reaming. Bevel plain ends of ferrous pipe.
- C. Install piping neatly, free from unnecessary traps and pockets. Work into place without springing or forcing. Use fittings to make changes in direction. Field bending and mitering is prohibited. Make connections to equipment using flanged joints, unions or couplings. Make reducing connections with reducing fittings only.
- D. Install piping without tapping out of the bottom of pipe.
- E. Press Connections: Copper press fittings ½” through 4” shall be applied in accordance with the manufacturer’s installation instructions. The tubing/pipe shall be fully inserted into the fitting and the tubing/pipe marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing/pipe to assure the tubing/pipe is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer. If soldering (thread adapters, etc.) near press fittings, take precautions to not damage the O-ring fittings. Maintain three pipe diameters or use a cooling agent. Viega-“Pro-Press”.

3.2 WELD

- A. Weld and fabricate piping in accordance with ANSI Standard B31.1, latest edition, Code for Pressure Piping.
- B. Align piping and equipment so that no part is offset more than 1/16". Set fittings and joints square and true, and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.
- C. Do not permit any weld to project within the pipe so as to restrict flows. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.
- D. Do not split, bend, flatten or otherwise damage piping before, during or after installation.
- E. Remove dirt, scale and other foreign matter from inside piping before tying into existing piping sections, fittings, valves or equipment.
- F. Bevel ends of ferrous pipe.

3.3 OFFSETS AND FITTINGS

- A. Due to the small scale of drawings, the indication of offsets and fittings is not possible. Investigate the structural and finish conditions affecting the work and take steps required to meet these conditions.
- B. Install pipe close to walls, ceilings and columns so pipe will occupy minimum space. Provide proper spacing for insulation coverings, removal of pipe, special clearances, and offsets and fittings.

3.4 SECURING AND SUPPORTING

- A. Support piping to maintain line and grade, with provision for expansion and contraction. Use approved clevis-type or trapeze-type hangers connected to structural members of the building. Single pipe runs to be supported by approved clevis type hangers. Multiple pipe runs to be supported by approved trapeze type hangers. Do not support piping from other piping or structural joist bridging.
- B. Provide supports both sides of elbows for pipe 6" and larger.
- C. Support vertical risers with steel strap pipe clamps of approved design and size, supported at each floor. Support piping assemblies in chases so they are rigid and self-supported before the chase is closed. Provide structural support for piping penetrating chase walls to fixtures. On cold water pipe, supports shall be outside the insulation.
- D. Where insulation occurs, design hangers to protect insulation from damage. Pipe saddles and insulation shields, where required, are specified in the appropriate insulation section and are sized in accordance with the schedule on the drawings.
- E. Install trapeze hangers, properly sized, to support the intended load without distortion.
- F. Use electro-galvanized or zinc plated threaded rods, nuts, washers and hangers.
- G. At outdoor locations, all supports, brackets and structural members shall be hot-dipped galvanized.
- H. Support spacing: As recommended by the project structural engineer and support manufacturer, but not more than listed below. Not to exceed spacing requirements of smallest pipe.

Pipe Size	Copper & Steel Max. Support Spacing, Feet	Cast Iron Max. Support Spacing, Ft.	Minimum Rod Diameter, Inches
1" & smaller	6		3/8
1-1/4" & 1-1/2"	8	5	3/8
2"	10	5	3/8
3"	10	5	1/2
4" & 5"	10	5	5/8
6" and above	10	5	3/4

3.5 PIPE SUPPORTS

- A. Provide P1001 or P 5000 Unistrut metal framing members and appurtenances for pipe support. Hot-dip galvanize members and appurtenances when located outside. Sagging of pipes or supports is not acceptable.
- B. Adjustable clevis hangers shall be used for single pipe supports; Anvil Fig. 260. When oversized clevis is used, a nipple shall be placed over the clevis bolt as a spacer to assure that the lower U-strap will not move in on the bolt. Provide adjustable clevis with a nut / washer above and below the hanger on the support rod. Ring type clevis hangers are not acceptable.
- C. Provide Anvil Figure 45 galvanized or primed and painted channel assembly for trapeze hangers.

3.6 PIPE SUPPORTS ON ROOF

- A. Support gas pipe on roof with Portable Pipe Hanger Model PP-10 with roller and fully adjustable height throughout pipe run. Base material shall be high density / high impact polypropylene with UV inhibitors and anti-oxidants. Provide with hot dip galvanized rod finish and framing. Nuts and washers shall be hot dip galvanized.

3.7 ANCHORS

- A. Provide anchors as required. Use pipe anchors consisting of heavy steel collars with lugs and bolts for clamping to pipe and attaching anchor braces. Install anchor braces in the

most effective manner to secure desired results. Do not install supports, anchors or similar devices where they will damage construction during installation or because of the weight or the expansion of the pipe. When possible, install sleeves in structural concrete prior to pouring of concrete.

3.8 FLOOR PENETRATIONS

- A. At locations where pipe passes through floors, provide watertight concrete curb around penetration.

3.9 PIPE SLEEVES

- A. Sleeves through masonry and concrete construction:
 - 1. Fabricate sleeves of Schedule 40 galvanized steel pipe.
 - 2. Size sleeve large enough to allow for movement due to expansion and to provide continuous insulation.
- B. Sleeves through gypsum wall construction.
 - 1. Fabricate sleeves of 16 gauge galvanized sheet metal.
- C. Sleeves through elevated slab construction.
 - 1. Fabricate sleeves of Schedule 40 galvanized steel pipe with welded center flange in floor.
- D. Extend each sleeve through the floor or wall. Cut the sleeve flush with each wall surface. Sleeves through floors shall extend 2" above floor lines for waterproofing purposes. Slab on grade floors shall not be sleeved except where penetrating waterproofing membrane or insect control is required.
- E. Caulk sleeves water and air tight. Seal annular space between pipes and sleeves with mastic compound to make the space water and air tight.
- F. For sleeves below grades in outside walls, provide Thunderline Link-Seal or Advance Product and System Interlynx, with 316 stainless steel nuts and bolts, with cast iron pressure plate.
- G. Provide chrome plated escutcheon plates on pipes passing through walls, floors or ceilings exposed to view. At exterior walls, stainless steel sheet metal is to be used.
- H. For sleeves through fire and smoke rated walls, seal with a UL through-penetration firestop, rated to maintain the integrity of the time rated construction. Install in accordance with the manufacturer's installation instructions. Comply with UL and NFPA standards for the installation of firestops. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.

3.10 ISOLATION VALVES

- A. Provide piping systems with line size shutoff valves located at the risers, at main branch connections to mains for equipment, to isolate central plant, and at other locations.

3.11 DRAIN VALVES

- A. Install drain valves at low points of water piping systems so that these systems can be entirely drained. Install a line size drain valve for pipes smaller than 2" unless indicated otherwise. For pipes 2-1/2" and larger, provide 2" drain valves unless indicated otherwise. Drain valves shall be plugged when not in use and at completion.

3.12 CLEANING OF PIPING SYSTEMS

- 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. 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.
- C. 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.
- D. 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.
- E. Dispose of water in approved manner.
- F. 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.
- G. 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.
- H. Submit status reports upon completion of each phase of work on each system.

3.13 TESTING

- A. Test piping after installation with water hydrostatic pressure of 1-1/2 times operating pressure (150 psig minimum) and carefully check for leaks. Repair leaks and retest system until proven watertight.
- B. Do not insulate or conceal piping systems until tests are satisfactorily complete.
- C. If any leaks or other defects are observed, suspend the test and correct the condition at once. Repeat testing until leaks are eliminated and the full test period is achieved.
- D. The satisfactory completion of testing does not relieve the Contractor of responsibility for ultimate proper and satisfactory operation of piping systems and their accessories.

3.14 PIPE MARKERS

- A. Identify interior exposed piping and piping in accessible chases or plenums with Opti-Code Brady Pressure Sensitive Adhesive Pipe Markers, consisting of pipe marker and direction of flow arrow tape. Clean pipe prior to installation. Background colors of markers, arrows and tape for each type of system shall be the same. Meet ANSI/OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.
- B. Identify exterior and mechanical room piping with Snap Around pipe markers through 4-inch pipe and Strap Around markers 5-inch pipe and larger. Pipe markers consisting of pipe marker and direction of flow arrow tape; 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. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.
- C. Install identification in the following locations:
 - 1. Both sides of penetrations through walls, floors and ceilings.
 - 2. Close to valves or flanges.
 - 3. Intervals on straight pipe runs not to exceed 50 feet
 - 4. Apply marker where view is obstructed.
- D. Pipe markers shall meet or exceed the specifications of the ASME A13.1 "Scheme for

Identification of Piping Systems”.

END OF SECTION

SECTION 22 33 33
ELECTRIC WATER HEATER (Commercial ASME)

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Electric water heaters for domestic water systems.

1.2 RELATED WORK

- A. Division 22 Plumbing
 - 1. Domestic Water Piping.
 - 2. Plumbing Piping Insulation.
 - 3. Division 26 Electrical.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- A. Lochinvar.
- B. State.
- C. Rheem / Ruud
- D. A. O. Smith

2.2 PRODUCTS

- A. Provide electric water heaters with kilowatt, recovery ratings, and storage capacities as scheduled on drawings.
- B. Provide an ASME code construction tank designed for 150 psig working pressure. Furnish glass-lined tank. Lining shall be corrosion-resistant.
- C. Furnish factory-assembled, integral units equipped as follows:
 - 1. Immersion thermostat.
 - 2. High temperature limit switch (energy cutout).
 - 3. Low-water cutoff.
 - 4. Heavy duty UL rated for 100,000 cycles.
 - 5. Temperature and pressure relief valve.
 - 6. Anode rod.
- C. Provide heavy-duty, medium watt density elements having nicoloy sheathing and prewired leads.
- E. The entire vessel shall be enclosed in a round steel enclosure with baked enamel finish and shall enclose the tank with R-16 foam insulation.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installations shall be in accordance with the manufacturer's published recommendations.
- C. Furnish all supports required by the equipment included in this Contract.
- D. Provide a 4" thick reinforced concrete housekeeping pad beneath heaters.
- E. Furnish and install all necessary valves, traps, gauges, strainers, unions, etc. to facilitate proper functioning and servicing of equipment.
 - 1. Install a line size shutoff valve in cold water inlet and hot water outlet close to each heater.
 - 2. Provide a temperature gauge in the domestic hot water piping within five feet of

outlet to each heater, upstream of all shut-off valves. Size and locate gauges to be easily readable from a standing position.

- F. Provide dielectric isolation device where copper lines connect to ferrous lines or equipment, such as dielectric coupling or dielectric flange fitting.
- G. Route condensate to a vented receiver.
- H. Pipe relief valve discharge and all equipment drains indirectly to appropriate floor drain.
- I. Set the operating and safety controls.
- J. Set thermostats on domestic water heaters to delivery maximum water temperature as indicated on Contract Drawings.
- K. Furnish and install an expansion tank on cold water supply to heater. Locate tank as close to water heater as possible between water heater and all check valves or backflow preventers. Expansion tank capacity shall be as scheduled on Contract Drawings. Install expansion tank in accordance with manufacturer's recommendations.
- L. Install water heater in galvanized drain pan piped to floor drain. Elevate water heater tank bottom above drain pan as to not allow standing water inside of drain pan to touch bottom of tank.

3.2 STARTUP

- A. Startup shall be performed by factory trained and authorized personnel. The factory representative shall also provide a technical and practical operation and maintenance training seminar including a hands-on operation and maintenance demonstration, and classroom presentation with handouts and visual aids, for no less than three physical plant personnel.

END OF SECTION

SECTION 22 40 00
PLUMBING FIXTURES AND FIXTURE CARRIERS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install water closets, urinals, lavatories, electric drinking fountains, fixture carriers and plumbing appurtenances.

1.2 RELATED WORK

- A. Division 22 Plumbing
 - 1. Drains, Hydrants and Cleanouts.
 - 2. Domestic Water Piping.
 - 3. Soil, Waste and Sanitary Drain Piping and Vent Piping.

1.3 JOB REQUIREMENTS

- A. Furnish plumbing fixtures and trim as shown and specified. Provide faucets, fittings, supply stops and similar devices of a single manufacturer. Furnish faucets and supply stops with renewable seats. Porcelain to steel and enameled cast iron fixtures shall be acid resistant. Wall hung fixtures shall be installed with a fixture carrier.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Plumbing Fixtures (Vitreous China):
 - 1. American Standard.
 - 2. Kohler.
 - 3. Toto
 - 4. Zurn
 - 5. Sloan
- B. Plumbing Faucets:
 - 1. Chicago
 - 2. T&S Brass (Manual Faucets only)
 - 3. American Standard
 - 4. Moen Commercial
 - 5. Zurn
- C. Supports and Carriers:
 - 1. Josam
 - 2. Zurn
 - 3. J.R. Smith.
 - 4. Wade
 - 5. Watts
- D. Flush Valves:
 - 1. Sloan "Royal"
 - 2. Zurn "XL"
 - 3. Toto "TMT1HNC-32"
 - 4. Moen Commercial
- E. Supplies, Stops and Chrome Plated Tubular Brass:
 - 1. McGuire
 - 2. T&S Brass
- F. Water Closet Seats:
 - 1. Beneke
 - 2. Church

3. Olsonite
4. Bemis
5. Centoco
- G. Electric Drinking Fountains: (Stainless Steel Only)
(No electronic solenoid valves; only mechanically operated valves.)(No Filtered Units)
 1. Halsey Taylor
 2. Elkay
- H. Electric Drinking Fountains (Stainless Steel Only) (Bi-Level with Bottle Filler)
 1. Halsey Taylor Model HTHBHVR8BL-NF, no filter.
- I. Outdoor Drinking Fountains:
 1. Acorn
 2. Haws
- J. Floor Drains:
 1. Josam
 2. Zurn
 3. J.R. Smith
 4. Wade
 5. Watts
- K. Cleanouts:
 1. Josam
 2. Zurn
 3. J.R. Smith
 4. Wade
 5. Watts
- L. Shower Systems:
 1. Bradley
 2. Willoughby
- M. Shower Valves
 1. Acorn
 2. Bradley
- N. Shower Stall
 1. Aquabath
 2. LASCO
 3. Aquarius
 4. Best Bath Systems (Access)
- O. Stainless Steel Sinks:
 1. Elkay
 2. Moen Commercial
- P. Mop Sinks:
 1. Crane Fiat
 2. Stern Williams
 3. Mustee
- Q. Roof Drains:
 1. Josam
 2. Zurn
 3. J.R. Smith
 4. Wade
 5. Watts
- R. Thermostatic Mixing Valves
 1. Symmons

- 2. Leonard
- S. Emergency Safety Equipment
 - 1. Bradley
 - 2. Encon
 - 3. Chicago
- T. Shock Arrestors:
 - 1. Precision Products
- U. Backflow Preventors
 - 1. Apollo RPLF 4A Series for 2-1/2 inch and larger
 - 2. Febco
 - 3. Watts
- V. Hose Bibbs
 - 1. Wade
 - 2. Chicago
 - 3. Josam
 - 4. Woodford
 - 5. Zurn
 - 6. J.R. Smith
- W. Wall Hydrants
 - 1. Wade
 - 2. Woodford
 - 3. Zurn
 - 4. J.R. Smith
 - 5. Josam
- X. Solids Interceptors & Hair/Lint Traps
 - 1. Watts
 - 2. J.R. Smith
 - 3. Zurn
- Y. Trap Primers
 - 1. Precision Plumbing Products (All Brass construction)
- Z. Interceptors (Central Outdoor)
 - 1. Park USA
 - 2. Hydro-Recycle
- AA. Urinal Strainers
 - 1. American Standard Washbrook FloWise Vandal Resistant Strainer
#7381408-200.002A
Note: Urinals must accommodate this strainer.
- BB. Shampoo Sink
 - 1. Belvedere
- CC. Roof Hydrants
 - 1. Mapa Products Model MPH-24-FP:24/9
Note: Roof hydrants with a drain connection are not allowed.

2.2 REQUIREMENTS

- A. Refer to the drawings for equipment to be supplied.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's instructions.
- B. Make rough-in and final connection of service to each fixture provided under this Section

- and other Sections or Architectural or Plumbing Drawings.
- C. Provide necessary stops, valves, traps, unions, vents, cold water, hot water, sanitary, etc. for a complete installation.
 - D. Provide isolation valves in domestic water lines to isolate all equipment, restrooms, hose bibbs, and where shown on drawings.
 - E. Remove piping and services roughed-in incorrectly and install correctly, without cost.
 - F. Exposed piping, fittings and appurtenances shall be chrome-plated brass.
 - G. Coordinate with the Contractor for locations and service required for each plumbing fixture.
 - H. All floor drains and floor sinks shall have Pro-Set "Trap Guard" for trap seal protection.
 - I. All floor drains and floor sink locations are to be coordinated with all equipment. Locate drains in mechanical equipment spaces to conform to drain locations of equipment furnished. Coordinate drain location with food service equipment and Architectural Drawings.
 - J. All floor drains, floor sinks and cleanout covers are to be provided with stainless steel screws. (No Vandal Resistant Screws)
 - K. Trap primer valves installed in concealed spaces shall have approved access doors for accessibility.

END OF SECTION

SECTION 22 63 11 GAS PIPING AND APPURTENANCES

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Furnish and install steel gas pipe inside buildings, including the supply line from the meter, service lines to gas equipment and appliances, termination of the service line with a plug valve, drip leg, and final connection to equipment and appliances with unions.
- B. Coordinate service line from utility main and extend to meter. Coordinate installation of the service line and meter with Gas Company.
- C. Extend steel gas piping from meter to inside the building to all fixtures, appliances and equipment requiring gas.

1.2 RELATED WORK

- A. Division 22 Plumbing
 - 1. Plumbing Pipe and Fittings
 - 2. Valves and Vents

1.3 UTILITY CONNECTIONS

- A. Make arrangements for and pay all fees and connection charges for obtaining service to the building.

PART 2 – PRODUCTS

2.1 PIPE AND FITTINGS - ABOVE GRADE

- A. Pipe 2 inch and Smaller:
 - 1. Schedule 40 ASTM A 53 black steel pipe
 - 2. Factory fabricated socket weld fittings.
- B. Pipe Larger than 2 inch:
 - 1. Schedule 40 ASTM A 53 black steel pipe.
 - 2. Factory fabricated butt weld fittings for welded steel pipes shall conform to ASTM A-234 WPB (seamless weld fittings).
- C. Unions:
 - 1. Standard 150 lb. (300 lb. water, oil or gas) malleable iron.
 - 2. Ground joint unions, with bronze seat.
 - 3. Flange joints for pipe larger than 2 inch in diameter.
- D. Flanges:
 - 1. Steel flanges. ANSI B16.5 and ASTM A-105.

2.2 PIPE AND FITTINGS - BELOW GRADE OUTSIDE BUILDING

- A. Polyethylene pipe shall be ASTM D3350 Grade PE24 cell classification and ASTM D1248 Class B material classification.
- B. Pipe shall be medium density polyethylene PE 2406 and PE 2708 manufactured by Poly Pipe Industries, Inc. or Performance Pipe. 1-1/2" to 2" shall be SDR 11 and 3" to 4" shall be SDR 11.5.
- C. Polyethylene yellow molded butt fittings for use with medium density polyethylene pipe shall meet testing requirements of ASTM D2513 and resin material listing of ASTM D3350 with PPI designation of PE 2406 as manufactured by Central Plastics Co.

2.3 VALVES

- A. See Section 22 05 23.

2.4 GAS PRESSURE REGULATOR

- A. Size the gas pressure regulator in accordance with the manufacturer's recommendations for flow quantities and reduced pressure as required for all equipment. Coordinate final equipment gas pressure requirements prior to ordering regulators. Provide American Meter Company regulators or approved equal, suitable for outdoor installation.

Regulators outside exposed to weather shall be installed with vent in vertical down position.

- B. All line pressure regulators shall be listed in accordance with ANSI (American National Standard) Z21.80 and CSA (Canadian Standards Association Standard) 6.22.
- C. Emergency shut off for science classrooms; color: yellow.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Installation Standards: Install gas piping in accordance with recommendations of the National Fire Protection Association.
- B. Drip Legs: Install a capped drip leg 6 inches long at the base of each vertical rise.
- C. Coating and Wrapping. Coat and wrap underground piping in accordance with the service utility company standards.
- D. Sleeves.
 - 1. Encase gas piping running in or through solid partitions with thin wall metal conduit. Sleeve piping and fittings shall be two pipe sizes, but not less than 1 inch larger than encased gas piping.
 - 2. Encase gas piping running below slab in Schedule 40 PVC, minimum size two pipe sizes larger than gas pipe. Vent sleeve to atmosphere with a 1-1/2 inch vent with 1-1/2 inch return bend above building roof. Seal ends of sleeve with UL fire rated caulk.
- E. Do not install gas piping exposed to view inside public area, or occupied spaces, without prior written approval.
- F. Weld all gas piping above grade.
- G. Provide test ports and isolation valves to enable proper testing of system in the future.
- H. Provide isolation valve and unions across regulators for proper removal.
- I. Provide transition risers where below grade polyethylene pipe changes to steel pipe above grade.
- J. Gas Pressure Regulators / Vents:
 - 1. Piping shall be sized in accordance with the regulator manufacturer's instructions. Never use pipe sizes smaller than the vent size; smaller pipe sizes restrict the gas flow. Where there is more than one regulator at a location, each regulator shall have a separate vent to the roof / outdoors. Headers with various installed devices can cause regulator malfunction.
 - 2. Support the vent pipe to eliminate strain on the regulator diaphragm case.
 - 3. Install vent piping from regulators to location to prevent gas smells from entering building. Do not locate the vent line terminus near windows, fans, or other ventilation equipment. See the installation instructions furnished with the regulator.
 - 4. Install double elbows and insect screen at end of piping to prevent moisture and insects from entering. Always point outdoor vent pipes in the downward position to reduce the possibility of rain, snow, sleet, and other moisture entering the pipe.
 - 5. When installed inside building route vents horizontally and terminate through building sidewall. The vent must be piped to the outside atmosphere using the shortest length of pipe, the fewest possible pipe elbows, and a pipe diameter as large as the vent size or larger. If a long gas run must be used, increase the pipe one nominal size every ten feet to keep the flow restriction as low as possible. Vents terminating through roof must have prior approval from Architect before installation. Through roof penetrations shall be minimized.
 - 6. Regulators installed outside or on roof top: Install regulator vent turned downward with insect screen over vent opening. The vent shall be designed to prevent the entry of water, insects, or other foreign materials that could cause blockage.
 - 7. Ensure the end of the vent line is away from ANY potential ignition sources. It is the installer's responsibility to ensure the vent line is exhausting to a safe environment

8. Adhere to all applicable codes and regulations.

3.2 TESTING GAS PIPING

- A. Preliminary gas test as required by Code, but minimum test pressure of 50 PSI held for not less than eight hours without noticeable drop.
- B. Test joints with a soap solution while lines are under pressure.
- C. Repair leaks.
- D. Final gas test shall be with a diaphragm gauge with a minimum dial size of 3-1/2 inches with a set hand and a pressure range not to exceed twenty (20) psig with 2/10-pound increments. The minimum test pressure shall not be less than ten (10) psi and the maximum test pressure shall not exceed twelve (12) psig. This test will be observed for no less than (30) thirty minutes with no drop in pressure. Final gas test must be witnessed by Cy-Fair ISD Plumbing Department personnel.
- E. Provide copy of gas pressure test reports in Operations & Maintenance Manual.
- F. Provide Railroad Commission of Texas Pipeline Safety Form PS-86B.
 1. To find form online, go to: Texas School Gas Test Form
- G. School renovations projects shall have all gas piping tested. Report and document gas leaks found to the Architect and Engineer. Repair leaks at no additional cost to the Owner.
- H. The District must be notified to witness any gas system test.
- I. Send copy of gas piping material and domestic manufacture for approval to Bill Smith and Shannon Thompson at CFISD. Provide test valve opening downstream of main gas shutoff and meter but before building entry with valve to be Nibco T585-70UL (1/4") with plug cap.

3.3 IDENTIFICATION CONDUCTOR

- A. Spiral A #12 AWG insulated copper conductor the full length of the thermoplastic piping system. Fasten to the pipe at 3 foot intervals with plastic tie wraps.
- B. Terminate at each end in a 12 inch x 12 inch x 4 inch FRP junction box.
 1. Bolted gasketed cover with stainless steel screws.
 2. Screw type terminal strip.
 3. Legend on cover "gas pipe identification conductor."
- C. Set in concrete pad.

3.4 PAINT EXPOSED OUTSIDE GAS PIPE

- A. Interior and Exterior Gas piping shall be protected from rust.
- B. Paint pipe with a flat alkyd coating, clean pipe prior to painting by preparing surface by hand tool cleaning per SSPC-SP2-82, applying one coat of Glidden Y-590 Rustmaster Metal Primer White and top coat of Yellow Alkyd Flat Enamel.

END OF SECTION

SECTION 23 01 00
HVAC OPERATING AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Compilation product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare operating and maintenance data as specified.
- B. Instruct Owner's personnel in operation and maintenance of equipment and systems.
- C. Submit three copies of complete manual in final form.

1.2 SUBMITTALS

- A. Thirty (30) days after the Contractor has received the final scheduled identified submittals bearing the Architect/Engineer's stamp of acceptance (including resubmittals), submit for review one copy of the first draft of the Operating and Maintenance Manual. This copy shall contain as a minimum:
 - 1. Table of Contents for each element.
 - 2. Contractor information.
 - 3. All submittals, coordination drawings and product data, reviewed by the Architect/Engineer; bearing the Architect/Engineer's stamp of acceptance. (When submittals are returned from Engineer "Correct as Noted", corrected inserts shall be included.)
 - 4. All parts and maintenance manuals for items of equipment.
 - 5. Warranties (without starting dates)
 - 6. Certifications that have been completed. Submit forms and outlines of certifications that have not been completed.
 - 7. Operating and maintenance procedures.
 - 8. Form of Owner's Training Program Syllabus (including times and dates).
 - 9. Control operations/equipment wiring diagrams.
 - 10. Schedule of filters for each item of equipment.
 - 11. Schedule of belts for each item of equipment.
 - 12. Other required operating and maintenance information that are complete.
- B. Copy will be returned to the Contractor within 15 days with comments for corrections.
- C. Submit three (3) completed manuals in final form to the Architect/Engineer one day after substantial completion, and prior to Owner's instructions. Include all specified data, test and balance reports, drawings, dated warranties, certificates, reports, along with other materials and information.
- D. The Architect/Engineer will review the manuals for completeness within fifteen (15) days.
- E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Architect / Engineer. The manuals will not be retransmitted.
- F. Two (2) complete Manuals will be delivered to the Owner.

PART 2 - PRODUCTS

2.1 BINDERS

- A. Commercial quality black three-ring binders with clear overlay plastic covers.
- B. Minimum ring size: 1".
Maximum ring size: 3".
- C. When multiple binders are used, correlate the data into related groupings.
- D. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 - EXECUTION

3.1 OPERATION AND MAINTENANCE MANUAL

- A. Form for 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 flyleaf 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. Schedule of filters for each air handling system.
 - k. Schedule of belts for each item of equipment.
 - l. Each Contractor's coordination drawings.
 - m. As installed color coded piping diagrams.
 - n. Charts of valve tag number, with location and function of each valve.
 - o. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
 - p. 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 extended compressor warranty certificates.

END OF SECTION

SECTION 23 05 00
MECHANICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of the General Requirements, and other provisions and requirements of the contract documents apply to work of Division 23 Mechanical.
- B. Applicable provisions of this section apply to all sections of Division 23, Mechanical.

1.2 CODE REQUIREMENTS AND FEES

- A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.
- B. Mechanical work shall comply with applicable inspection services:
 - 1. Underwriters Laboratories
 - 2. National Fire Protection Association
 - 3. State Health Department
 - 4. Local Municipal Building Inspection Department
 - 5. Texas Department of Licensing & Regulations (ADA)
- C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.
- D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.
- E. Obtain all permits required.

1.3 CONTRACTOR'S QUALIFICATIONS

- A. An approved contractor for the work under this division shall be:
 - 1. A 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 has served their Owners satisfactorily for not less than 3 years

1.4 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date bids are received. Requirements in reference specifications and standards are minimum for all equipment, material, and work. In instances where specified capacities, size, or other features of equipment, devices, or materials exceed these minimums, meet specified capacities.

1.5 CONTRACT DRAWINGS

- A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.

1.6 PROJECT RECORD DOCUMENTS

- A. Maintain at the job site a separate set of white prints (black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is at variance with the contract drawings. Mark the

drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various lines, valves, ductwork, traps, equipment, and other pertinent items, as installed. Include flow-line elevation of sewer lines. Record existing and new underground and under slab piping with dimensioned locations and elevations of such piping.

- B. At the conclusion of project, obtain without cost to the Owner, erasable mylars of the original drawings and transfer as-built changes to these. 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 2014 files on disk (CD Rom).
- C. 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 RECORD 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 mechanical piping and elevation.
 - 7. Indicate exact location of all underground electrical raceways and elevations.
 - 8. Correct schedules to reflect (actual) equipment furnished and manufacturer.
 - 9. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and mechanical valves.
 - 10. Exact location of all electrical equipment in and outside of the building.
 - 11. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
 - 12. Cloud all changes.

1.7 SPACE REQUIREMENTS

- A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.8 RELATION WITH OTHER TRADES

- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements.
- B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.
- C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.
- D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.
- E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under that Division. Determine from the Contractor for the various trades, the Owner, and by direction from the Architect/Engineer, the exact location of all items.

1.9 CONCEALED AND EXPOSED WORK

- A. When the word "concealed" is used in connection with insulating, painting, piping, ducts and the like, the work is understood to mean hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is understood to mean open to view.

1.10 GUARANTEE

- A. Guarantee work for 1 year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

1.11 MATERIAL AND EQUIPMENT

- A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 NOISE AND VIBRATION

- A. Select equipment to operate with minimum noise and vibration. If objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, rectify such conditions at no additional cost. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.13 ACCEPTABLE MANUFACTURERS

- A. Manufacturers names and catalog number specified under sections of Division 23 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer will be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before bid due date. Submit complete design and performance data to the Engineer.

1.14 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.

1.15 WARRANTIES

- A. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.16 BUILDING CONSTRUCTION

- A. It shall be the responsibility of each sub-contractor to consult the Architectural and Engineering drawings, details, and specifications and thoroughly familiarize himself with the project and all job related requirements. Each sub-contractor shall cooperate with the General Contractor to verify that all piping and other items are placed in the walls, furred spaces, chases, etc., so there will be no delays in the job.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 OPENINGS

- A. Framed, cast or masonry openings for ductwork, equipment or piping are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.2 AIR FILTERS AND PIPE STRAINERS

- A. Immediately prior to substantial completion of the project, inspect, clean and service air filters and strainers. Replace air filters.

3.3 LUBRICATION, REFRIGERANT AND OIL

- A. Provide a complete charge of correct lubricant for each item of equipment requiring lubrication.
- B. Provide a complete and working charge of proper refrigerant, free of contaminants, into each refrigerant system. After each system has been in operation long enough to ensure completely balanced conditions, check the charge and modify for proper operation as required.
- C. Provide a complete charge of special oil for refrigeration use, suitable for operation with refrigerant, in each system.

3.4 HOUSEKEEPING PADS

- A. Provide equipment housekeeping pads under all floor mounted and ground mounted HVAC equipment, and as shown on the drawings.
- B. Concrete work as specified in Division 3.
- C. Concrete pads:
 - 1. 4" high, rounded edges, minimum 2500 psi unless otherwise indicated on the drawings
 - 2. Chamfer strips at edges and corner of forms.
 - 3. Smooth steel trowel finish.
 - 4. Doweled to existing slab
- D. Install concrete curbs around duct penetrations or multiple pipe penetrations.

3.5 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 40 hours dedicated instructor time.
 - 2. 8 hours on each of 5 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 Operating and Maintenance Manual.

3.6 EQUIPMENT IDENTIFICATION

- A. Provide a laminated engraved plastic nameplate on each piece of equipment and starter.
 - 1. Designation approved by Architect/Engineer.
 - 2. Equipment includes, but is not limited to, air handling units, fan coil units, variable volume boxes, fans, pumps, boilers and chillers.
 - 3. Submit schedule of equipment to be included and designations.
- B. Provide nameplates with 1/2" high letters and fastened with epoxy or screws.

3.7 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
 - 1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
 - 2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
- B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.8 PROTECTION

- A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.

3.9 INDOOR AIR QUALITY

- A. All equipment and ductwork shall be installed to allow sufficient space for testing, maintenance, and commissioning functions. Access doors or panels shall be installed in ventilation equipment, ductwork, and plenum enclosures for inspection and cleaning of outdoor air intakes, mixing plenums, up and downstream of coils, filters, drain pans and fans.
- B. Practice source control and eliminate potential contaminants in material selection,

- installation, and maintenance.
- C. Provide installation and disposal instructions for all materials and chemicals that are potential contaminants.
 - D. Obtain and conform to the requirements of the Material Safety Data Sheets (MSDSs) in the use of materials.
 - E. Utilize manufacturer's recommendations and provide installation instructions for all chemicals, compounds, and potential contaminants including pre-installation degassing if required.
 - F. Ventilate completed building prior to final completion using no less than design outside air for at least 48 hours before occupancy.
 - G. Make provisions for controls to prevent the entry of air contaminants into the HVAC air distribution system.
 - H. Steps shall be taken to ensure that the HVAC system continues to function effectively and are not damaged or contaminated during construction activities.

END OF SECTION

SECTION 23 05 10
HVAC CONTRACT QUALITY CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Contract quality control including workmanship, manufacturer's instructions, mock-ups and demonstrations.

1.2 QUALITY CONTROL PROGRAM

- A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work in accordance with contract documents.

1.3 WORKMANSHIP

- A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform work by persons qualified to produce workmanship of specified quality.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.
- D. Provide finishes to match approved samples. All exposed finishes shall be approved by the Architect. Submit color samples as required.

1.4 MANUFACTURER'S INSTRUCTIONS

- A. Comply with instructions in full detail, including each step in sequence.
- B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.5 MANUFACTURER'S CERTIFICATES

- A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.6 MANUFACTURER'S FIELD SERVICES

- A. When required in individual Specification Sections, manufacturer shall provide qualified personnel to observe:
 - 1. Field conditions.
 - 2. Condition of installation.
 - 3. Quality of workmanship.
 - 4. Start-up of equipment.
 - 5. Testing, adjusting, and balancing of equipment.
- B. Representative shall make written report of observations and recommendations to Architect / Engineer.

1.7 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.

1.8 SCHEDULING OF 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.

PART 2 - PRODUCTS

2.1 REFERENCE APPLICABLE SPECIFICATION SECTIONS.

PART 3 - EXECUTION

3.1 AIR HANDLING UNIT

- A. Mock-up an air handling unit, completely installed, including:
 - 1. Piping connections; including thermowells, test stations, test wells and other piping appurtenances.
 - 2. Pipe insulation.
 - 3. Condensate drain piping.
 - 4. Electrical connections.
 - 5. Ductwork beyond the first transition.
 - 6. Control valves and bypass.
 - 7. Cabinet/internal vibration isolation.
 - 8. Block valves and balancing valves.
 - 9. Duct insulation.
 - 10. Instrumentation.
- B. Tests: Air flow at scheduled static pressure.
- C. Demonstrate:
 - 1. Filter accessibility.
 - 2. Accessibility to drain and components for service.
 - 3. Controls sequence.

3.2 DUAL DUCT TERMINAL BOX

- A. Mock-up a Dual Duct Terminal Box completely installed, including:
 - 1. Electrical connections.
 - 2. Duct connection beyond first transition.
 - 3. Cabinet/internal vibration isolation.
 - 4. Suspension system.
- B. Tests: Air flow at scheduled static pressure.
- C. Demonstrate:
 - 1. Control Sequence.
 - 2. Accessibility to components for service.

3.3 HOT AND CHILLED WATER CIRCULATING PUMPS

- A. Mock-up one each system pump, completely installed including:
 - 1. Pump mounted on housekeeping pad.
 - 2. Auxiliary drain pan. (Chilled water only)
 - 3. Piping to a point beyond the complete valve and instrumentation assemblies.
 - 4. Strainers with blowdown.
 - 5. Flexible piping connection.
 - 6. Pipe supports.
 - 7. Pipe insulation.

8. Pump painting.
9. Electrical connections.

3.4 PROTECTION OF EQUIPMENT

- A. 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 a like kind at no additional cost to the Owner.
- B. Adequately protect equipment from damage after delivery to the project. Cover with heavy tarpaulins, drop cloths or other protective coverings as required to protect from plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion.

END OF SECTION

**SECTION 23 05 11
MECHANICAL ALTERATIONS PROJECT PROCEDURES**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Inspect and service existing equipment and materials that are to remain or to be reused.
- B. Disposal of equipment, materials, or housekeeping pads to be abandoned. Prior to disposal, the Contractor shall verify with the Owner what is to be salvaged by the Owner and what is to become the property of the Contractor.
- C. Handling of equipment and materials to be removed.

1.2 QUALITY ASSURANCE

- A. Coordination with the Owner prior to the disconnection or shutdown of existing equipment, or to the modification of existing operational systems.

1.3 CONTRACT DRAWINGS

- A. There is the possibility that existing conditions and devices are affected by the work indicated on the drawings and called for in the specifications (project manual) which do not appear on the drawings. It is the Contractor's responsibility to visit the site and determine all of the existing conditions and to consider these existing conditions when making and presenting a proposal, to have a complete proposal.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Material used to upgrade and repair existing equipment shall conform to that specified.
- B. Material used to upgrade and repair existing equipment shall not void existing warranties or listings of the equipment to be upgraded or repaired.
- C. Material used to upgrade and repair existing equipment shall be new and shall be of the same manufacturer of the existing equipment, shall be acquired through the existing original equipment manufacturer's approved distribution channels, shall have manufacturer's warranties for the new material being used, and shall be listed for the use intended.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Existing materials and equipment indicated on the drawings or in the specifications to be reused shall be inspected for damaged or missing parts. Contractor shall notify the Architect / Engineer, in writing, accordingly.
- B. If using materials specified or shown on the drawing voids or diminishes the warranty or operation of remaining equipment or systems, the Contractor shall notify the Architect / Engineer, in writing.
- C. Verify field measurements, above and underground piping connections and flows.
- D. Demolition Drawings are based on casual field observation, and when available, existing record documents. Report discrepancies to Architect before disturbing existing installation, and immediately after such discrepancies are discovered.
- E. Field verify existing conditions and actual utility uses prior to final connections. Existing drawings may not have been available for all required information. Use pipe inspection camera system to field verify existing sanitary / grease waste connections. Verify actual HVAC supply and return piping connections. Verify flow direction and depth prior to connection to existing plumbing systems.

3.2 APPLICATION

- A. Existing materials and equipment indicated on the drawings or in the specifications to be reused shall be cleaned and reconditioned, including cleaning of piping systems and HVAC coils prior to installation and reuse.
- B. Material and equipment removed that is not to be salvaged for Owner's use or for reuse on the project shall become the property of the Contractor and be removed from the site.
- C. Material or equipment salvaged for Owner's use shall be carefully handled and stored where directed by the Owner or the Architect / Engineer. Relocate material and / or equipment as directed by Owner.
- D. Materials and equipment not indicated to be removed or abandoned shall be reconnected to the new system.
- E. Materials, equipment and housekeeping pads not to be reused or reconnected shall be removed for Owner's review and salvaged by Contractor.
- F. Prior to start of construction, Contractor shall walk areas to be renovated with Owner to identify and document items to be salvaged for Owner's use.
- G. Clean and repair existing materials and equipment that remain or are to be reused.
- H. Contractor shall utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

3.3 SEQUENCE AND SCHEDULE

- A. Coordinate utility service outages with Utility Company, Architect and Owner.
- B. Provide additional or temporary valves, piping, ductwork and connections to maintain existing systems in service during construction.
- C. Existing HVAC and Plumbing Service: Refer to drawings for work in remodeled areas. Where facilities in these areas are to remain in service, any related work to keep the facilities in operation is specified in this Division. Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from Owner at least 48 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area. Maintain acceptable temperature and humidity control within existing building during renovation activities.
- D. Remove and replace existing Mechanical systems and appurtenances as occasioned by new or remodeled construction. Re-establish service that may be interrupted by remodeled construction.
- E. Refer to other drawings series for work in remodeled areas. Where facilities in these areas are required to remain in service, any related work required to keep these facilities in operation is specified in this Division.
- F. Remove and replace existing piping, grilles, boxes and ductwork coincident with the construction.
- G. Remove or relocate existing piping, grilles, ductwork or housekeeping pads as occasioned by new or remodeled construction. Cap unused HVAC or domestic piping and duct beyond the new finish line.
- H. Relocate all HVAC and or domestic piping, grilles, boxes and ductwork as required to accommodate new work requiring precedence.
- I. Remove concrete housekeeping pad where materials or equipment have been removed.
- J. Remove all known utilities, which do not provide service to the buildings that remain.
- K. Remove existing plumbing or mechanical vent penetrations through roof not to be reused.

3.4 DEMOLITION AND EXTENSION OF EXISTING MECHANICAL WORK

- 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 materials shall remain the property of the Owner, and shall be delivered to such destination as directed by the Owner's representative unless they are not wanted, then it will be the responsibility of this Contractor to remove such items and properly dispose of them. 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 approval of the Owner's representative substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.

- B. All items 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 relocations and to restore them 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.
- C. When items scheduled for relocation and/or reuse are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner's representative 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's representative, at no additional cost to the Owner.
- D. HVAC, Plumbing, piping, ductwork and appurtenances to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner's representative. Piping and ductwork 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 Construction Inspector. 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 that must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner's representative hereinbefore specified.
- E. Repair adjacent construction and finishes damaged during demolition and extension work.
- F. Maintain access to mechanical installations that remain active. Modify installation or provide access panel as appropriate.
- G. Extend existing installations using materials and methods compatible with existing mechanical installations, or as specified.
- H. Existing mechanical piping and devices found to need additional hangers installed should be added at no additional cost to the Owner.

3.5 PROTECTION OF THE WORK

- A. Provide adequate temporary support and auxiliary structure as necessary to ensure structural value or integrity of affected portion of work.
- B. Provide devices and methods to protect other portions of work from damage.
- C. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.

3.6 IDENTIFICATION OF EQUIPMENT IN RENOVATED AREAS

- A. Identification of Equipment: Provide new identification of all existing equipment to be reused and located within the renovated areas. Do not include the description "existing". Provide new nameplates for all existing mechanical equipment in renovated areas as specified in Section 23 05 00 Mechanical General Provisions.

3.7 REFRIGERANT DISPOSAL

- A. Contractor shall dispose of refrigerant from all DX equipment including refrigerant piping per OSHA, EPA, Federal, State and Local Codes.

END OF SECTION

SECTION 23 05 12
SHOP DRAWINGS, COORDINATION DRAWINGS & PRODUCT DATA

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Prepare submittals as required by these specifications as outlined below.
- B. The term submittal, as used herein, refers to all:
 - 1. Shop Drawings
 - 2. Coordination Drawings
 - 3. Product data
- C. Submittals shall be prepared and produced for:
 - 1. Distribution as specified
 - 2. Inclusion in the Operating and Maintenance Manual, as specified, in the related section

1.2 SHOP DRAWINGS

- A. Present drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.
- B. Show all dimensions of each item of equipment on a single composite Shop Drawing. Do not submit a series of drawings of components.
- C. Identify field dimensions; show relationship to adjacent features, critical features, work, or products.
- D. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.

1.3 COORDINATION DRAWINGS

- A. Present in a clear and thorough manner. Title each drawing with project name. Identify each element of drawings by reference to sheet number and detail, or room number of contract documents. Minimum drawing scale: $\frac{1}{4}'' = 1'-0''$.
- B. Prepare coordination drawings to coordinate installations for efficient use of available space, for proper sequence of installation, and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.
- C. For each mechanical room and for each outside equipment pad where equipment is located, submit plan and elevation drawings. Show:
 - 1. Actual mechanical equipment and components to be furnished
 - 2. Service clearance
 - 3. Relationship to other equipment and components
 - 4. Roof drains and leader piping
 - 5. Fire protection piping and equipment
- D. Identify field dimensions. Show relation to adjacent or critical features of work or products.
- E. Related requirements:
 - 1. Ductwork shop drawings
 - 2. Coordination drawing specified in Division 26
- F. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.
- G. Gas piping sketch indicating proposed location of piping prior to proceeding with the installation.

1.4 PRODUCT DATA AND INSTALLATION INSTRUCTION

- A. Submit only pages which are pertinent to the project. All options which are indicated on

the product data shall become part of the contract and shall be required whether specified are not.

- B. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number.
- C. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.
- D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.
- E. Mark up a copy of the specifications for the product. Indicate in the margin of each paragraph the following: COMPLY, DO NOT COMPLY, or NOT APPLICABLE. Explain all DO NOT COMPLY statements.
- F. Provide a separate transmittal for each submittal item. Transmittals shall indicate product by specification section name and number. Separate all submittals into appropriate specification section number. Do not combine specification sections.

1.5 MANUFACTURERS INSTRUCTIONS

- A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, calibrating, balancing and finishing.

1.6 CONTRACTOR RESPONSIBILITIES

- A. Review submittals prior to transmittal.
- B. Determine and verify:
 - 1. Field measurements
 - 2. Field construction criteria
 - 3. Manufacturer's catalog numbers
 - 4. Conformance with requirements of Contract Documents
- C. Coordinate submittals with requirements of the work and of the Contract Documents.
- D. Notify the Architect/Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.
- E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect / Engineer's acceptance.
- F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect / Engineer reviews submittals or not.
- G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect/Engineer reviews submittals or not, unless Architect / Engineer gives written acceptance of the specific deviations on reviewed documents.
- H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
 - 1. Proper sizes and capacities
 - 2. That the item will fit in the available space in a manner that will allow proper service
 - 3. Construction methods, materials and finishes
- I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

1.7 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor.

- B. Number of submittals required:
 - 1. Shop Drawings and Coordination Drawings: Submit one reproducible transparency and three opaque reproductions.
 - 2. Product Data: Submit the number of copies which the contractor requires, plus those which will be retained by the Architect/Engineer.
- C. Accompany submittals with transmittal letter, in duplicate, containing:
 - 1. Date
 - 2. Project title and number
 - 3. Contractor's name, address and contact number.
 - 4. The number of each Shop Drawing, Project Datum and Sample submitted
 - 5. Other pertinent data
- D. Submittals shall include:
 - 1. The date of submission
 - 2. The project title and number
 - 3. Contract Identification
 - 4. The names of:
 - a. Contractor
 - b. Subcontractor
 - c. Supplier
 - d. Manufacturer
 - 5. Identification of the product
 - 6. Field dimensions, clearly identified as such
 - 7. Relation to adjacent or critical features of the work or materials
 - 8. Applicable standards, such as ASTM or federal specifications numbers
 - 9. Identification of deviations from contract documents
 - 10. Suitable blank space for General Contractor and Architect/Engineer stamps
 - 11. Contractor's signed and dated Stamp of Approval
- E. Coordinate submittals into logical groupings to facilitate interrelation of the several items:
 - 1. Finishes which involve Architect/Engineer selection of colors, textures or patterns
 - 2. Associated items which require correlation for efficient function or for installation

1.8 SUBMITTAL SPECIFICATION INFORMATION

- A. Every submittal document shall bear the following information as used in the project manual:
 - 1. The related specification section number
 - 2. The exact specification section title
- B. Submittals delivered to the Architect/Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.9 RESUBMISSION REQUIREMENTS

- A. Make re-submittals under procedures specified for initial submittals.
 - 1. Indicate that the document or sample is a re-submittal
 - 2. Identify changes made since previous submittals
- B. Indicate any changes which have been made, other than those requested by the Architect / Engineer.

1.10 CONTRACTOR'S STAMP OF APPROVAL

- A. Contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
- B. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect/Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.
- C. Do not deliver any submittals to the Architect/Engineer that do not bear the Contractor's stamp of approval and signature.
- D. Submittals delivered to the Architect/Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.11 ARCHITECT / ENGINEER REVIEW OF IDENTIFIED SUBMITTALS

- A. The Architect / Engineer will:
 - 1. Review identified submittals with reasonable promptness and in accordance with schedule
 - 2. Affix stamp and initials or signature, and indicate requirements for re-submittal or approval of submittal
 - 3. Return submittals to Contractor for distribution or for resubmission
- B. Review and approval of submittals will not extend to design data reflected in submittals which is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.
- C. Architect / Engineer's review and approval is only for conformance with the design concept of the project and for compliance with the information given in the contract.
 - 1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
 - 2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes or coordination with the work of other trades.
- D. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.12 SUBSTITUTIONS

- A. Do not make requests for substitution employing the procedures of this Section.
- B. The procedure for making a formal request for substitution is specified in Div. 1.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 23 05 13
ELECTRICAL PROVISIONS OF HVAC WORK

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Electrical provisions to be provided as mechanical work are indicated in other Division 23 sections, on drawings, and as specified.
- B. Types of work, normally recognized as electrical but provided as mechanical, specified or partially specified in this Section, include but are not necessarily limited to the following:
 - 1. Motors for mechanical equipment.
 - 2. Starters for motors of mechanical equipment, but only where specifically indicated to be furnished integrally with equipment.
 - 3. Wiring from motors to disconnect switches or junction boxes for motors of mechanical equipment, but only where specifically indicated to be furnished integrally with equipment.
 - 4. Wiring of field-mounted float control switches, flow control switches, and similar mechanical-electrical devices provided for mechanical systems, to equipment control panels.
 - 5. Wiring of smoke detectors for shutdown of air handling equipment when a fire alarm system is not included in the project.
 - 6. Wiring of oil pump, vibration and oil level limit switches for cooling towers.
 - 7. Refrigerant monitor/sensor/alarming and field installed visual/audible display alarms.
 - 8. Pipe heat tracing.
 - 9. Cooling tower vibration switch/interlock/reset.
 - 10. Field interlock wiring from chiller: flow switches, pump aux. Contacts, pump start/stop.
 - 11. Power supply 120 VAC and control signal from chiller control panel to condenser water flow control valve installed in piping leaving chiller.
 - 12. Wiring of all related circulating water system chemical treatment devices.
 - a. Low voltage electric contacting water meter
 - b. Solenoid valve/blow-down assembly
 - 13. Radiant heater timer switches and/or thermostats
 - 14. Low Voltage thermostat wiring
 - 15. Wiring for pump motor internal heaters
- C. Refer to Division 23 Controls Sections for related control system wiring.
- D. Refer to Division 23 sections for specific individual mechanical equipment electrical requirements.
- E. Refer to Division 26 sections for motor starters and controls not furnished integrally with mechanical equipment.
- F. Refer to Division 26 sections for junction boxes and disconnect switches required for motors and other electrical units of mechanical equipment.

1.2 RELATED WORK

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to work of this Section.

1.3 QUALITY ASSURANCE

- A. Wherever possible, match elements of electrical provisions of mechanical work with similar elements of electrical work specified in Division 26 sections for electrical work not otherwise specified.

- B. For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards for definitions of terminology. Comply with National Electrical Code (NFPA 70) for workmanship and installation requirements.

1.4 SUBMITTALS

- A. Include in listing of motors, voltage, notation of whether motor starter is furnished or installed integrally with motor or equipment containing motors.

PART 2 - PRODUCTS

2.1 MOTORS

- A. Provide motors for mechanical equipment manufactured by one of the following:
 - 1. Baldor Electric Company.
 - 2. Century Electric Div., Inc.
 - 3. General Electric Co.
 - 4. Louis Allis Div.; Litton Industrial Products, Inc.
 - 5. Lincoln Electric
 - 6. Marathon Electric Mfg. Corp.
 - 7. Reliance Electric Co.
 - 8. Westinghouse Electric Corp.
 - 9. WEG
 - 10. U.S. Motors
- B. Motor Characteristics. Except where more stringent requirements are indicated, and except where required items of mechanical equipment cannot be obtained with fully complying motors, comply with the following requirements for motors of mechanical work:
- C. Temperature Rating. Rated for 40 Degrees C environment with maximum 50 Degrees C temperature rise for continuous duty at full load (Class A Insulation).
- D. Provide each motor capable of making starts as frequently as indicated by automatic control system, and not less than 5 starts per hour for manually controlled motors.
- E. Phases and Current Characteristics. Provide squirrel-cage induction polyphase motors for 3/4hp and larger, and provide capacitor-start single-phase motors for 1/2hp and smaller, except 1/6hp and smaller may, at equipment manufacturer's option, be split-phase type. Coordinate current characteristics with power specified in Division 26 sections, and with individual equipment requirements specified in other Division 23 requirements. For 2-speed motors provide 2 separate windings on polyphase motors. Do not purchase motors until power characteristics available at locations of motors have been confirmed, and until rotation directions have been confirmed.
- F. Service Factor. 1.15 for polyphase motors and 1.35 for single-phase motors.
- G. Motor Construction. Provide general purpose, premium efficiency motors, continuous duty motors, Design "B" except "C" where required for high starting torque.
 - 1. Frames. NEMA #56.
 - 2. Bearings are to be ball or roller bearings with inner and outer shaft seals, regreasable except permanently sealed where motor is inaccessible for regular maintenance. Where belt drives and other drives produce lateral or axial thrust in motor, provide bearings designed to resist thrust loading. Refer to individual section of Division 23 for fractional-hp light-duty motors where sleeve-type bearings are permitted.
 - 3. Except as indicated, provide open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation, and provide guarded drip-proof motors where exposed to contact by employees or building occupants.

Provide weather-protected Type I for outdoor use, Type II where not housed.
Refer to individual sections of Division 23 for other enclosure requirements.

4. Provide built-in thermal overload protection and, where indicated, provide internal sensing device suitable for signaling and stopping motor at starter.
5. Noise Rating: Provide "Quiet" rating on motors.
- H. All motors shall be premium efficiency.
- I. Provide an inverter duty motor on all equipment that utilizes a variable frequency drive.
- J. Provide TEFC or TEAO motors on all Air Handling Units, Pumps, Supply Fans, Cooling Towers and Fan Coil Units with motors larger than 1 HP.

2.2 EQUIPMENT FABRICATION

- A. Fabricate mechanical equipment for secure mounting of motors and other electrical items included in work. Provide either permanent alignment of motors with equipment, or adjustable mountings as applicable for belt drives, gear drives, special couplings and similar indirect coupling of equipment. Provide safe, secure, durable, and removable guards for motor drives. Arrange for lubrication and similar running-maintenance without removal of guards.

2.3 GENERAL REQUIREMENTS – SHAFT GROUNDING RINGS

- A. All motors operated on variable frequency drives shall be equipped with a maintenance-free, conductive microfiber shaft grounding ring to meet NEMA MG-1, 3.4.4.4.3 requirements, with a minimum of two rows of circumferential microfibers to discharge damaging shaft voltages away from the bearings to ground. SGR's Service Life: Designed to last for service life of motor. Provide AEGIS SGR Conductive MicroFiber Shaft Grounding Ring, or approved equal.
- B. Application Note: Motors up to 100 HP shall be provided with one shaft ground ring installed on either the drive end or non-drive end. Motors over 100 HP shall be provided with an insulated bearing on the non-drive end and a shaft grounding ring on the drive end of the motor with the exception of line contact bearings in the drive end of the machine. In this instance the line contact bearing must be electrically insulated and the AEGIS Bearing Protection Ring installed on the opposite drive end of the motor. Grounding rings shall be provided and installed by the motor manufacturer's recommendations.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, anchored to resist torque, drive thrusts, and other external forces inherent in mechanical work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.
- B. Verify voltage with Electrical Plans.
- C. Install all electrical and control conduit into the bottom only of all electrical enclosures for motors, VFD cabinets, control cabinets, chillers, etc. (No top or side cabinet penetrations) Top of electrical enclosure must be kept water tight. Top or side cabinet penetrations will not be accepted inside or outside of the building.
- D. Motor Connections: For motors 10 HP and larger, at the motor connection do not use wire nuts. Provide listed insulated multitap connectors or provide copper alloy split bolt connection, or compression lugs and bolts: insulate connection with Scotch Super 88 vinyl electrical tape over rubber tape.

END OF SECTION

SECTION 23 05 14
HVAC CONDENSATE DRAIN PIPING SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide and install air conditioning condensate drains.

1.2 RELATED WORK

- A. Division 23 – Mechanical:
 - 1. Insulation
 - 2. Fan/Coil Units
 - 3. Air Handling Units
 - 4. Chilled Water Pumps
 - 5. Air Compressor Storage Tanks
 - 6. Equipment Drain Pans

PART 2 - PRODUCTS

2.1 PIPE MATERIAL

- A. Type “L” copper with drainage pattern fittings.
- B. For Air Handling Units – Schedule 40 Galvanized Steel Pipe.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install the system to facilitate easy removal.
 - 1. Use threaded plugged tee at each change of direction to permit cleaning.
 - 2. Install a cleanout every 50 feet of straight run piping
 - 3. Maintain a positive slope on all piping
- B. Install a water seal trap leg based on the fan pressure.
 - 1. Size the length of the trap leg 1 inch larger than the actual system pressure.
- C. Install traps and cleanout as shown in the drawing details.
 - 1. Confirm requirements with manufacturer's installation instructions

3.2 SIZE PIPE AS SHOWN ON DRAWINGS.

- A. Do not install piping sized smaller than the unit drain connection size.

3.3 SECONDARY DRAINS

- A. Provide secondary drains where required by code, shown on the drawings, or where equipment has secondary drain connections.
- B. Provide secondary drain line to approved location whenever possible.

END OF SECTION

**SECTION 23 05 17
HVAC ACCESS DOORS**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install access doors in wall or ceiling locations as required or shown for access to valves, controls, fire dampers, air distribution devices and other equipment requiring maintenance, adjustment or operation.

PART 2 - PRODUCTS

2.1 NON-FIRE RATED ACCESS DOORS

- A. 16-Gauge frames
- B. 14-gauge steel panels
- C. Continuous fully concealed hinges
- D. Flush screwdriver cam lock & cylinder lock for Owner selection
- E. Automatic closing and latching mechanism
- F. Prime coat finish
- G. Brushed satin stainless steel finish for restroom, kitchen or cafeteria installation
- H. Material suitable for wall and/or ceiling mounting

2.2 FIRE RATED ACCESS DOORS

- A. UL listed, 1-1/2 hour Label "B", access doors
- B. 16-Gauge stainless steel
- C. 20-Gauge insulated sandwich-type door panel.
- D. Two inch thick with fire rated insulation
- E. Continuous fully concealed hinge
- F. Automatic closing and latching mechanism
- G. Knurled knob and recessed key operation for Owner selection
- H. Interior latch release slide for opening from inside
- I. Prime coat finish
- J. Material suitable for wall and/or ceiling mounting

2.3 ACCEPTABLE MANUFACTURERS

- A. Milcor
- B. MIFAB
- C. Acudor
- D. Elmdor

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Access doors specified in Division 23 will be installed by other crafts. Not all required access doors are shown. Coordinate with the Contractor to locate access doors for ease of operation and maintenance of concealed equipment.
- B. Installation shall be in accordance with the manufacturer's printed instructions.
- C. Minimum size required:
 - 1. 36" x 24" for Mechanical HVAC equipment related items
 - 2. 18" x 18" for electrical related items
 - 3. 12" x 12" minimum for Fire and Smoke dampers

END OF SECTION

SECTION 23 05 18
VARIABLE FREQUENCY INVERTER

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install a variable frequency inverter for the following equipment items.
 - 1. Variable Volume Air Handling Units.

1.2 RELATED WORK

- A. Division 23 Mechanical
 - 1. Electrical Provisions of Mechanical Work.
 - 2. Air Handling Units
 - 3. Building Management Control System Sequences

1.3 COOPERATION WITH OTHER TRADES

- A. Coordinate this work with work under Division 26 Electrical to ensure that intended functions are achieved.
- B. Coordinate the size of the variable frequency inverter with the equipment being served by the inverter. The rated current output amps are to be equal to or greater than motor rated full load amps.

1.4 SUBMITTALS

- A. Submit manufacturer's information and shop drawings as specified.
 - 1. Complete technical details.
 - 2. Dimensions and manufacturer's installation manual.
 - 3. Schematic diagrams of the circuitry and field connections.
 - 4. Manufacturer's start-up manual.

1.5 STANDARDS

- A. UL.
- B. CSA.
- C. ISO 9001
- D. NEC
- E. FCC

1.6 WARRANTY

- A. Provide a three year parts and labor warranty from date of Substantial Completion. Provide warranty in writing to Owner and HVAC supervisor with applicable warranty coverage dates.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. ABB
- B. Danfoss Graham
- C. Yaskawa

2.2 CABINET

- A. The inverter and all accessories shall be provided within a wall mounted UL Listed NEMA 1 enclosure in interior AHU mechanical rooms and in NEMA 12 enclosure with deadsides and removeable, gasketed doors with provisions for locking in all Plant locations and pump rooms. Cabinet shall be constructed of metal for reduction of radio

frequency interference (RFI) and electromagnetic frequency interference.

2.3 INTERFERENCE WITH OTHER SYSTEMS

- A. The inverter shall be designed and constructed to comply with IEEE Standard 519-1993 with respect to line noise and RFI generation. All units shall generate less than 3% total harmonic distortion back to the incoming power line at the point of common connection with sensitive equipment. A harmonic analysis shall be submitted with the approval drawings to verify compliance with the latest version of IEEE-519 voltage and current distortion limits as shown in Table 1.2 and 10.3 at the point of common coupling (PCC). The PCC shall be defined as the consumer-utility interface or primary side of the main distribution transformer.
- B. Dual DC Bus filtered chokes (factory installed and wired in the drive enclosure) equivalent to 5% input line reactors shall be provided to minimize harmonics reflected onto the input line.
 - 1. Shall not interfere with computer and other electronic systems in the building.
 - 2. If not inherently protected, provide a suitable isolation transformer.
 - 3. The system shall not produce spikes on the incoming line.
- C. Any inverter that generates sufficient electrical line noise to interfere with the operation of sensitive building equipment shall be field modified or replaced by the inverter supplier at no additional cost to the Owner.

2.4 PROTECTIVE CIRCUITS

- A. Provide the following protection:
 - 1. Input line fuses or molded case circuit breaker rated at 100 AIC.
 - 2. Input line noise suppression with MOV's (metal oxide varistors) and snubber circuits. MOV's shall be provided across incoming line terminals, AC input reactors, DC choke filters, and transistors to protect inverter from voltage surges and spikes.
 - 3. Protection of solid state inverter devices by limiting output current to 110% of inverter rating, automatically prevent overcurrent trip due to momentary overload conditions.
 - 4. Current limiting DC buss fuse between input and output sections of inverter.
 - 5. Input overvoltage trip.
 - 6. Input undervoltage (-12%) trip.
 - 7. Instantaneous overcurrent protection of solid state inverter devices.
 - 8. Individual overcurrent protection of solid state inverter devices.
 - 9. Output overvoltage trip.
 - 10. Loss of input phase, phase reversals, or blown fuse.
 - 11. Thermal overload trip for overload protection of solid state devices.
 - 12. Ground fault protection on start-up.
 - 13. Output line to line short circuit protection.
 - 14. Phase to phase short circuit or severe overload conditions of output.
 - 15. Overload of motor.
 - 16. Frequency stall.
 - 17. DC buss high voltage.
 - 18. Control function error.
 - 19. Heatsink over temperature (Max. operating ambient: 122 degrees F)
 - 20. Controller able to operate without a motor or any other equipment connected to the output (To facilitate startup and troubleshooting).
 - 21. Capable of restarting into a rotating motor without component damage.
 - 22. Shut down safely without component failure in the event of a sustained power

- loss, and will automatically return to normal operation, if start is "on" and power is restored.
23. Shut down safely without component failure in the event of a momentary power loss. Automatically return to normal operation if the start is "on", and normal power is restored. Capable of establishing speed control without shutdown or component failure.
 24. Designed for input power contactor opening or closing while control is activated, without damage to the controller.
 25. Automatically reset trip resulting from overcurrent, undervoltage, overvoltage, or over temperature, and automatically restart after removal, or correction of the faulty condition.
 26. Provide status lights or digital display for indication of failure conditions, and form C relay provided for remote indication. Digital display or status lights to indicate power on, at speed, and drive enabled.
 27. Operation and fault diagnostic function circuits shall be built into each inverter that provides information in determining the cause and source of a fault.
Diagnostics to provide the following information:
 - a. Operating mode at trip (Accel, Decel, Constant speed).
 - b. Output current at trip.
 - c. Output voltage at trip.
 - d. Additional faults that occurred simultaneously or immediately before displayed tripped.Any drive requiring separate card to provide this information shall provide a diagnostic card for each drive.
 28. DC link reactor.
 29. Input power disconnect, lockable type.
 30. Input power disconnect switch / circuit breaker, with lockable type handle.

2.5 OPERATOR DEVICES

- A. The following operator devices shall be door or remote mounted:
 1. Digital keypad and LCD provided to perform all parameter adjustments, operation monitoring, and operation programming.
 2. Power on indication light.
 3. Flush mounted meters or digital display to indicate output voltage, output frequency, and output current, in percent of maximum 0 to 100%.
 4. Manual/Off/Auto 3 position selector switch (hand-off-auto) and manual speed setting control to provide the following control sequences:
 - a. In automatic mode, controller shall follow an external control signal and respond to remote start-stop contact.
 - b. In manual (hand) mode, controller shall follow speed signal set via door mounted keypad and start/stop switch. Switching from "hand" to "auto" and vice versa shall require a single keystroke to a dedicated changeover key. Inverters requiring multiple keystrokes and/or reprogramming of internal parameters to accomplish changeovers are not acceptable.
 - c. An integral "safety interlock" protection shutdown circuit shall be provided for interface with firestats, smoke detectors, high static pressure limit switches, vibration switches, etc.
 5. Programmable lockout code to prevent unauthorized programming.
 6. Critical frequency avoidance capability (up to 3 resonant points).

2.6 FIELD ADJUSTMENTS

- A. The following shall be adjustable in the field:
1. Maximum Speed: 0 to 125% adjustable.
 2. Minimum Speed: 0 to 100% adjustable.
 3. Acceleration/deceleration rates: 0 to 3600 sec.
 4. Instantaneous overcurrent trip: 50% to 2000%.
 5. Volts/hertz ratio: Field adjustable to 16 patterns or set for automatic selection of proper V/F load profile to operate motor without overdriving or overloading.
 6. Current limit circuit: 60 to 100%.
 7. Carrier frequency: 6 to 16 KHZ.
 8. Control interface: selectable to follow a 0-5 VDC, 0-10 VDC, 4-20 MA, either direct or indirect acting.
 9. Control signal Bias: 0 to 80 HZ.
 10. Control signal gain: 0 to 80 HZ.
 11. Calibration of remote speed signal: 0 to 80 HZ.

2.7 ELECTRICAL CONSTANT SPEED BYPASS

- A. Provide all components and circuitry necessary to provide manual bypass of the inverter. The bypass package shall be mounted in a cabinet common with the inverter and shall be constructed in such a manner that the inverter can be removed for repair while still operating the motor in the "bypass" mode. Manual bypass shall contain the following:
1. Two contactors mechanically interlocked via a three position through the door selector switch to provide the following control:
 - a. "Inverter" Mode connects the motor to the output of the inverter.
 - b. "Bypass" Mode connects the motor to the input sine wave power.
Transfer must occur with input disconnect open. Motor is protected via thermal overload.
 - c. "Off" Mode disconnects motor from all input power.
 2. A molded case circuit breaker or fused disconnect switch with door interlocked handle (lock out type) that interrupts input power to both the bypass circuitry and the drive.
 3. An input contactor, interlocked with both the thermal motor overload and external safeties which disconnects power to the motor regardless of the mode of operation (either "inverter" or "bypass" mode).
 4. A thermal overload to provide protection of motor in the bypass mode.
 5. A safety interlock circuit that disconnects power to the motor (regardless of the mode of operation – "inverter" or "bypass") in response to a signal from the thermal overload and/or external safety circuits.
 6. Line voltage to 24 volt DC power source, fused per NEC, shall provide power to all bypass control circuits.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation as per manufacturer's recommendations and requirements.
1. Inverter chassis is properly grounded.
 2. Line, Load, Control, and Fire/Safety wiring are installed in separate conduits.
 3. Length of wire between Motor and Variable frequency drive shall not exceed 100 feet.
 4. Install all electrical and control conduit into the bottom only of VFD cabinet. (No top or side cabinet penetrations)

3.2 MANUFACTURER START-UP SERVICE

- A. Factory trained personnel shall be provided for start-up assistance, minimum (1) day per unit.
 - 1. The manufacturer shall provide start-up commissioning of the VFD and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. Sales personnel and other agents who are not factory certified shall not be acceptable as commissioning agents.
 - 2. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system.
 - 3. Adjustable devices, components, and assemblies to assure optimum performance.
 - 4. Make final adjustments to the installed drive to assure proper operation of the fan system. Obtain performance requirements from installer of driven loads.
 - 5. Assistance will be provided to the Owner (upon request) to determine the optimum capacitance for per factory correction and avoidance of potential resonance problems and will determine optimum line filter required.
 - 6. A written report, duly signed by the technician detailing set points of adjustable devices, amperages recorded, and any other pertinent data. This information is to be included in the operation and maintenance manual.
- B. Input DC voltage to dry motor windings when motor is not in operation at all locations.

3.3 DEMONSTRATION AND TRAINING

- A. Provide system demonstration to personnel, Owner, and/or Owner's selected representatives. Provide training plan in writing to owner.
- B. Demonstrate operation of controllers in the automatic and manual modes.
- C. Provide a minimum of two days of technical training for the owner's operating and technical staff. Schedule training with Owner's authorized representatives, during normal business hours and not less than 30 days prior to planned session.
- D. Training may be consecutive or random, at Owner's option.

END OF SECTION

SECTION 23 05 19
HVAC PRESSURE AND TEMPERATURE INSTRUMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This section specifies gauges, thermometers, wells and/or pressure and temperature test stations to be installed as specified.

1.2 RELATED WORK

- A. Division 23, Mechanical
 - 1. 23 05 00 - Mechanical General Provisions
 - 2. 23 20 00 - Pipe and Pipe Fittings, General
 - 3. 23 05 23 - Valves, Strainers and Vents
 - 4. 23 21 13 - Hot Water and Chilled Water Piping, Valves and Appurtenances

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - GAUGES AND THERMOMETERS

- A. Trerice
- B. Taylor
- C. Marsh
- D. Weksler
- E. Marshalltown
- F. Weiss
- G. Miljoco

2.2 PRESSURE GAUGES

- A. Case and Ring: 4" type 304 stainless steel; liquid filled case with stainless steel bayonet ring.
- B. Dial: White aluminum with black markings
- C. Window: Clear acrylic
- D. Tube: Phosphor bronze and forged brass socket.
- E. Gauge accuracy: +/- 1% over operating range.
- F. For pulsating service, provide impulse dampers.
- G. Without flange for pipe mounting.
- H. With flange for wall mounting.
- I. Weiss Model: LF44S-1B or equal.

2.3 THERMOMETER WELLS

- A. Brass or type 300 stainless steel. Machined bar stock, 1-piece construction.
- B. Where installed in insulated piping or vessels, provide with extension neck to match insulation thickness.
- C. Provide metal-to-metal contact with bulb chamber for maximum sensitivity.
- D. Wells shall be sized to extend a minimum of 50% into pipe.

2.4 THERMOMETERS IN PIPING SYSTEMS OR VESSELS

- A. Die cast aluminum case with baked epoxy finish.
- B. Adjustable angle 9" scale length.
- C. Clear acrylic window.
- D. Brass stem, length to match well.
- E. Red reading organic spirit filled-in magnifying glass column.
- F. White background with black figures and markings.

- G. Brass stems and union connections.
- H Accuracy: +/- 1% of scale range.
- I. Range:
 - 1. Hot water lines: 30°F to 240°F.
 - 2. Chilled water lines: 0°F to 100°F or 120°F

2.5 PRESSURE AND TEMPERATURE TEST STATIONS

- A. "Test Station" fitting to receive either a temperature or pressure probe. Fitting shall be solid brass with two valve cores of Nordel.
 - 1. Fitted with a color coded cap strap with gasket.
 - 2. Acceptable Manufacturer: Peterson Equipment Company.
 - 3. Provide with extension neck to match insulation thickness.
- B. Provide to the Owner a fitted case with:
 - 1. Two 0-100 psi pressure gauges as specified and adapters with 1/8" OD probe.
 - 2. Four 5" stem pocket testing thermometers.
 - a. Two with range 25°F to 125°F for chilled water and condenser water.
 - b. Two with range 0°F to 220°F for hot water.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with drawing details and manufacturer's recommendations.
- B. Provide a ball valve at each gauge.
- C. Locate gauges and thermometers to be easily readable from the floor at a 5'-6" eye level. Use adjustable angle or rigid stem as required. Install gauges in upright position.
- D. Install gauges in the following locations: across pumps, chiller cooler and condenser, storage tanks, heat exchangers.
- E. Test wells for automatic temperature controls shall be furnished by Building Management Control Section and installed by Mechanical Contractor.
- F. Install thermometer in the following locations: Across chiller cooler and condenser, storage tanks, across heat exchangers, across boiler, leaving side of water heater, leaving water side of tempered water valves, common chilled and hot water lines.
 - 1. Hot water lines: 30°F to 240°F.
 - 2. Chilled water lines: 0°F to 100°F or 120°F

END OF SECTION

SECTION 23 05 23
HVAC VALVES, STRAINERS AND VENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. HVAC Valves
- B. Pipe strainer and suction diffusers.

PART 2 - PRODUCTS

2.1 VALVES

- A. Pressure Ratings:
 - 1. Unless otherwise indicated, use valves suitable for 125 minimum psig working steam pressure (WSP) and 450°F.
 - 2. The pressure temperature rating of valves shall be not less than the design criteria applicable to components of the system.
- B. Butterfly Valves
 - 1. Butterfly valves shall conform to MSS-SP67.
 - 2. Liners, inserts and discs shall be suitable for the intended service.
 - 3. Valves shall have a full lug type body designed for installation between ANSI standard flanges, and shall be rated at full working pressure with downstream flange removed.
- C. Balancing Valves
 - 1. Provide balancing valves with:
 - a. Corrosion resistant plug with resilient seal when required.
 - b. O-ring stem seal.
 - c. Permanently lubricated, corrosion resistant bearings.
 - 2. Connections
 - a. Through 2" pipe size use threaded connections.
 - b. For valves 2-1/2" pipe size and larger shall be provided with 150 psig flange connections.
 - 3. Provide each valve with:
 - a. Memory stop.
 - b. Plastic drip cap.
 - c. 1/8" gauge tap.
- D. Ball Valves
 - 1. Provide ball valves with:
 - a. Blowout proof stem.
 - b. Full size port, 316 stainless steel ball and stem.
 - c. Cast bronze body.
 - d. Threaded ends.
 - 2. Seat, seals, thrust washers and packing shall be suitable for the intended service.
 - 3. Service rating:
 - a. 150 psi saturated steam.
 - b. 600 psi WOG.
 - 4. Where piping is insulated, ball valves shall be equipped with 2" extended handles of non-thermal conductive material. Provide a protective sleeve that allows operation of the valve without breaking the vapor seal or disturbing the insulation.
 - 5. Provide with memory stop for balancing valves.
- E. Valve Connections
 - 1. Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use pipe size valves. Sweated joints are not allowed.

2. Thread pipe sizes 2" and smaller.
 3. Flange pipe sizes 2-1/2" and larger.
 4. Use screw to solder adapters for copper tubing.
 5. Use grooved body valves with mechanical grooved jointed piping.
- F. Valve Operators
1. Where butterfly valves are provided:
 - a. Provide gear operators on valves 6" and larger.
 - b. Where valves are located 7' or more above the finished floor in equipment room areas provide chain-operated sheaves. Extend chains to about 5' above floor and hook to clips, arrange to clear walking space.
 - c. Lever lock handle with toothed plate for shut-off service and infinitely adjustable handle with lock and nut and memory stop for throttling service on valves 4" and smaller.
 - d. Provide worm gear operators on discharge side of pumps for balancing, for all sizes of valves.
 - e. All valves 2-1/2" and larger provided by Milwaukee Valve shall be provided with gear operators.
- G. Acceptable Manufacturers
1. Dezurik
 2. Crane
 3. Nibco
 4. Keystone
 5. Kitz (Hot Water Only)
 6. Milwaukee Valve
 7. Keckley
- H. Check Valves
1. Bronze body, 2" and smaller, bronze disc (Teflon disc for steam service), regrinding swing check, screw-in cap, threaded connection.
 2. Iron body, 2-1/2" and larger, bronze trim, non-slam: stainless steel pins and springs, and bronze plate or bronze mounted, regrind-renew check, bronze seat ring and disc. Provide either wafer or threaded lug.
 3. Acceptable Manufacturers
 - a. Mission Duocheck
 - b. Nibco
 - c. Keystone
 - d. Milwaukee Valve
 - e. Keckley
- K. Provide valves of same manufacturer throughout where possible.
- L. Provide valves with manufacturer's name and manufacturing location, duty and pressure rating clearly marked on outside of body.
- M. Where valves are installed in insulated piping, provide with extended neck so valve operator and stop plate clears the full thickness insulation.
- N. Provide valve, seat and trim materials suitable for the intended service.
- O. Provide memory stops for all valves used for throttling service. Valves for throttling service shall be butterfly, plug, caged or ball type.

2.2 PIPE SYSTEMS STRAINERS

- A. Body:
1. "Y" pattern or basket as shown on the drawings.
 2. Line size.
 3. Threaded strainer blow down port.

4. ASTM A #126 Class B Cast Iron Body.
- B. Construction:
 1. 2" size and smaller with screw connections rated 400 psi WOG.
 2. Over 2" size with flanged connections, rated 125 psi WOG.
- C. Fabricate screens of Monel or type 304 stainless steel:
 1. With 20 mesh woven wire in piping systems through 2".
 2. With 0.045 perforations in piping systems 2-1/2" and 3".
 3. With 0.125 perforations in piping systems 4" and larger.
- D. Start-up:
 1. Provide an additional fine mesh disposable screen for use during start-up operations.
 2. Remove after 30 days.
 3. Attach to piping for owners review.
- E. Acceptable Manufacturers
 1. Crane
 2. Zurn
 3. Mueller
 4. Armstrong
 5. Bell & Gossett
 6. Keckley

2.3 SUCTION DIFFUSER

- A. For each pump as shown on the drawing, provide an angle type suction diffuser. Body is to fit both the pump inlet and suction pipe size.
- B. Components:
 1. Inlet straightening vanes.
 2. Removable end cap.
 3. Gauge ports.
 4. Threaded strainer blow down port.
 5. Adjustable support foot.
 6. Removable magnetic insert.
- C. The screen shall be as specified for pipe system strainers.
- D. Provide an additional fine mesh disposable strainer for use during start up operations.
 1. Remove after 30 days operation and all flushing is complete.
 2. Attach to piping for owners review.
- E. Construction:
 1. 2" size and smaller with screw connections rated 400 psi WOG.
 2. Over 2" size with flanged connections, rated 125 psi WOG.
- F. Fabricate screens of Monel or type 304 stainless steel:
 1. With 20 mesh woven wire in piping systems through 2".
 2. With 0.045 perforations in piping systems 2-1/2" and 3".
 3. With 0.125 perforations in piping systems 4" and larger.

2.4 VALVE SCHEDULE

- A. Hydronic Service
 1. Chilled Water Service
 - a. Ball Valves up to 2": Nibco T-585-70-66 w/Nib-Seal insulated Handle
 - b. Butterfly Valve 2-1/2" and larger: Nibco LD - 2000
Keystone Figure 222
 2. Heating & Condenser Water Service
 - a. Ball Valves up to 2": Nibco T-585-70-66
 - b. Butterfly Valve 2-1/2" and larger: Nibco LD - 2000

Keystone Figure 222

3. Check Valve:
 - a. Nibco Check Valve: T - 413 - B
 - b. Nibco Check Valve 2-1/2" and larger: F - 918 - B
 - c. Nibco Check Valve 2-1/2" and larger: W - 920 -W (Wafer)
 - d. Keystone Check 2-1/2" and larger: FIQ 810

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install valves with stems upright or horizontal, not inverted.
- B. Install valves for shut-off and isolating service at each piece of equipment, at vertical risers, and where shown on the drawings.
- C. Use butterfly valves and ball valves in circulating water systems, for balancing duty. Provide infinite position gear operator with memory stop.
- D. Provide drain valves at main shut-off valves and low points of piping and apparatus so the systems can be entirely drained.
 1. 1" valve for pipes 6" and larger.
 2. 3/4" valve for pipes smaller than 6".
 3. Terminate with pipe plug.
 4. Drain valves shall be ball valves.
- E. Where valves are installed in insulated pipe, valve operator shall have an insert so the lever or handle will not damage the insulation. Install handles so the lever or handles will not damage the insulation.
- F. Provide clearance for installation of insulation and access to valves.
- G. Provide access where valves are not exposed.
- H. Float valves / stilling wells provided and installed in cooling tower or condenser water basins for water level control. Stilling wells provided around float to prevent turbulence ripples or wind from interference.

3.3 PIPE SYSTEMS STRAINERS

- A. Provide an additional fine mesh disposable strainer for use during start up operations.
 1. Remove after 30 days operation and all flushing is complete.
 2. Attach to piping for owners review.
- B. Provide strainer in supply piping for all coil connections.
- C. Provide strainer in condenser water piping outside near pump and after pump discharge.

3.4 WATER SYSTEM AIR VENTS

- A. Provide manual air vents at high points and at any other air pockets of closed circulating pipe systems. Extend 3/8" hard drawn copper tubing discharge drains to nearest floor or hub drain. Provide 1/4" Ball Valve as specified.
- B. Where high point vents are not readily accessible provide additional valves at vent termination.

END OF SECTION

**SECTION 23 05 33
HVAC PIPE HEAT TRACING**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install a complete industrial, constant wattage, UL listed system of electric pipe heat tracing and controls on all make-up water piping outdoors above grade to prevent freezing. The heat tracing system shall conform to ANSI/IEEE Standard 515-1989.
- B. Protect the pipe, valves, fittings, meters and appurtenances. Apply sufficient cable and overheat thermostat to protect the entire system.

1.2 SUBMITTALS

- A. Submit shop drawings and product data as specified in Section 23 05 12
- B. Submit detailed calculations for length of heat tracing cable per foot of pipe, based on actual length of piping installed.
- C. Submit manufacturer's certified capacity charts with selections plotted thereon.
- D. Submit manufacturer's installation instructions.
- E. Submit full load ampere requirement and voltage for branch circuit.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Raychem Corporation
- B. Thermon Manufacturing Company

2.2 COMPONENTS

- A. Self-regulating heater.
 - 1. The self-regulating heater shall consist of two 16 AWG tinned-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature all along its length, allowing the heater to be crossed itself without overheating and to be cut in the field. The heater shall be covered by a radiation cross-linked modified polyolefin dielectric jacket.
 - 2. In order to provide energy conservation, and to prevent overheating, the heater shall have a self-regulating factor of at least 90%.
 - 3. The heater shall operate on a line voltage of 120 VAC without the use of transformers.
 - 4. The heater shall be sized according to the following. The required heater output rating is in watts per foot at 50°F (heater selection based on 1-1/2 inch fiberglass insulation on metal piping).
 - 5. The heater shall be XL-Trace as manufactured by Raychem Corporation or XL-Econotrace as manufactured by Thermon Manufacturing Company.
 - 6. Power connection, end seal, splice and tee kits components shall be applied in the field.
 - 7. The system shall be controlled by an ambient sensing thermostat set at 40°F either directly or through an appropriate contactor.
 - 8. Provide an end-of-circuit voltage indicating light

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install and start up the pipe heat tracing system in accordance with the manufacturer's Installation, Start-up and Service Instructions.
- B. Install the pipe heat tracing cable under the pipe insulation.
- C. Apply "Electrically Traced" signs to the outside of the thermal insulation.
- D. Ground fault protection of the equipment shall be provided per the 1996 National Electrical Code, Article 427-22.
- E. Provide a cast aluminum weatherproof NEMA-4 rated junction box for installation of the cable, with pilot light to indicate operation of the cable.
- F. Use only electrical components as recommended by the manufacturer.

3.2 ELECTRICAL WORK

- A. Furnish and install the wire, conduit and raceway systems required for the automatic operation of the pipe heat tracing system. Conform to the National Electrical Code.
- B. The specified wiring work includes:
 - 1. Wiring of control instruments between thermostat and junction boxes
 - 2. Installation of thermostat and junction boxes
 - 3. Wiring from the heat tracing cable to the junction boxes
- C. Related branch circuit power wiring from the junction box to ground fault type circuit is specified to be provided in Division 26.
- D. Provide devices and appurtenances as specified in Division 26.
- E. Identify each circuit at each terminal with a separate tag.
- F. Color code wires in accordance with IPCEA Standards.
- G. Make all joints and connections with approved mechanical connectors.

3.3 TESTING OF THE PIPE HEAT TRACING SYSTEM

- A. Test the pipe heat tracing system:
 - 1. Simulate freezing outside air conditions
 - 2. Measure the amperage draw of the heat tracing system
 - 3. Compare to the manufacturer's capacity rating of the actual system
 - 4. After installation and before and after installing the thermal insulation, subject heat to testing using a 1000 VDC megger. Minimum insulation resistance should be between 20 to 1000 megohms regardless of the length.
- B. Submit records of test for approval prior to substantial completion; insert in the Owner's Manual.

END OF SECTION

SECTION 23 05 48
VIBRATION ISOLATION

PART 1 - GENERAL

1.1 SCOPE

- A. Furnish, install, and adjust vibration isolation.

1.2 RELATED WORK

- A. Division 23 Mechanical.
 - 1. Refer to the Section on Ductwork for flexible connections between fans and ducts.
 - 2. Refer to the Section on Equipment Supports for equipment foundation pads.

1.3 SUBMITTALS

- A. Submit product data showing type, size, load, deflection and other information required. Include clearly outlined procedures for installing and adjusting isolators.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Amber Booth
- B. Kinetics
- C. Mason
- D. Korfund
- E. VSI.
- F. Vibration Eliminator Co., Inc.
- G. Metraflex

2.2 ISOLATOR TYPES

- A. Neoprene mountings shall have a minimum static deflection of 0.35 inches (9mm). All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Bolt holes shall be provided on the bottom and a tapped hole and cap screw on top. Steel rails shall be used above the mountings under equipment such as small vent sets to compensate for the overhang.
- B. Hangers shall consist of rigid steel frames containing minimum 1-1/4 inch (32mm) thick neoprene elements at the top and a steel spring with general characteristics as in specification B 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.
- C. Flexible spherical expansion joints shall employ Peroxide cured EPDM in the covers, tubes and frictioning of the reinforcement. Reinforcement must be DuPont Kevlar. Solid steel rings shall be used within the raised face rubber ends to prevent pullout. No substitutions for the DuPont Kevlar or the solid steel embedded flange rings are acceptable. Sizes 2 inch (50mm) and larger shall have two spheres reinforced with a metal ring between spheres to maintain shape and complete with split ductile iron or steel flanges with hooked or similar interlocks. Sizes 16 inch (400mm) to 24 inch (600mm) may be single sphere. Sizes 3/4 inch (20mm) to 1-1/2 inch (40mm) may have threaded bolted flange assemblies, one sphere and cable retention. 14 inch (300mm) and smaller connectors shall be rated at 250 psi (17 BAR) up to 190°F (88°C) with a uniform drop in allowable pressure to 190 psi (13 BAR) at 250°F

(121°C). 16 inch (400mm) and larger connectors are rated 180 psi (12 BAR) at 190°F (88°C) and 135 psi (9 BAR) at 250°F (121°C). Safety factors to burst and flange pullout shall be a minimum of 3/1. All joints must have permanent markings verifying a 5 minute factory test at twice the rated pressure. Concentric reducers to the above specifications may be substituted for equal ended expansion joints.

High pressure joints shall be substituted for the above where operating pressures are higher than standard. Expansion joints shall be installed in piping gaps equal to the length of the expansion joints under pressure. Control rods need only be used in unanchored piping locations where the manufacturer determines the installation exceeds the pressure requirement without control rods. Control rods are not desirable in seismic work. If control rods are used, they must have 1/2- inch (12mm) thick Neoprene washer bushings large enough in area to take the thrust at 1000 psi (6.9 N/mm²) maximum on the washer area. Standard diameter bolt washers are not acceptable.

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. All expansion joints shall be installed on the equipment side of the shut off valves.

Flexible expansion joint device shall be provided with a 5-year warranty against leaks and failure.

2.3 ISOLATOR APPLICATION

EQUIPMENT	ISOLATOR TYPE	MINIMUM DEFLECTION
Chiller	A	0.35"
Pump	B	1.5"
Condensing Units	A	0.35"
In-Line Fans	B	0.5"

2.4 PIPING ISOLATOR APPLICATIONS

EQUIPMENT	ISOLATOR TYPE
Floor Mounted Pumps	C
Chiller Pipe Connections	C
Suspended Pumps	C

2.5 FLEXIBLE CONNECTIONS IN PIPING AT PUMPS

- A. Provide flexible connections at suction and discharge of chilled water, and hot water pumps, piping connections on chillers and where indicated on drawings. Refer to schedule above.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Stock Requirements. The isolation manufacturer's representative shall maintain an adequate stock of springs and isolators of type used so that changes required during construction and

- installation can be made.
- B. **Factory Representation.** After installation, furnish factory-trained representative of the isolation manufacturer to check various isolators and report measured versus anticipated deflection on all isolators. Have the representative certify that isolators have been installed in accordance with manufacturer's recommendations and approved submittals. Provide written report to Engineer indicating compliance prior to final acceptance.

END OF SECTION

SECTION 23 05 93
TESTING, BALANCING AND ADJUSTING (TAB) OF ENVIRONMENTAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Balance, adjust and test the air distribution system including the exhaust system.
- B. Balance, adjust and test the hydronic system.
- C. Verify and record the duct test results performed by the mechanical contractor.

1.2 RELATED SECTIONS

- A. COORDINATION OF TESTING AND BALANCING

1.3 PAYMENT PROCEDURES

- A. The work of this Section of the Specifications shall be paid directly by the Owner.

1.4 SUBMITTALS

- A. History of the TAB organization.
- B. Agency certification.
- C. Personnel qualifications.
- D. TAB data forms.
- E. Instrumentation list.
- F. Name of the project supervising engineer.
- G. Name and address and contact person of five successfully completed projects of similar size and scope.
- H. To perform required professional services, the balancing agency shall have a minimum of one test and balance engineer certified by the Associated Air Balance Council.

1.5 TAB FIRM QUALIFICATIONS

- A. The organization performing the work shall be a Certified member in good standing of the (AABC) Associated Air Balance Council.
- B. Able to furnish evidence of having contracted for and completed not less than five systems of comparable size and type that have served their Owners satisfactorily for not less than five years.
- C. A specialist in this field and have the personnel, experience, training, skill, and the organization to perform the work.
- D. The balancing agency shall furnish all necessary calibrated instrumentation to adequately perform the specified services. An inventory of all instruments and devices in possession of the balancing agency may be required by the engineer to determine the balancing agency's performance capability.
- E. The balancing agency shall have operated for a minimum of five years under its current name.
- F. Personnel:
 - 1. The project supervisor shall be a Professional Engineer registered in Texas.
 - a. Extensive knowledge of the work involved.
 - b. At least five years experience conducting tests of the type specified.
 - c. This test and balance engineer shall be responsible for the supervision and certification of the total work herein specified.
 - 2. All work shall be conducted under the direct supervision of the supervising engineer.
 - 3. Technicians shall be trained and experienced in the work they conduct.

1.6 WARRANTY

- A. Provide (AABC) guarantee in writing.
- B. Extended warranty.
 - 1. Include an extended warranty of 2 years after completion of test and balance work, during which time the Architect/Engineer may request a retest or resetting of any outlet or other items as listed in the test report.
 - 2. Provide technicians and instruments to assist the Architect/Engineer in making any tests he may require during this period.
 - 3. The balancing agency shall perform an inspection of the HVAC system during the opposite season from that which the initial adjustments were made. The balancing agency shall make any necessary modifications to the initial adjustments to produce optimum system operation.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 TAB TOLERANCES

- A. The water, outside air, supply air, return air, and exhaust air for each system shall be adjusted to within +/- 5% of the value scheduled on the drawings.

3.2 SITE VISITS

- A. During construction, the balancing agency shall inspect the installation of the piping systems, sheetmetal work, temperature controls, energy management system, and other component parts of the heating, ventilating, and air conditioning systems. One inspection shall take place when 60% of the ductwork is installed and another inspection shall take place when 90% of the equipment is installed. The balancing agency shall submit a brief written report of each inspection to the architect and engineer.
- B. Upon completion of the installation and start-up of the mechanical equipment by the mechanical contractor, the balancing agency shall test and balance the system components to obtain optimum conditions in each conditioned space of the building. If construction deficiencies are encountered that preclude obtaining optimum conditions, and the deficiencies cannot be corrected by the mechanical contractor within a reasonable period of time, the balancing agency shall cease testing and balancing services and advise the architect, engineer, general contractor and owner, in writing, of the deficiencies.
- C. Note proper piping installation, location of valves, and flow measuring instruments.
- D. Make one series of visits, phased as required by construction progress, prior to installation of the ceiling. Note proper installation of balancing dampers.
- E. Continue the site visits up to completion of project. In each succeeding report, list corrections made from previous reports.

3.3 TESTING INSTRUMENTS

- A. Submit a list of all instruments to be used for the test and balance procedures.
 - 1. Catalog sheets
 - 2. Certificate of last calibration
 - 3. Calibration within a period of six months prior to balancing
- B. Testing equipment shall be in good working order and tested for accuracy prior to start of work.

3.4 COORDINATION WITH OTHER SPECIFICATION SECTIONS

- A. Review the related ductwork shop drawings and piping shop drawings. Make recommendations concerning suitability with respect to the testing, balancing and

- adjusting work.
- B. Make tests to verify proper placement of the static pressure sensors for the variable air volume fan system control.
 - C. In cooperation with the work specified in Building Management and Control System section, a systematic listing of the testing and verification shall be included in the final TAB report. The TAB firm shall provide a laptop computer to operate with the Building Management and Control System. Building Management and Control System shall provide all necessary software and special interface cables, as required, to communicate with the DDC system:
 - 1. Work with the temperature control contractor to ensure the most effective total system operation within the design limitations, and to obtain mutual understanding of the intended control performance.
 - 2. Verify that all control devices are properly connected.
 - 3. Verify that all dampers, valves, and other controlled devices, are operated by the intended controller.
 - 4. Verify that all dampers and valves are in the position indicated by the controller (open, closed or modulating).
 - 5. Verify the integrity of valves and dampers in terms of tightness of close-off and full open positions. This includes dampers in multizone units, terminal boxes and fire/smoke dampers.
 - 6. Observe that all valves are properly installed in piping system in relation to direction of flow and location.
 - 7. Observe the calibration of all controllers.
 - 8. Verify the proper application of all normally opened and normally closed valves.
 - 9. Observe the locations of all thermostats and humidistats for potential erratic operation from outside influences such as sunlight, drafts or cold walls.
 - 10. Observe the location of all sensors to determine whether their position will allow them to sense only the intended temperatures or pressures of the media. Control contractor will relocate as deemed necessary by the Engineer.
 - 11. Verify that the sequence of operation for any control mode is in accordance with the approved shop drawings and specifications. Verify that no simultaneous heating and cooling occurs.
 - 12. Verify the correct operation of all interlock systems and installation is per the manufacturer recommendations.
 - 13. Check all dampers for free operation.
 - 14. Verify that all controller setpoints meet the design intent.
 - 15. Perform variable volume system verification to assure the system and its components track with changes from full flow to minimum flow.
 - D. Upon completion of the testing and balancing, submit three days prior notice that the systems are ready for a running test. A qualified representative of the test and balance organization shall be present, with a representative from the engineers office, to field verify TAB report readings. Specific and random selections of data recorded in the certified test and balance report will be reviewed.

3.5 INSTRUMENT TEST HOLES

- A. When it is required to make holes in the field to measure temperature, static pressure or velocity in the ducts:
 - 1. Drill holes, plug and tape external duct insulation.
 - 2. Repair damaged insulation to Engineer's approval.

3.6 TESTING THE AIR DISTRIBUTION SYSTEM

- A. The TAB agency shall verify that all ductwork, dampers, grilles, registers, and diffusers have been installed per design and set full open. The TAB agency shall perform the following TAB procedures in accordance with the AABC National Standards and all results shall be recorded in the TAB report:
1. Supply Fans:
 - a. Fan speeds: Test and adjust fan RPM to achieve design CFM requirements.
 - b. Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure fan motor is not in or above the service factor.
 - c. Pitot-Tube Traverse: Perform a Pitot-Tube traverse of the main supply and return ducts, as applicable, to obtain total CFM. If a Pitot-Tube traverse is not practical, an explanation of why a traverse was not made must appear on the appropriate data sheet. Measurements must be recorded with an Inclined Manometer or an Inclined/Vertical Manometer.
 - d. Outside Air: Test and adjust the outside air on applicable equipment using a Pitot-Tube traverse. If a Pitot-Tube traverse is not practical, an explanation of why a traverse was not made must appear on the appropriate data sheet. If a traverse is not practical, use the mixed air temperature method, if the inside and outside temperature difference is at least 20°F, or use the difference between Pitot-tube traverse of the supply and return ducts.
 - e. Static Pressure: Test and record system static pressure, including the static pressure profile of each supply fan.
 2. All Other Fans:
 - a. Fan speeds: Test and adjust fan RPM to achieve design CFM requirements.
 - b. Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure fan motor is not in or above the service factor.
 - c. Pitot-Tube Traverse: Perform a Pitot-Tube traverse of the main return ducts, as applicable, to obtain total CFM. If a Pitot-Tube traverse is not practical, an explanation of why a traverse was not made must appear on the appropriate data sheet. Measurements must be recorded with an Inclined Manometer or an Inclined/Vertical Manometer.
 - d. Static Pressure: Test and record system static pressure, including the static pressure profile of each return fan.
 3. VAV Terminal Units:
 - a. Set and record volume regulators on all terminal boxes to meet design maximum and minimum CFM requirements.
 - b. Identification: Identify the type, location, and size of each terminal unit. This information must be recorded on the terminal box data sheets.
 4. Diffusers, Registers and Grilles:
 - a. Tolerances: Test, adjust, and balance each diffuser, grille, and register to within 5% of design requirements. Minimize drafts. Observe throws are in direction as indicated on drawings.
 5. Coils (including electric coils):
 - a. Air Temperature: Once air flows are set to acceptable limits, take wet bulb (cooling coil only) and dry bulb air temperatures on the entering and leaving side of each coil. Calculate the sensible and latent (cooling coil

- only) capacity of the coil. Provide information in TAB report.
- B. Record preliminary air handler data, including fan RPM and static pressures across filter, fans and coils.
 - C. Perform a velocity traverse of the main supply ducts using a pitot-tube and inclined manometer to establish initial air delivery. Perform a Pitot-tube traverse of main supply and return ducts, as applicable, to obtain total CFM. If a pitot-tube traverse is not practical, a detailed explanation of why a traverse was not made must appear on the appropriate data sheet.
 - D. Where air measuring stations are installed, use pitot tube traverse readings to verify and record the correct calibration of the stations output.
 - E. Make adjustments in fan RPM and damper settings, as required, to obtain design supply air, return air, and outside air.
 - F. Measure and adjust all supply and return branches to design air delivery.
 - G. Measure and adjust all diffusers to design air delivery to +/- 5% of design requirements.
 - H. Make a set of recordings showing final system conditions.

3.7 TESTING THE HYDRONIC SYSTEMS

- A. The TAB agency shall, as applicable, verify that all hydronic equipment, piping, and coils have been filled and purged; that strainers have been cleaned; that water has been flushed and is in a clean condition, and that all balancing valves (except bypass valves) are set full open. As applicable, check air vents and expansion or compression tank for proper operation. The TAB agency shall perform the following testing and balancing functions in accordance with the AABC National Standards and all results shall be recorded in the TAB report:
 - 1. Record preliminary pump data.
 - a. Pump RPM.
 - b. Pump shut-off differential head.
 - c. Pump operating differential head.
 - d. Check and verify pump alignment.
 - e. Verify impeller diameter.
 - B. Adjust balancing valves in the pump discharge lines to obtain design water quantity as read from the manufacturer's pump curve and from a flow meter.
 - C. In variable flow systems, the water flow of the pump shall be set at the scheduled gpm, not the total of all the valves. Determine the diversity of the system and balance the individual coils with the maximum pump water quantity flowing in the system.
 - D. Balance flow through:
 - 1. Chillers.
 - 2. Coils.
 - 3. Boiler.
 - 4. Pumps
 - 5. Condensers.
 - 6. Cooling tower.
 - 7. Heat Exchanger.
 - E. Use flow meters, differential pressures and temperature relationships as required.
 - F. Balance by-pass lines to obtain the same pressure drop with systems on by-pass as full flow through the coil including the valve.
 - G. Repeat steps, as required, to obtain a final systems balance and make a set of recordings showing final systems conditions.
 - H. Pumps:
 - 1. Test and adjust pumps to meet design water flow requirements. Check pumps for proper operation. Pumps shall be free of vibration and cavitation Record

- appropriate gauge readings for final TDH and Block-Off\Dead head calculations.
Check and verify pump alignment.
2. Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure pump motor is not in or above the service factor.
- I. Coils:
1. Tolerances: Test, adjust, and balance all chilled water and hot water coils within 5% of design flow requirements.
 2. Verification: Verify the type, location, final pressure drop and water quantity (GPM) of each coil. Calculate the actual capacity of all coils. This information shall be recorded on coil data sheets.
- J. Boilers:
1. Verify that boilers have been filled and started by others, and are in operation.
 2. Current and Voltage: As applicable, test and record motor voltage and amperage, and compare data with the nameplate limits to ensure motor is not in or above the service factor.
 3. Test, adjust and record water flows through water boilers.
 4. Test and record water temperature profiles of each boiler.
- K. Chillers:
1. Verify that chillers have been started by the manufacture and are in operation. Test and adjust chiller water flows to within 5% of the design requirements by using a U-TUBE manometer and setting balancing valves.
 2. Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure compressor motor is not in or above the service factor.
 3. Test and record temperature profiles of each chiller at design water flow.
- L. Cooling towers:
1. Verify that cooling towers have been filled and started by others and are in operation.
 2. Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure cooling tower fan motor is not in or above the service factor.
 3. Test and adjust water flows to balance tower cells and flows between towers.
 4. Test and record water temperature profiles of each condenser at design water flow for water and air side operation.
- M. Heat exchangers:
1. Verify that heat exchangers have been filled and started by others, and are in operation.
 2. Test and record temperature and pressure profiles of water and steam heat exchangers.

3.8 EQUIPMENT POWER READINGS

- A. Record the following information for each motor:
1. Equipment designation.
 2. Manufacturer.
 3. Unit model number and serial number and frame.
 4. Motor nameplate horsepower; nameplate voltage; phase and full load amperes.
 5. Heater coil in starter.
 - a. Rating in amperes.
 - b. Manufacturer's recommendation.
 6. Motor RPM/driven equipment RPM.

7. Power reading (voltage, amperes of all legs at motor terminals).

3.9 BOILERS

- A. Check for proper operation and with operation at near design conditions, record the following:
 1. Manufacturer, model number, serial number and nameplate.
 2. If water type, water flow in GPM, entering and leaving water temperature and water pressure drop in feet.
 3. Type of fuel and heating value.
 4. Rate of fuel consumption.
 5. Capacity in MBH.
 6. Efficiency.
 7. Flue gas analysis.
 8. Motor data.
- B. Observe demonstration that all controls and safety devices are functioning properly. Record observations.

3.10 CHILLERS (Water Cooled)

- A. Balance flow of water thru each evaporator and condenser to be within a range of 100% to 110% of design flow with all pumps operating. With only one pump operating, the maximum flow shall not exceed the maximum tube velocity recommended by the manufacturer.
- B. Verification of safety interlocks and controls are the responsibility of the manufacturer.
- C. With each chiller operating at near design temperature and water flow conditions, measure and record the following:
 1. Manufacturer, model number, serial number and all nameplate data.
 2. Evaporator water entering temperature, leaving temperature, pressure drop (ft.) and water quantity (GPM).
 3. Condenser water entering temperature, leaving temperature, pressure drop (ft.) and water quantity (GPM).
 4. Evaporator and condenser refrigerant temperatures and pressures (using instruments furnished with the machine by the manufacturer).
 5. Volts and amps for each phase.
 6. Power factor.
 7. KW input.
 8. Tons of cooling.
 9. KW per ton of cooling.
- D. Reference chiller specification for additional requirements.

3.11 CHILLERS (Air Cooled)

- A. Balance flow of water through each evaporator to be within a range of 100% to 110% of design flow with all pumps operating. With only one pump operating, the maximum flow shall not exceed the maximum tube velocity recommended by the manufacturer.
- B. Verification of safety interlocks and controls are the responsibility of the manufacturer.
- C. With each chiller operating at near design temperature conditions, measure and record the following:
 1. Manufacturer, model number, serial number and all nameplate data.
 2. Evaporator water entering temperature, leaving temperature, pressure drop (ft.) and water quantity (GPM).
 3. Condenser air entering temperature, leaving temperature.
 4. Evaporator and condenser refrigerant temperatures and pressures (using

- instruments furnished with the machine by the manufacturer).
- 5. Volts and amps for each phase.
- 6. Power factor.
- 7. KW input.
- 8. Tons of cooling.
- 9. KW per ton of cooling.
- D. Reference chiller specification for additional requirements.

3.12 TESTING THE VARIABLE AIR VOLUME SYSTEM

- A. All VAV boxes used are to be calibrated to produce the rated air quantity.
- B. Set and record the supply air static pressure controller to provide actual design air flow at the most resistive terminal.
- C. Measure and adjust the design air delivery at the inlet of each VAV box.
- D. Measure and record the air quantity from each VAV box at its maximum flow. Manipulate the controller to achieve maximum flow.
- E. Reset each box to yield and record minimum primary air flow.
 - 1. DDC controllers record the correction factor required to establish actual desired air quantity as designed.
 - 2. Pneumatic controllers adjust velocity controller as required to establish actual desired air quantity as designed.
- F. If the box is operating with inlet static pressure in excess of the minimum cataloged pressure specified by the manufacturer and is not producing rated air quantity, field adjust the box to produce rated air quantity. Retest until approved results are obtained.
- G. Position the VAV boxes to the proportion of maximum fan air volume to total installed box maximum volume.
- H. Set the fan to deliver the AHUs scheduled design airflow.
- I. Perform and record a total air traverse.
- J. With the system terminal boxes set for full flow or diversity, the system will be delivering the scheduled design CFM with the most restrictive box in control. Make a speed increase if either or both static and volume are low.
- K. Set the boxes to minimum and adjust the inlet vanes and or speed controllers to prevent excessive static in the system.
- L. Coordinate with the work specified in Building Management and Control System on the final location of the sensors for the static pressure controller. Locate in the supply duct far enough from the fan discharge to be truly representative of the average static pressure in the system.
- M. Modulate the fan speed on the supply fan. Adjust as required to coordinate with the static pressure sensing network.
- N. Make a set of recordings showing final system conditions including system duct static pressures and control system setpoint.

3.13 DUCT TEST

- A. Test and Balancing Contractor shall verify and record the duct test results. A copy of the duct test results, as completed, shall be submitted to the engineer for review within five days. Provide a complete report of all the duct test results in the final TAB report.

3.14 DIRECT EXPANSION EQUIPMENT

- A. With each unit operating at near design conditions, measure and record the following:
 - 1. Manufacturer, model number, serial number and all nameplate data.
 - 2. Ambient temperature, condenser discharge temperature.

3. Amperage and voltage for each phase.
4. Leaving and entering air temperatures.
5. Suction and discharge pressures and temperatures.
6. Tons of cooling.
7. Verification that moisture indicator shows dry refrigerant.

3.15 TAB REPORT

- A. The activities described in this specification shall be recorded in a report form; and four individually bound copies shall be provided to the Architect and Engineer. Neatly type and arrange data. Include with the data the date tested, personnel present, weather conditions, nameplate record of the test instruments used and list all measurements taken after all corrections are made to the system. Record all failures and corrective action taken to remedy any incorrect situation. The intent of the final report is to provide a reference of actual operating conditions for the Owner's operations personnel. Provide a "Preface" which shall include a general discussion of the system and any abnormalities or problems encountered.
- B. All measurements and recorded readings (of air, water, electricity, etc.) that appear in the report must have been recorded on site by the permanently employed technicians or engineers of the TAB firm.
- C. Submit reports on forms approved by the engineer that will include the following data as a minimum:
 1. Title Page
 - a. Company Name
 - b. Company Address
 - c. Company telephone number
 - d. Project name
 - e. Project location
 - f. Project Manager
 - g. Project Engineer
 - h. Project Contractor
 - I. Project Identification Number
 2. Summary of the TAB report data
 3. Index
 4. Instrument List
 - a. Instrument
 - b. Manufacturer
 - c. Model
 - d. Serial Number
 - e. Range
 - f. Calibration Date
 - g. What test instrument is to be used for:
 5. Fan Data
 - a. Location
 - b. Manufacturer
 - c. Model
 - d. Air flow, specified and actual
 - e. Total static pressure (total external) specified and actual
 - f. Inlet pressure
 - g. Discharge pressure
 - h. Fan RPM
 6. Return Air/Outside Air Data

- a. Identification/location
 - b. Design return air flow
 - c. Actual return air flow
 - d. Design outside air flow
 - e. Actual outside air flow
 - f. Return air temperature
 - g. Outside air temperature
 - h. Required mixed air temperature
 - I. Actual mixed air temperature
7. Electric Motors
- a. Manufacturer
 - b. HP/BHP
 - c. Phase, voltage, amperage, nameplate, actual
 - d. PM
 - e. Service Factor
 - f. Starter size, heater elements, rating
8. V-Belt Drive
- a. Identification/location
 - b. Required driven RPM
 - c. Drive sheave, diameter and RPM
 - d. Belt, size and quantity
 - e. Motor sheave, diameter and RPM
 - f. Center-to-center distance, maximum, minimum and actual
9. Duct Traverse
- a. System zone/branch
 - b. Duct size
 - c. Area
 - d. Design velocity
 - e. Design air flow
 - f. Test velocity
 - g. Test air flow
 - h. Duct static pressure
 - I. Air correction factor
10. Air Monitoring Station Data
- a. Identification/location
 - b. System
 - c. Size
 - d. Area
 - e. Design velocity
 - f. Design air flow
 - g. Test velocity
 - h. Test air flow
11. Air Distribution Test Sheet
- a. Air terminal number
 - b. Room number/location
 - c. Terminal type
 - d. Terminal size
 - e. Correction factor
 - f. Design velocity
 - g. Design air flow
 - h. Test (final) velocity

- i. Test (final) air flow
12. Pump Data
 - a. Identification/number
 - b. Manufacturer
 - c. Size/model
 - d. Impeller
 - e. Service
 - f. Design flow rate, pressure drop, BHP
 - g. Actual flow rate, pressure drop, BHP
 - h. Discharge pressure
 - I. Suction pressure
 - j. Total operating head pressure
 - k. Shut off, discharge and suction pressures
 - l. Shut off, total head pressure
 - m. Pressure differential settings
13. Cooling Coil Data
 - a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Entering air DB temperature, design and actual
 - f. Entering air WB temperature, design and actual
 - g. Leaving air DB temperature, design and actual
 - h. Leaving air WB temperature, design and actual
 - i. Water pressure flow, design and actual
 - j. Water pressure drop, design and actual
 - k. Entering water temperature, design and actual
 - l. Leaving water temperature, design and actual
 - m. Air pressure drop, design and actual
 - n. Capacity - sensible and latent
14. Heating Coil Data
 - a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Entering air DB temperature, design and actual
 - f. Leaving air DB temperature, design and actual
 - g. Water pressure flow, design and actual
 - h. Water pressure drop, design and actual
 - i. Entering water temperature, design and actual
 - j. Leaving water temperature, design and actual
 - k. Air pressure drop, design and actual
 - l. Capacity
15. Electric Coil Data
 - a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Entering air DB temperature, design and actual
 - f. Leaving air DB temperature, design and actual
 - g. Electrical Characteristics

- h. Capacity
- 16. Sound Level Report
 - a. Location (Location established by the design engineer)
 - b. N C curve for eight (8) bands-equipment off
 - c. N C curve for eight (8) bands-equipment on
- 17. Vibration Test on equipment having 10 HP motors or greater in size.
 - a. Location of points:
 - 1) Fan bearing, drive end
 - 2) Fan bearing, opposite end
 - 3) Motor bearing, center (if applicable)
 - 4) Motor bearing, drive end
 - 5) Motor bearing, opposite end
 - 6) Casing (bottom or top)
 - 7) Casing (side)
 - 8) Duct after flexible connection (discharge)
 - 9) Duct after flexible connection (suction)
 - b. Test readings:
 - 1) Horizontal, velocity and displacement
 - 2) Vertical, velocity and displacement
 - 3) Axial, velocity and displacement
 - c. Normally acceptable readings, velocity and acceleration
 - d. Unusual conditions at time of test
 - e. Vibration source (if non-complying)
- 18. Control verification indicating date performed and any abnormalities identified.
 - a. Point Location/Description
 - b. EMS Readout (Setpoint and Actual)
 - c. Actual Readout of all points
 - d. Interlocks
 - e. Safeties
 - f. Variable speed drive tracking with EMS input
 - g. Variable speed drive Bypass operation
 - h. Sequence of operation

END OF SECTION

SECTION 23 05 94
COORDINATION OF TESTING AND BALANCING

PART 1 - TESTING, BALANCING AND ADJUSTING

1.1 WORK INCLUDED

- A. Balancing and adjusting of the environmental systems is specified in Section 23 05 93.
- B. Coordination of the work is specified in this Section.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 COORDINATION

- A. Bring the work to a state of readiness for testing, balancing, and adjusting.
 - 1. Install air terminal devices.
 - 2. Provide specified filters in air handling equipment. Install clean filters just prior to the start of the test and balance work.
 - 3. Verify lubrication of equipment.
 - 4. Install permanent instrumentation.
 - 5. Clean piping systems and fill with clean water.
 - 6. Complete "Start-up" of equipment.
 - 7. Check rotation and alignment of rotating equipment and tension of belted drives.
 - 8. Verify ratings of overload heaters in motor starters.
 - 9. Verify that safety and operating control set points are as designed and automatic control sequences have been checked.
 - 10. Provide control diagrams and sequence of operation.
 - 11. Collect material for maintenance manuals and prepare one manual especially for use in testing and balancing.
 - 12. Verify that graphic operational data such as start/stop instructions, valve tag schedules, and piping identification schedules have been provided where needed.
 - 13. Verify that equipment and piping identification work has been completed with valve tags, schedules, and piping identification system.
 - 14. Comb out fins on extended-surface heat transfer coils where damaged.
 - 15. Clean all strainers as required.
 - 16. Remove construction strainers after water is cleaned and treated.
 - 17. Remove all temporary filters from HVAC equipment.
 - 18. Provide start-up reports listing all start-up information and manufacturer's information attached.
- B. Provide and install new pulleys and belts as required to effect the correct speed ratio. Adjustments where no belt or pulley change is required, is specified in Section 23 05 93.
- C. Verify that the systems are ready for balancing and adjusting.
- D. Submit a letter stating:
 - 1. The specified pieces of equipment have been checked, started, and adjusted by the manufacturer.
 - 2. Other equipment has been checked and started.
 - 3. The systems have been operated for the specified period of time.
 - 4. The automatic controls system has been adjusted, calibrated, and checked, and is operating as specified.
- E. Provide the services of a technician full time at all times at the project when testing, balancing and adjusting work is being conducted.
- F. Provide instrumentation and services to take readings of the required data for the refrigerant circuits.

- G. Provide and install volume dampers required for balancing by the TAB Contractor.

3.2 START-UP OF EQUIPMENT

- A. Pre-start & Start-up equipment using the procedures as recommended by the manufacturers.
- B. Complete start-up of equipment prior to start of testing & balancing.
- C. Submit start-up procedures as outlined by the manufacturers and complete the "HVAC FAN / AIR HANDLING / START-UP REPORT FORM" to Engineer.

HVAC FAN / AIR HANDLING UNIT / START-UP REPORT FORM														
<i>Equipment Description</i>	<i>Actual</i>			<i>Disc.</i>	<i>Rotatio n</i>	<i>Belt</i>		<i>RPM</i>	<i>Vibratio n Isolatio n</i>	<i>Attachme nt To Roof</i>	<i>List Of Damage Parts</i>	<i>Bearing s Lubricat ed</i>	<i>Filter Installed</i>	<i>Interlocks & Dampers Operational</i>
	<i>Voltag e</i>	<i>Amps</i>	<i>HP</i>	<i>Switch</i>		<i>Condition</i>	<i>Tension</i>	<i>Correct</i>		<i>Correct</i>				
				<i>Wired</i>	<i>Correct</i>	<i>& Part #</i>	<i>Correct</i>	<i>Submitt al</i>	<i>Correct</i>	<i>Curb</i>				

END OF SECTION

SECTION 23 07 13
EXTERNAL DUCT INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install external insulation on supply, return and outside air ductwork.
- B. External insulation of concealed and exposed ducts is included in this Section. Internal acoustic duct lining is specified under ductwork and not included in this Section.

1.2 RELATED WORK

- A. Division 9 - FINISHES. Painting and Color Coding.
- B. Division 23 - MECHANICAL.
 - 1. Air Handling Units. Internal insulation for air units is specified in the sections on air handling units. The units do not require external insulation.
 - 2. Internal Duct Liner. Internal duct liner is specified in the section on ductwork.
 - 3. Insulation. Refer to specific sections on individual insulation types.
 - 4. Refer to insulation and liner plan detail.

1.3 QUALITY ASSURANCE

- A. The intent of insulation specifications is to obtain superior quality workmanship, resulting in an installation that is absolutely satisfactory in both function and appearance. Provide insulation in accordance with the specifications for each type of service and apply as recommended by the manufacturer and as specified.
- B. An approved contractor for this work under this Division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, skill, and the 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.
- C. All duct insulation used on the project inside the building must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50 as determined by test procedures ASTM E84, NFPA 255 and UL 723. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive. Components such as adhesives, mastics and cements must meet the same individual ratings as the minimum requirements and bear the UL label.
- D. Condensation on any insulated system is not approved.
- E. Replace insulation damaged by either moisture or other means. Insulation that has been wet, whether dried or not, is considered damaged. Make repairs where condensation is caused by improper installation of insulation. Also repair any damage caused by the condensation.
- F. Where existing insulated ductwork or other services are tapped, remove existing insulation back to undamaged sections and replace with new insulation of the same type and thickness as existing insulation. Apply as specified for insulation of the same service.

1.4 APPROVALS

- A. Submittals. Submit product data on each insulation type, adhesive, and finish to be used in the work. Make the submittal as specified in Division 1 General Requirements and obtain approval before beginning installation. Include product description, list of materials and thickness for each service and location, and the manufacturer's installation instructions for each product.
- B. Sample Application. Make an application of each type of insulation to display the

material, quality and application method. Obtain approval of the sample application before proceeding with installation of the work.

PART 2 - PRODUCTS

2.1 INSULATION

- A. Glass fiber rigid duct insulation.
 - 1. Minimum density of 3 pcf, installed R value to be 6.0 (when located in a conditioned plenum) and 8.0 (when located in an unconditioned plenum) at 75°F mean, facing of 0.7 mil aluminum foil reinforced with glass yarn mesh and laminated to 40 lbs. fire-resistant Kraft. R-value to be indicated on exterior side of insulation to be verified by City inspector.
 - 2. Acceptable Manufacturers
 - a. Schuller 814 spin-glas FSK.
 - b. Owens-Corning Type 703 board RKF.
 - c. Knauf 3 PCF FSK.
- B. Glass fiber blanket duct insulation.
 - 1. Minimum density of 1.0 pcf, installed R value to be 6.0 (when located in a conditioned plenum) and 8.0 (when located in an unconditioned plenum) at 75°F mean, facing of 0.35 mil foil reinforced with glass yarn mesh and laminated to 40 lbs. fire resistant Kraft. R-value to be indicated on exterior side of insulation to be verified by City inspector.
 - 2. Acceptable Manufacturers
 - a. Manville R-series Microlite FSKL.
 - b. Owens-Corning ED100 RKF.
 - c. Knauf 1.0 PCF FSK.
- C. Fiberglass reinforcing cloth mesh.
 - 1. Acceptable Manufacturers
 - a. Perma Glass Mesh.
 - b. Alpha Glass Mesh.
 - c. Childers Chil-Glas #10
 - d. Foster Mast a Fab
 - e. Vimasco.
- D. Mastics, sealants, coatings and adhesives.
 - 1. Acceptable Manufacturers
 - a. Childers.
 - B. Foster.
 - c. Vimasco.
- E. Fireboard Insulation
 - 1. Totally encapsulated with foil facing.
 - 2. Two hour rated fire protection.
 - 3. Zero clearance to combustible protection.
 - 4. System shall be listed and labeled by an NRTL.
 - 5. Tested per ISO 6944, Type A Duct and achieve a 2 hour rating for stability, integrity and insulation.
 - 6. Provided system is subject to the approval of the Local Authority Having Jurisdiction.
 - 7. Acceptable Manufacturers
 - a. Unifrax ON Fyrewrap Elite 1.5
 - b. Partak Insulation, Inc. Paroc Fireboard
 - c. Thermal Ceramics FireMaster 3M
 - d. Premier Refractories International, Pyroscat.

- F. Rigid Closed Cell Insulation
 - 1. Acceptable Manufacturers
 - a. Dow Trymer.
 - b. Phenolic Foam.
- G. Reinforced Foil Tape
 - 1. Acceptable Manufacturers
 - a. Venture 1525CW
 - b. 3" FSK
 - 2. Thickness 6.5 mils
 - 3. Color: silver

2.2 COATING AND ADHESIVE

- A. Coating. Provide Childers CP-38 or Foster 30-80 vapor barrier coating. Coating must meet MIL Spec C-19565C, Type II and be QPL Listed. Permeance shall be 0.013 perms or less at 43 mils dry. Tested at 100°F and 90% RH per ASTM E96.
- B. Outdoors: Provide as insulation coating Childers Encacel X or Foster Monolar 60-90. Permeance shall be 0.03 perms or less at 30 mils dry. Tested at 100°F and 90% RH per ASTM F 1249.
- C. Adhesive. Provide Childers CP-82 or Foster 85-20 vapor barrier adhesive.
- D. Reinforcing Mesh. Provide 10 x 10 white glass or polyester reinforcing mesh.

2.3 OUTDOOR DUCT LAMINATED JACKETING

- A. Rubberized bitumen compound material:
 - 1. Ultraviolet resistant
 - 2. Weatherproof
 - 3. Vapor retarding jacketing
 - 4. Laminated jacketing
 - 5. Cross-laminated high strength polyethylene film
 - 6. Laminated to aluminum foil
 - 7. Minimum 60-mil thickness
- B. Acceptable Manufacturers:
 - 1. Alumaguard 60
 - 2. Flex Clad 400
 - 3. Venture Clad 1577CW

PART 3 - EXECUTION

3.1 FIRE SAFETY REQUIREMENTS

- A. Do not extend duct coverings through walls or floors required to be fire-stopped or required to have a fire resistance rating. Interrupt duct coverings in the immediate vicinity of heat sources such as electric resistance or fuel-burning heater.

3.2 CONCEALED DUCT

- A. Provide flexible glass fiber insulation with factory-applied, reinforced UL labeled Foil-Skrim-Kraft (FSK) facing.
- B. Standing Seams. Insulate standing seams and stiffeners, which protrude through the insulation with 0.6 lb. per cubic foot density, 1-1/2" thick, faced, flexible blanket insulation. Insulation shall not prevent adjustment of damper operators.
- C. Insulation shall be wrapped tightly on the ductwork with all circumferential joints butted and longitudinal joints overlapped a minimum of 2". In addition, secure insulation to the bottom of rectangular ductwork by the use of either weld pins with washers or cup-head pins welded to the ductwork or perforated based insulation hangers glued to the duct on

- twelve inch centers to prevent sagging of insulation.
- D. On circumferential joint, the 2" flange on the facing shall be stapled with 9/16" outward clinch steel staples on 2" centers and taped using 3" wide foil tape applied with additional adhesive of Foster 85-75. Cover all seams, joints, pin penetrations and other breaks with foil tape and glue.
 - E. Ductwork in mechanical rooms is considered concealed spaces.

3.3 EXPOSED DUCT INSULATION

- A. Ductwork in exposed locations is to be insulated with fiberglass rigid / semi-rigid board insulation.
 - 1. Apply fabric and mastic to provide a smooth surface for painting.
- B. Standing Seams: Insulate standing seams and stiffeners which protrude through the insulation with 0.6 lb per cubic foot density, 1-1/2 inch thick, faced insulation. As a vapor seal, use reinforcing mesh with vapor barrier coating. Insulation shall not prevent adjustment of damper operators.
- C. Insulation shall be wrapped tightly on the ductwork. Adhere insulation to ductwork with adhesive. In addition, secure insulation to the bottom of rectangular ductwork by the use of either weld pins with washers or cup-head pins welded to the ductwork or perforated based insulation hangers glued to the duct on 12 inch centers to prevent sagging of insulation.
- D. Cover all seams, joints, pin penetrations and other breaks with coating reinforced with reinforcing mesh. Fabric shall not be visible after coating.

3.4 OUTDOOR DUCTWORK COVERING

- A. Cover all supply and return ductwork outdoors:
 - 1. 1-1/2" thick, rigid closed cell insulation with reinforced foil facing.
- B. Install a high point in center and slope in both directions so water will not stand on horizontal surfaces.
- C. Impale the insulation over mechanical fasteners and washers.
 - 1. A minimum of 2 rows of fasteners per side on 12-inch centers.
 - 2. Seal all breaks, joints and punctures by applying a 1/8" thick vapor barrier mastic coating, embedded in open mesh reinforcing mesh.
- D. Standing S, or flanged connections shall be covered with the same thickness of insulation overlapped a minimum of 4".
- E. Apply a tack coat of Childers CP-10/11 or Foster 46-50 weather barrier mastic over the entire surface.
 - 1. While this coat is still tacky, Childers #5 glass fiber reinforcing mesh shall be smoothly applied and pressed into the mastic. The cloth shall be taut with adjacent edges overlapped a minimum of 4".
 - 2. After the first coat of mastic has taken its set, the second coat shall be applied over the cloth by palm, trowel, or spray to sufficient thickness that, when dried, the combined thickness of mastic and cloth is not less than 1/8".
 - 3. Upon completion, the openings in the cloth shall be completely sealed and the yarn shall not be visible. The completed work shall be completely smooth and present a plane surface.
 - 4. Aluminum gray or white finish as approved by the Architect.
- F. Standing water on horizontal surfaces is not approved.
- G. Apply outdoor duct laminated jacketing protection over entire insulation surface. Apply rubberized bitumen compound, applied to a cross-laminated high strength polyethylene film, laminated to aluminum foil.

3.5 KITCHEN GREASE EXHAUST DUCTWORK / KILN DUCTWORK / FUME HOOD DUCT

- A. Secure fireboard insulation to duct with impaling pins and 3" square speed clips. In addition, provide a wire mesh support system and additional sealing or support as required by the code enforcing authority. The insulation support system shall include framed access to allow the insulation to be removed and replaced without damage at the access doors in the duct system for inspection and cleaning. Coordinate location of access openings to correspond accurately. Provide stainless steel banding on 12" centers.

3.6 GENERAL INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Apply insulation on clean, dry surfaces only.
- C. Continue insulation with vapor barrier through penetrations.
- D. Neatly finish insulation at supports, protrusions and interruptions.
- E. Install insulation on clean, dry surfaces, and only after building is weatherproofed sufficiently to preclude any rainwater on insulation.
- F. Apply mastic over the fiberglass reinforcing mesh to a thickness where fabric is not visible after completion.
- G. Install fiberglass blanket duct insulation on top of supply air grilles not fire rated.

END OF SECTION

SECTION 23 07 16 VESSEL INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install insulation for both high and low temperature vessels.
- B. Low temperature installations include expansion tanks, air eliminators, chiller nozzles, chiller heads and other vessels containing liquids 60°F and below.
- C. High temperature installations include expansion tanks, air eliminators, domestic water storage tanks, boiler stack / transition and other vessels containing liquids above 60°F.

1.2 QUALITY ASSURANCE

- A. The intent of insulation specifications is to obtain superior quality workmanship resulting in an installation that is absolutely satisfactory in both function and appearance. Provide insulation in accordance with the specifications for each type of service and apply as recommended by the manufacturer and as specified.
- B. An approved contractor for this work under this Division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, skill, and the 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.
- C. All vessel insulation used on the project inside the building must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50, as determined by test procedures ASTM E 84, NFPA 255 and UL 723. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive. Components such as adhesives, mastics and cements must meet the same individual ratings as the minimum requirements and bear the UL label.
- D. Condensation on any insulated vessel system is not acceptable.
- E. Replace insulation damaged by either moisture or other means. Insulation that has been wet, whether dried or not, is considered damaged. Make repairs where condensation is caused by improper installation of insulation, also repair any damage caused by the condensation.
- F. Where existing insulated vessel, or other surfaces are tapped, remove existing insulation back to undamaged sections for hot surfaces or to nearest insulation stop for cold surfaces, and replace with new insulation of the same type and thickness as existing insulation. Apply as specified for insulation of the same service.

1.3 APPROVALS

- A. Submit product data on each insulation type, adhesive, and finish to be used in the work. Make the submittal as specified in Division 1 General Requirements and obtain approval before beginning installation. Include product description, list of materials and thickness for each service and location and the manufacturer's installation instructions for each product.
- B. Make an application of each type of insulation to display the material, quality and application method. Obtain approval of the sample application before proceeding with installation of the work.

1.4 RELATED WORK

- A. Division 9 Finishes. Painting and color-coding

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Glass fiber pipe & tank insulation:
 - 1. Schuller Type 817
 - 2. Owens-Corning Type 705
 - 3. Knauf 2.8 PCF
- B. Closed cell, non-wicking pipe & tank insulation:
 - 1. Armaflex FS, 2" thickness
- C. Aluminum Jacketing:
 - 1. Childers
 - 2. Pabco
 - 3. RPR
- D. Monel Staples
 - 1. Bostich Monel
 - 2. Duo-Fast Monel
 - 3. Markwell Monel
- E. Fiberglass reinforcing cloth mesh:
 - 1. Perma Glass Mesh
 - 2. Alpha Glass Mesh
 - 3. Childers Chil-Glas
 - 4. Foster Mast a Fab
- F. Weather Resistant Coating:
 - 1. WB Armaflex Finish

2.2 CEMENT, MASTICS, SEALANTS, ADHESIVES AND COATINGS

- A. Adhesive: Provide Childers CP-127 or Foster 85-60 fiberglass adhesive to seal insulation for low temperature vessels.
- B. Adhesive / Joint Sealant: Provide Armaflex 520 adhesive to seal insulation for low and temperature vessels.
- C. Lagging Adhesive / Coating: Furnish Childers CP50AHV2 or Foster 30-36 lagging adhesive / coating to provide a finish coat and to secure finish cloth for high temperature vessels.
- D. Insulation Joint Sealant: Use Childers CP-76 or Foster 95-50 to seal the joints of insulation on low temperature vessels.
- E. Metal Jacketing Sealant: Use Childers CP-76 or Foster 95-44 on all metal jacketing laps outdoors.
- F. Vapor Barrier Coating: Indoors - Use Childers CP-38 or Foster 30-80 vapor barrier coating finish to coat the canvas finish on low temperature vessels. Permeance shall be 0.013 perms or less as tested by ASTM E96. Coating must comply with MIL-C-19565C, Type II and be QPL listed. Permeance shall be 0.03 perms or less at 30 mils, dry. Tested at 100°F and 90% RH per ASTM F 1249 and by Hypalon rubber based.
- G. Weather Barrier Mastic: Furnish Childers CP-10/11 or Foster 46-50 weather barrier mastic and reinforcing mesh for outdoor finish.
- H. Reinforcing Mesh: Furnish 10 X 10 white glass or polyester reinforcing mesh.

PART 3 - EXECUTION

3.1 HIGH TEMPERATURE VESSELS (FIBERGLASS)

- A. Apply a first layer of insulating board. Band the board on immediately after application,

- using bands on 12" centers, drawn tight and securely fastened.
- B. Apply successive layers of insulation as specified for the first layer, with joints staggered. After insulation has been applied, finish with Childers CP-38 or Foster 30-80 vapor barrier coating reinforced with glass or polyester reinforcing mesh per manufacturer's recommendations. Provide a flood coat of Childers CP-10/11 or Foster 46-50 with Foster Mast a Fab polyester or Chil Glas #10 reinforcing mesh.
 - C. To insulate removable heads, provide two equal sections of heavy-gauge, galvanized sheet metal covers, angle reinforced and lined with insulation board. Make covers easily removable to allow free access to the heads for inspection, cleaning and dismantling. Provide suitable flanges on the sections with neoprene gaskets between them, permitting a tight seal when the two sections are bolted together. Fill the voids with glass fiber wall cavity insulation.

3.2 LOW TEMPERATURE VESSELS (CLOSED CELL)

- A. Apply a layer of insulating board. Band the insulation on immediately after application, using bands on 12" centers, drawn tight and securely fastened.
- B. To insulate removable heads, provide two equal sections of heavy-gauge, galvanized sheet metal covers, angle reinforced and lined with insulation board. Make covers easily removable to allow free access to the heads for inspection, cleaning and dismantling. Provide suitable flanges on the sections with neoprene gaskets between them, permitting a tight seal when the two sections are bolted together. Fill the voids with closed cell insulation.
- C. Apply weather protective finish on closed cell insulation. Provide a minimum of three coats.

3.3 ALUMINUM JACKETING (Insulated vessels outdoors above grade)

- A. Apply aluminum jacket on vessels according to manufacturer's recommendations using aluminum strapping and metal jacketing sealant to provide weather tight covering.
- B. Aluminum jacketing is not considered as contributing to the vapor barrier or the insulation jacket. The vapor barrier must be sufficient in itself for this function.
- C. Install straps on 12" centers.

3.4 VESSEL INSULATION REQUIREMENTS

- A. Insulate all low and high temperature vessels located exterior (outside) of the building, including the following:
 - 1. Air separators
 - 2. Expansion Tanks
 - 3. Chemical feeders
 - 4. Chilled water system volume tanks
 - 5. Heat Exchangers
 - 6. Insulation thickness shall match thickness of adjoining pipe insulation
- B. Insulate all low temperature vessels located interior (inside of the building, including the following):
 - 1. Air separators
 - 2. Chemical feeders
 - 3. Chilled water system volume tanks
 - 4. Insulation thickness shall match thickness of adjoining pipe insulation
- C. Insulate the following high temperature vessels located interior (inside the building).
 - 1. Air Separators

2. Insulation thickness shall match thickness of adjoining pipe insulation
- D. As indicated on the drawings

END OF SECTION

SECTION 23 07 19 HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install piping insulation, jackets, accessories and covering of specified materials. The insulation shall be used for high and low temperature piping applications including chilled water, hot water, and condensate piping.

1.2 QUALITY ASSURANCE

- A. The intent of insulation specifications is to obtain superior quality workmanship resulting in an installation that is absolutely satisfactory in both function and appearance. Provide insulation in accordance with the specifications for each type of service and apply as recommended by the manufacturer and as specified.
- B. An approved contractor for this work under this Division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, skill, and the 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.
- C. All piping insulation used on the project inside the building must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50, as determined by test procedures ASTM E 84, NFPA 255 and UL 723. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive. Components such as adhesives, mastics and cements must meet the same individual ratings as the minimum requirements and bear the UL label.
- D. Condensation on any insulated piping system is not acceptable.
- E. Replace insulation damaged by either moisture or other means. Insulation that has been wet, whether dried or not, is considered damaged. Make repairs where condensation is caused by improper installation of insulation. Also repair any damage caused by the condensation.
- F. Where existing insulated piping, or other surfaces are tapped, remove existing insulation back to undamaged sections for hot surfaces or to nearest insulation stop for cold surfaces, and replace with new insulation of the same type and thickness as existing insulation. Apply as specified for insulation of the same service.

1.3 SUBMITTALS

- A. Submit product data on each insulation type, adhesive, and finish to be used in the work. Make the submittal as specified in General Requirements and obtain approval before beginning installation. Include product description, list of materials and thickness for each service and location and the manufacturer's installation instructions for each product.
- B. Make a field application of each type of insulation to display the material, quality and application method. Obtain approval of the sample application before proceeding with installation of the work.

1.4 RELATED WORK

- A. Finishes. Painting and color-coding
- B. Pipe Heat Tracing

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Glass fiber pipe insulation:
 - 1. Johns-Manville Micro-Lok AP-T
 - 2. Owens-Corning ASJ/SSL
 - 3. Knauf ASJ/SSL
- B. Cellular Glass Insulation (Foamglass):
 - 1. Pittsburg Corning
 - 2. Cell-U-Foam
- C. Rigid Foam Insulation:
 - 1. Koolphen - Phenolic Foam
 - 2. Dow Trymer
 - 3. Tarec Ecophen – Phenolic Foam
- D. Aluminum Jacketing:
 - 1. ITW Lock-on (Childers)
 - 2. ITW Z-lock (Pabco)
- E. Fiberglass reinforcing cloth mesh:
 - 1. Perma Glass Mesh
 - 2. Alpha Glass Mesh
 - 3. Childers Chil-Glas
 - 4. Foster Mast a Fab
 - 5. Vimasco
- F. Mastics, Sealants, Coatings and Adhesives
 - 1. Childers
 - 2. Foster
 - 3. Vimasco
 - 4. Armstrong 520 Adhesive
- G. Elastomeric Insulation
 - 1. Armacell
- H. Weather Resistant Coating
 - 1. WB Armaflex Finish
 - 2. Foster 30-64
- I. Glass fiber blanket insulation
 - 1. Manville R-series Microlite FSKL
 - 2. Owens-Corning eD75 or ED100 RKF
 - 3. Knauf 0.75 PCF FSK

2.2 RIGID FOAM PIPE INSULATION

- A. Polyisocyanurate pipe insulation or phenolic foam pipe insulation, with all service reinforced vapor barrier jacket having integral laminated vapor barrier.
 - 1. Polyisocyanurate: Thermal conductivity 0.14 @ 75°F mean (ASTM C518).
 - 2. Phenolic Foam: Thermal conductivity 0.13 @ 75°F mean (ASTM C 518); minimum 2.5# density.
 - 3. Polyisocyanurate is not to be used inside of buildings without 25/50 rating.

2.3 FIBERGLASS PIPE INSULATION

- A. Heavy density, dual temperature fiberglass insulation with factory applied, all service, reinforced vapor barrier jacket having integral laminated vapor barrier. Provide with a factory applied pressure sensitive tape closure system and matching butt strips. Supply in thickness as shown.
 - 1. Thermal conductivity 0.23 @ 75°F mean (ASTM 335).

2.4 ELASTOMERIC INSULATION

- A. Insulation material shall be flexible, closed-cell elastomeric insulation in tubular or sheet form. Material shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E84, latest revision. Sheet material with a thickness greater than ¾" shall have a flame spread rating of 25 or less and a smoke developed rating of 100 or less when tested in accordance with ASTM E84, latest revision. In addition, the product, when tested, shall not melt or drip flaming particles, and the flame shall not be progressive. In addition, all materials shall pass simulated end-use fire test.
 - 1. Thermal conductivity 0.27 at 75°F mean (ASTM C177 or C518)

2.5 CELLULAR GLASS INSULATION

- A. ASTM C552:
 - 1. "k" value of 0.35 @ 75°F ("ksi" value of 0.047 @ 24°C);
 - 2. 8.0 lb/cu.ft. (128 kg/cu.m.) density

2.6 INSULATION/SHIELD AT HANGERS

- A. Field fabricated: Use 360° sections of rigid foamglass insulation that will support the bearing area at hangers and supports. Further support insulation at hangers and supports with a shield of galvanized metal covering at least half of the pipe circumference, and conforming to the schedule. Insulation shall extend at least 1" beyond metal shield on each end. When pipe is guided at top and bottom, metal shields shall cover the whole pipe circumference. Adhere metal shield to insulation so that metal will not slide with respect to insulation with ½" aluminum bands (2) per shield.
 - 1. Sections of foam glass insulation may be used of the same outside diameter of the adjoining pipe insulation.
 - 2. Minimum thickness of foam glass insulation shall not be less than 1" thick.
- B. Pipe saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter or more than 22". Provide 18 gauge through 4" pipe and 16-gauge 5" pipe and above.

2.7 SEALANT, ADHESIVE AND FINISH

- A. Lap Adhesive. Provide Childers CP-82 or Foster 85-20 adhesive.
- B. Vapor Barrier Finish:
 - 1. Indoors: Provide as insulation coating Childers CP-38 or Foster 30-80, white. Coating must meet MIL Spec C-19565C, Type II and be QPL Listed. Permeance shall be 0.013 perms or less at 43 mils dry. Tested at 100°F and 90% RH per ASTM E96.
 - 2. Outdoors: Provide as insulation coating Childers Encacel X or Foster 60-90. Permeance shall be 0.03 perms or less at 30 mils dry. Tested at 100°F and 90% RH per ASTM F 1249 and must be Hypalon rubber based.
 - 3. Underground: Provide Childers CP-22/24 or Foster 60-25/26 for fittings and areas. Pittwrap cannot be used.
- C. Insulation Joint Sealant. Provide Childers CP-76 or Foster 95-50 vapor barrier sealant.
- D. Metal Jacketing Sealant. Provide Childers CP-76 or Foster 95-44 metal jacketing sealant for all outdoor metal jacketing laps.
- E. Lagging Adhesive. Provide Childers CP-50AMV1 or Foster 30-36.
- F. Other products of equal quality will be acceptable only upon approval.

2.8 ALUMINUM JACKETING

- A. Finish insulated piping outdoors with a smooth prefabricated Z-lock aluminum jacket

0.016" thick with factory applied 1 mil polyethylene/40 lb and Fab strap. Kraft moisture barrier.

- B. Valves, Fittings and Flanges. For finishing valves, fittings, flanges and similar installations, provide formed aluminum covers, 0.024" thick.
- C. Straps and Seals. Provide ½" x 0.020 stainless steel strapping and seals for jackets and covers according to manufacturer's recommendations.

2.9 GLASS FIBER BLANKET INSULATION

- A. Minimum density of 1.0 PCF, 2" thick, installed R value to be 6.0 or better at 75°F mean, facing of 0.35 mil foil reinforced with glass yarn mesh and laminated to 40 lbs fire resistant kraft.

PART 3 - EXECUTION

3.1 INTERIOR PIPING

- A. Cover all hot water piping with glass fiber, heavy density, dual temperature pipe insulation with a vapor barrier jacket. Apply insulation to clean, dry pipes. Longitudinal seams shall be joined firmly together and sealed with self-sealing lap joints. Butt insulation joints firmly together and seal with a 3" wide ASJ butt strip seal. Longitudinal seams and butt strip laps shall be coated and sealed with CP-35 vapor barrier coating for chilled water piping applications.
- B. Cover all chilled water piping with rigid foam insulation.
 - 1. Adhere the vapor barrier jacket longitudinal seam with vapor barrier adhesive.
 - 2. Cover all valves, fittings and flanges with factory made molded or field fabricated segments of pipe insulation of a thickness and material equal to the adjoining insulation. Adhere segments together with no voids, using CP-82 adhesive. Secure fitting insulation covers and segments in place with ½" wide glass filament tape.
 - 3. Apply a tack coat of fitting mastic over the insulation and tape.
 - 4. Neatly embed with 10 x 10 fiberglass cloth into the tack coat.
 - 5. Apply mastic over the fiberglass cloth to a thickness where the fabric is not visible after completion.
 - 6. Seal ends of pipe insulation with vapor barrier mastic at valves, flanges, fittings and every 21' on straight runs of piping. Mastic should extend on top of ASJ jacket, across the foam, down onto the pipe, making a complete seal.
- C. Install hanger with protective shield, on the outside of all insulation.
- D. Pipe Saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter. Provide 18-gauge through 4" pipe and 16-gauge for 5" pipe and above.
- E. Seal ends of pipe for chilled water insulation with vapor barrier mastic at valves, flanges, fittings and every 21' on straight runs of piping. Mastic should extend on top of ASJ jacket, across the glass, down onto the pipe making a complete seal.
- F. Apply a smooth flood coat of white lagging Foster 8142W over all exposed insulation.
- G. Piping to be insulated as specified above:
 - 1. Chilled water and heating water
 - 2. Make-up water

3.2 REFRIGERANT AND CONDENSATE PIPING

- A. Cover all pipe with elastomeric insulation by slitting tubular sections or sliding unslit sections over the open ends of piping or tubing. Seams and butt joints shall be adhered and sealed using Foster 85-75, Childers CP-82 or Armstrong 520 Adhesive.
- B. All fittings shall be insulated with the same insulation thickness as the adjacent piping.

All seams and mitered joints shall be adhered with Foster 85-75, Childers CP-82 or 520 Adhesive.

- C. Pipe Saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter.
- D. Outdoor exposed piping shall be painted with two coats of either WB or SB Armaflex finish or Foster 30-64 elastomer foam coating. All seams shall be located on the lower half of the pipe.

3.3 PIPING OUTDOORS ABOVE GRADE

- A. Insulate all chilled and hot water piping exterior of building above grade with rigid foam insulation and aluminum jacketing.
- B. Adhere the vapor barrier jacket longitudinal seam with vapor barrier adhesive.
- C. Cover all valves, fittings and flanges with factory made molded or field fabricated segments of pipe insulation of a thickness and material equal to the adjoining insulation. Adhere segments together with no voids, using Childers CP-82 or Foster 85-20 adhesive. Secure fitting insulation covers and segments in place with ½" wide glass filament tape.
- D. Apply a tack coat of fitting vapor barrier coating over the insulation and tape.
- E. Neatly embed with 10 x 10 fiberglass or polyester reinforcing mesh into the tack coat.
- F. Apply coating over the fiberglass cloth to a thickness where the mesh is not visible after completion.
- G. Seal ends of pipe insulation with vapor barrier coating at valves, flanges, fittings and every 21' on straight runs of piping. Mastic should extend on top of ASJ jacket, across the foam, down onto the pipe, making a complete seal.
- H. Finish with aluminum jacketing as specified.

3.4 FLANGE, VALVE AND FITTING INSULATION

- A. Cover valves and flanges with fabricated segments, fittings with two-piece factory molded fittings, and both of matching pipe insulation type and thickness equal to that of the adjoining pipe. Fittings and fabricated segments shall be securely held in place.
 - 1. Apply a tack coat of insulating coating/mastic to the insulated fitting to produce a smooth surface.
 - 2. After mastic is dry, apply a second coat of vapor barrier coating/mastic. Neatly embed with 10 x 10 fiberglass or polyester reinforcing mesh into the tack coat.
 - 3. Overlap coating/mastic and fiberglass/polyester reinforcing mesh by 2" on adjoining sections of pipe insulation.
 - 4. Apply a second coat of coating/mastic over the fiberglass/polyester reinforcing mesh to present a smooth surface.
 - 5. Apply coating/mastic to a wet film thickness of 3/64".
 - 6. Fabric shall not be visible after completion.
 - 7. Vapor seal flanges, valves and fittings with Childers CP-38 or Foster 30-80. Coating must meet MIL Spec C-19565C, Type II and be QPL Listed. Permeance shall be 0.013 perms or less at 43 mils dry. Tested at 100°F and 90% RH per ASTM E96.
- B. PVC fitting covers are not acceptable.

3.5 MISCELLANEOUS

- A. Insulate chilled water pumps with closed cell insulation box.
- B. Install materials after piping has been tested and approved.
- C. Apply insulation on clean, dry surfaces only.
- D. Apply weather protective finish on elastomeric insulation installed in non-conditioned

spaces. Provide a minimum of three coats.

3.6 INSULATION THICKNESS

THICKNESS

INSULATED UNIT

(Inches)

Refrigerant Piping	1-1/2
Chilled Water Piping (through 2" pipe)	1-1/2
Chilled Water Piping (2-1/2" pipe and Larger)	2
Condensate Drains	1
Heating Water Piping 2" Pipe and Larger	2
Heating Water Piping 1-1/2" Pipe and Smaller	1-1/2
Exterior Chilled and Hot Water Piping, 5" Pipe and Larger	2
Exterior Chilled and Hot Water Piping 4" Pipe and Smaller	1-1/2

END OF SECTION

SECTION 23 08 00
HVAC SYSTEMS TECHNICAL COMMISSIONING REQUIREMENTS

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. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.2 SUMMARY

- A. The purpose of this Section is to define responsibilities in the Commissioning Process. Additional system testing is required within individual Specification Sections.
- B. Commissioning requires the participation of the Contractor to ensure that all systems are operating in a manner consistent with the Contract Documents. General Commissioning requirements and coordination are detailed in Division 01. Division 20-25 Contractors shall be familiar with all parts of Division 01 and the Commissioning Plan issued by the Owner's CxA, shall execute all Commissioning responsibilities assigned to them in the Contract Documents and include the cost of Commissioning in the Contract price.
- C. HVAC systems to be commissioned include the following:
 - 1. Chillers
 - 2. Boilers
 - 3. Pumps
 - 4. Air Handling Unit Systems
 - 5. DX Split Systems
 - 6. Air Terminal Units (10% Sampling)
 - 7. Fan Coil Units
 - 8. Exhaust and Supply Fan Systems
 - 9. Fire, Fire/Smoke and Volume Dampers (Review of testing documentation provided by the contractor)
 - 10. HVAC / Building Automation System and Integrations
 - 12. HVAC / Emergency Power Source Integrations
 - 13. HVAC / Life Safety Systems Integrations
- D. The TAB Contractor will perform control sequence verification on each terminal unit shall independently verify each sensor and point and document the results to be included in the Final TAB Report. The CxA will commission 10% of the terminal units once TAB is complete with the CSV and point verification of the terminal units.

1.3 DEFINITIONS

- A. Refer to the General Commissioning Requirements for definitions.

1.4 SUBMITTALS

- A. Contractor shall provide Owner and/or CxA with documentation required for Commissioning Work. At minimum, documentation shall include: Detailed Start-up procedures, full sequences of operation, Operating and Maintenance data, performance data, control drawings, and details of Owner-contracted tests.
 - 1. Shop drawings and product submittal data related to systems or equipment to be commissioned.

- B. Contractor shall submit to Owner and/or CxA installation and checkout materials actually shipped inside equipment and actual field checkout sheet forms used by factory or field technicians.
- C. Where installation testing may be performed in a progressive manner (i.e., piping hydrostatic testing, ductwork pressure testing, etc.), the Contractor shall prepare and submit to the Owner, A/E team and CxA a testing plan that details how the progressive testing will be performed, documented and presented for approval prior to the start of any testing activities.
- D. Contractor shall provide any additional documentation needed to complete the requirements of the Commissioning Process
 - 1. Factory Performance Test Reports: Review and compile all factory performance data to assure that the data is complete prior to executing the FPTs.
 - 2. Installation testing reports such as ductwork pressure testing, piping hydrostatic testing, piping chemical treatment and flushing, bolt flange torqueing, and any documentation associated with local code authority inspections or authorizations.
 - 3. Completed equipment Start-up certification forms along with the manufacturer's field or factory performance and Start-up test documentation.
 - 4. Operating and Maintenance (O&M) information per requirements of the Technical Specifications and Division 01 requirements.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials and installation shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. Refer to the General Commissioning Requirements for other work products related to the Commissioning Process
- C. Contractor is required to follow all applicable industry and site specific safety practices, lockout / tagout requirements, specialized PPE requirements, and provide qualified, trained personnel to execute Commissioning Process requirements.

2.2 TEST EQUIPMENT

- A. Contractor shall provide all specialized tools, test equipment and instruments required to execute Start-up, checkout, and testing of equipment.
- B. All specialized tools, test equipment, and instruments required to execute Start-up, checkout, and testing of equipment shall be of sufficient quality and accuracy to test and/or measure system performance within specified tolerances. A testing laboratory must have calibrated test equipment within the previous twelve (12) months. Calibration shall be NIST traceable. Contractor must calibrate test equipment and instruments according to manufacturer's recommended intervals and whenever the test equipment is dropped or damaged. Calibration tags must be affixed to the test equipment or certificates readily available.

PART 3- EXECUTION

3.1 CONSTRUCTION PHASE

- A. In each purchase order or subcontract that is written for changes in scope, include the appropriate requirements for submittal data, Commissioning documentation, testing assistance, Operating and Maintenance (O&M) data, and training, as a minimum.
- B. Attend Pre-Commissioning Meeting(s), Pre-Installation Meeting(s), and other Project meetings scheduled by the Owner, CxA or Contractor to facilitate the Commissioning process.

- C. Provide manufacturer's data sheets and shop drawing submittals of equipment.
- D. Provide additional requested documentation to the Owner and/or CxA, prior to O&M manual submittals, for development of System Verification Checklists and Functional Performance Testing procedures.
 - 1. Typically, this will include detailed manufacturer's installation and Start-up, operating, troubleshooting and maintenance procedures, full details of any Owner-contracted tests, full factory testing reports, if any, and full warranty information.
 - 2. In addition, the installation, Start-up, and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Contractor and/or CxA.
 - 3. This information and data request may be made prior to normal submittals.
- E. With input from the BAS vendor and A/E, clarify the operation and control of commissioned equipment in areas where the Specifications, BAS control drawings, or equipment documentation are not sufficient for writing detailed test procedures.
- F. During the installation, Start-up and initial checkout process, execute and document related portions of the System Verification Checklists for all commissioned equipment according to the procedures indicated in the Commissioning Plan.
- G. Factory Start-ups: Factory Start-ups are specified for certain equipment. Factory Start-ups generally are Start-up related activities that will be reviewed and checked prior to Functional Performance Tests. All costs associated with factory Start-ups shall be included with the contract price unless otherwise noted. Notify the Commissioning Team of the factory Start-up schedule and coordinate these factory Start-ups with witnessing parties. The Commissioning Team members may witness these Start-ups at their discretion.
- H. Independent Testing Agencies: For systems that specify testing by an independent testing agency, the cost of the test shall be included in the Contract price unless otherwise noted. Testing performed by independent agencies may cover aspects required in the System Verification Checklists, Start-ups, and Functional Performance Tests. Coordinate with the independent testing agency so that CxA, Owner and/or A/E can witness the test to ensure that applicable aspects of the test meet requirements.
- I. Incorporate manufacturer's Start-up procedures with System Verification Checklists (SVC).
- J. Air and water test, adjust and balance shall be completed with discrepancies and problems remedied before Functional Performance Tests of the respective air or water related systems are executed.
- K. Provide skilled technicians to execute starting of equipment and to assist in execution of Functional Performance Tests. Ensure that they are available and present during the agreed-upon schedules and for a sufficient duration to complete the necessary tests, adjustments, and problem solving.
- L. Correct deficiencies (differences between specified and observed performance) as interpreted by the Owner's Project Manager and A/E and retest the system and equipment.
- M. During construction, maintain as-built marked-up Drawings and Specifications of all Contract Documents and Contractor-generated coordination Drawings. Update after completion of Commissioning activities (include deferred tests).
- N. Provide training of the Owner's operating personnel as specified.
- O. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

3.2 WARRANTY PHASE

- A. Execute seasonal or deferred tests, witnessed by the CxA and Owner, according to the Specifications.
 - 1. Complete deferred tests as part of this Contract during the Warranty Period. Schedule this activity with the Owner.
- B. Correct deficiencies and make necessary adjustments to O&M manuals, Commissioning documentation, and as-built drawings for applicable issues identified in any deferred or seasonal testing.

3.3 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with the Project Documents.

3.4 TRAINING

- A. Refer to the individual section of this Specification for specific training requirements on each system.
- B. Refer to the General Commissioning Requirements and Division 01 for overall training requirements related to the Commissioning process and this project.

END OF SECTION

SECTION 23 09 33
BUILDING MANAGEMENT AND CONTROL SYSTEM

PART 1 - GENERAL

1.1 SCOPE

- A. **Cy-Lakes High School** - The existing Building Management and Control System shall be removed and replaced in its entirety including the implementation of all new sequences here within. Provide and install a complete Building Management and Control System (BMCS), including industrial instrumentation necessary to obtain functions and results specified. A complete system includes items such as sensors, valves, dampers, valve and damper operators, DDC panels, relays, terminal equipment controllers, mounting brackets and thermowell, etc. Integrate all components to provide a complete and functioning system.
- B. **All existing Trane controls that are being removed from project shall be returned to owner. Components shall be stored in a clean and dry environment and delivered to Cyfair ISD Maintenance upon completion of demolition phase.**
- C. Temperature Control System components:
 - 1. Electronic instruments as specified
 - 2. Electric instruments as specified
 - 3. Microcomputer instruments as specified
- D. All control devices of the same type product shall be of a single manufacturer.
- E. Control, power and interlock wiring necessary to accomplish sequences specified in this Section shall be provided and installed by the Control Subcontractor. Materials and methods of execution as specified in Division 26, Electrical.
 - 1. Coordinate current characteristics of all electrical instruments and equipment with Division 26 of the specifications and related electrical drawings.
- F. The manufacturer of the building automation system shall provide documentation supporting compliance with ISO-9002 (Model for Quality Assurance in Production, Installation, and Servicing). The intent of this specification requirement is to ensure that the products from the manufacturer are delivered through a Quality System and Framework that will assure consistency in the products delivered for this project.
- G. The entire Building Management and Control System (BMCS) shall be installed, Commissioned, and tested; all performed by the Automation System Manufacturer or Authorized Distributor if approved by engineer.
 - 1. All components and elements.
 - 2. Start-up and point verification.
 - 3. The testing and acceptance procedure.
- H. The cost of the work specified in this section is included in an allowance.
 - 1. Selection of subcontractor will be determined at a future date.

1.2 RELATED WORK

- A. Division 23, Mechanical
- B. Division 26, Electrical

1.3 SUBMITTALS

- A. Submit items of the Building Management and Control System (BMCS).
 - 1. Temperature control equipment & Field devices.
 - 2. Wiring & Flow diagrams.
 - 3. Sequence of operation.
 - 4. Complete, detailed, control and interlock-wiring diagram.
 - 5. Indicate mechanical and electrical equipment furnished and electrical interlocks,

indicating terminal designation of equipment. Respective equipment manufacturers shall furnish through the Mechanical Contractor, approved drawings of equipment to be incorporated in this diagram.

6. Submit Input / Output summary of all points.
7. Submit an outline of testing procedures from section Testing and Acceptance.
8. Mark up a copy of the specifications for the product. Indicate in the margin of each paragraph the following: "Comply, "Do Not Comply", or "Not Applicable". Explain all "Do Not Comply" statements.
9. Submit sample of space temperature sensor and guards for review prior to purchase or installation.

1.4 COOPERATION WITH OTHER TRADES

- A. Furnish control valves, temperature sensing element wells, flow and pressure sensing devices, dampers and other similar devices to the Mechanical Contractor in a timely manner for installation under the Building Management and Control System (BMCS), Subcontractor's supervision.

1.5 METERING AND VERIFICATION REQUIREMENTS

- A. This project is a CHPS applicant. Granular data, derived from the BAS and inherent to this specification, is to be handled in such a way as to support this certification. Granular data is defined as temperatures, set points, run times and utility monitoring. This data is to be monitored on a fifteen-minute interval basis and stored in the BAS database. The BAS must have the inherent capability to trend and display all information as described below.
- B. Monitoring software must include outside environmental condition data which affect building performance. Heating degree days and cooling degree days must be logged and formatted in such a way that the data may be used for comparative analysis of multiple facilities, this facility and any CyFair ISD facility on a historical basis over time. This data must be imported from a reliable, certified, third party source. On site instrumentation is not acceptable.
- C. Metering and Verification requirements must be inherent to the BAS. It cannot be a "bolt on" product. It shall be of no extra cost to the project. It shall be easily accessible from the graphical interface on the main screens. It shall also be accessible from the BAS navigation tree. Data must be retrieved and stored in the BAS module until it is archived on the BAS server. Data acquisition and storage must continue even if communication to the facility is lost. Data for utility consumption and environmental indexing must be stored on the server for a minimum of two years.
- D. All data described in this section shall be easily extractable, without external software or programming.

1.6 WARRANTY

- A. Provide with a manufacturer's parts and labor warranty for a period of two years from substantial completion. Warranty shall include unlimited telephone technical support during the warranty period.
- B. Provide DDC controllers with a manufacturer's parts and labor warranty for a period of 5 years from substantial completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Automated Logic Branch Office – WebCTRL
- B. Unify Energy Solutions – Reliable Controls

2.2 SYSTEM ARCHITECTURE

- A. The Building Management and Control System (BMCS) shall consist of an information-sharing network of stand-alone Direct Digital Control Panels (DDCP) to monitor and control equipment as specified of the control sequence and input/output summary.
- B. "Information sharing" shall be defined as: The function of each DDCP to exchange data on the network trunk with other DDCP's without the need for additional devices such as network managers, gateways or central computers.
- C. "Stand-alone" shall be defined as: The function of each DDCP to independently monitor and control connected equipment through its own microcomputer.

2.3 COMMUNICATIONS PROCESSING

- A. The BMCS shall operate as a true token-pass peer-to-peer communication network. Resident processors in each DDCP shall provide for full exchange of system data between other DDCP's on the network trunk. Systems that limit data exchange to a defined number of system points are not acceptable.
- B. Systems that operate via polled response or other types of protocols that rely on a central processor or similar device to manage DDCP to DDCP communications may be considered only if a similar device is provided as a stand-by. Upon a failure of malfunction of the primary device, the stand-by shall automatically, without any operator intervention, assume all BMCS network management activities.
- C. The failure of any DDCP on the network shall not affect the operation of other DDCP's. All DDCP failure shall be annunciated at the specified alarm printers and terminals.
- D. Network shall support a minimum communications speed of 115.2 Kbps.
- E. The network shall support a minimum of 100 DDC controllers and PC workstations.
- F. Each PC workstation shall support a minimum of 4 peer-to-peer networks, either by hardwired connection or dial up.
- G. The system shall support integration of third party systems (fire alarm, security, lighting, PCL, chiller, boiler) via panel mounted open protocol processor. This processor shall exchange data between the two systems for inter-process control. All exchange points shall have full system functionality as specified herein for hardwired points. Provide examples of 5 reference projects utilizing gateways required for this project.

2.4 DDCP HARDWARE

- A. Each DDCP shall consist of a 32-bit microprocessor and controller, power supply, input / output boards and communication board. All program and point databases shall be stored in battery-backed RAM. Provide a minimum of 1.2 MEG RAM in each DDCP to allow for point expansion and trend data storage.
- B. Each DDCP shall incorporate a real-time clock.
- C. Each DDCP shall be provided with two RS232 communications port. Connecting an operator terminal, whether portable or stationery, shall allow the user to communicate with the entire network.
- D. Each DDCP shall provide for input / output connections to field equipment. The following point types shall be supported:
 - 1. Analog inputs - for measuring sensed variables. Inputs shall be capable of accepting voltage, resistance, current or pressure signals.
 - 2. Analog outputs - for controlling end devices. Outputs shall be capable of producing voltage, resistance, current or pressure signals. Pneumatic outputs shall be provided with a manual override for adjusting outputs in the event of a power loss at the DDCP.
 - 3. Digital inputs - for monitoring dry contacts such as relays, switches, pulses, etc.

4. Digital outputs - to control two position devices such as starters, actuators, relays, etc.
- E. Each DDCP shall be listed under UL916 (Energy Management Systems), and shall be tested to comply with sub-part J of Part 15 FCC rules for Class A computing equipment.
- F. Each DDC Controller shall have sufficient memory to support its own operating system and databases, including:
 1. Control processes
 2. Energy management applications
 3. Alarm management applications including custom alarm messages for each level alarm for each point in the system.
 4. Historical/trend data for points specified
 5. Maintenance support applications
 6. Custom processes
 7. Operator I/O
 8. Dial-up communications
 9. Manual override monitoring
- G. Operator shall have the ability to manually override automatic or centrally executed commands at the DDC Controller via local, point discrete, on-board hand/off/auto operator override switches for digital control type points and gradual switches for analog control type points.
 1. Switches shall be mounted either within the DDC Controllers key-accessed enclosure, or externally mounted with each switch keyed to prevent unauthorized overrides.
 2. DDC Controllers shall monitor the status of all overrides and inform the operator that automatic control has been inhibited. DDC Controllers shall also collect override activity information for reports.
 3. **All BMCS control modules shall have Hand Off Auto (HOA) switches on all outputs for HVAC and electrical, including digital outputs.**
- H. DDC Controllers shall provide local LED status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device. Graduated intensity LEDs or analog indication of value shall also be provided for each analog output. Status indication shall be visible without opening the panel door.
- I. In the event of the loss of normal power, there shall be an orderly shutdown of all DDC Controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.
 1. Upon restoration of normal power, the DDC Controller shall automatically resume full operation without manual intervention.
 2. Should DDC Controller memory be lost for any reason, the user shall have the capability of reloading the DDC Controller via the local RS-232C port, via telephone line dial-in or from a network workstation PC.
 3. Upon restoration of normal power, the DDC Controller shall automatically resume full operation without manual intervention.

2.5 PROGRAMMING FUNCTIONS

- A. Resident software in each DDCP shall provide custom programming of control strategies.
 1. Point database
 2. Operator interface
 3. Network communications

4. Facilities and energy management functions
- B. Programming of control and energy management strategies shall be accomplished via a high-level computer language such as BASIC, JC BASIC, C, or Powers Process Control Language. A standard math processor shall be part of the programming language. All analog loops shall be capable of proportional, integral and derivative control.
- C. Each DDCP shall incorporate an operator interface program (OIP) that provides an English language user interface. The OIP shall allow the user to program, interrogate, command and edit the BMCS via a self-prompting method. Operator terminals, whether textual or graphical, shall be able to access the entire network from any DDCP. Access shall be accomplished in a transparent fashion; that is, the operator shall not be required to address specific DDCP's in order to display or command system points.

2.6 FACILITY MANAGEMENT SOFTWARE

- A. The BMCS shall be provided with standard and custom report generation functions that include:
 1. Alarm summaries
 2. Motor status summaries
 3. Point displays by type, system, status, overrides, failures, location, equipment and enabled/disabled.
 4. Program listings
- B. All reports shall be either displayed or printed by:
 1. Operator request.
 2. Time of day.
 3. Event conditions (such as in response to an alarm, interlock, etc.).
- C. All reports shall be time and date stamped.
- D. An alarm-processing program shall be provided to annunciate those points designated as alarmable. Alarm points shall, upon alarm occurrence, be displayed or printed at designated terminals.
- E. Historical trend data shall be collected and stored at each DDCP for later retrieval. Retrieval shall be manual or automatic. Any point, physical or calculated, may be designated for trending. The system shall allow for two methods of trend collection: Either by a pre-defined time interval sample or upon a pre-defined change of value. Trend data shall be presented in a columnar format. Each sample shall be timed stamped. Trend reports may be a single point or may be a group of points, up to a maximum of (8) points in any single group. Any point, regardless of physical location in the system may become part of a multiple point group.
- F. Each BMCS network shall provide a point-monitoring function that can display single or multiple points in a continuous updated fashion for dynamic displays of point values.
- G. A database and configuration report program shall be provided that allows the user to interrogate BMCS status. As a minimum, the user shall be able to: Verify available RAM at each DDCP, verify DDCP status (on-line, off-line, and failed) and set the system clock.
- H. Any invalid operator entry shall result in an error message.
- I. DDCP's shall contain a password access routine that will assign an operator to one of three level of access. Level 1 shall permit display function only, level 2 shall additionally permit commanding of system points and level 3 shall additionally permit full program and database editing.
- J. DDCP's shall provide for the accumulation of totalized values for the purposes of run-time or energy totalization. Totalized values may be displayed or printed automatically or by operator request.

2.7 ENERGY MANAGEMENT SOFTWARE

- A. The BMCS shall be provided with an optimal start program such that the building may be divided into ten zones for optimum start. Warm-up and cool-down shall occur in sequence with succeeding zones starting only after the preceding zone has completed its warm-up or cool-down.
 - 1. The optimum start-up time of assigned equipment shall be determined based on a software calculation that takes into consideration outdoor air conditions, space conditions, and building thermal characteristics ("U" factor).
 - 2. The optimum start program shall control start-up of the cooling and heating equipment to achieve the target occupancy space temperature at the precise time of building occupancy.
 - 3. A built-in "learning" technique shall cause the BMCS to automatically adjust itself to the most affective time to start equipment based on historical data.
- B. The BMCS shall be provided with an operator interactive time of day (TOD) program. TOD programming and modifying shall be accomplished in a calendar-like format that prompts the user in English language to specify month, year, day and time and associated point commands. It shall be possible to assign single points or groups of points to any on or off time. Appropriate time delays shall be provided to "stagger" on times.
 - 1. TOD shall incorporate a holiday and special day schedule capability, which will automatically bring up a pre-defined holiday or special day schedule of operation. Holidays or special days can be scheduled up to one year in advance.
 - 2. In addition to the time dependent two-state control, TOD also provides time dependent setpoint control. This control provides the capability to output assignable, proportional setpoint values in accordance with the time of day and day of week. This program shall be used to accomplish night setback, morning warm-up and normal daily operating setpoints of all control system loops controlled by the BMCS. As with the two-state control, time dependent setpoint control shall be subject to the holiday schedule. The setpoints desired shall be user definable at any operator terminal.
 - 3. The operator shall be capable of reading and/or altering all sorted data pertaining to time of day, day of week, on/off times, setpoint values, and holiday designation.
 - 4. The TOD program shall also provide an override function that allows the user to conveniently change a start or stop time for any point up to one week in advance. The override command shall be temporary. Once executed the TOD program shall revert to its original schedule.
 - 5. The TOD program shall interface with the optimal start program (OSP) such that stop times may be assigned by OSP.
- C. Additional Program functions required are to be installed and programmed as requested by end user at no additional cost:
 - 1. Enthalpy optimization.
 - 2. Supply air reset.
 - 3. Hot water reset.
 - 4. Chilled water reset.
 - 5. Volumetric control.
 - 6. Dead band control. Install dual set points as requested by user.
 - 7. All specified energy management programs, whether or not applicable to this project shall be provided such that the owner may enable the program at a future date without the need to purchase additional software or modify existing software.
 - 8. Time lapse graphics
 - 9. Global point commands

2.8 WEB SERVER ACCESSIBILITY

- A. Industry leading encryption technology to provide accessibility through a web browser.
- B. Building Manager's ability to access, view and command critical building information in real time over the intranet or internet.
 - 1. Alarm Display
 - 2. Point Commanding
 - 3. Graphic Display
 - 4. Scheduling
 - 5. Running Reports
 - 6. Point Details

2.9 REMOTE NOTIFICATION

- A. Remote notification sends Alarm and System Event information to various notification devices as indicated below but not limited to. Operators can receive their building automation system alarms without restricting them to dedicated workstations.
 - 1. Alphanumeric pagers
 - 2. Numeric pagers
 - 3. Email
 - 4. Phones via voice or short message service (SMS) Text Messaging

2.10 POINT EXPANSION MODULES

- A. Capable of extending its input/output capabilities via special purpose modules.
 - 1. Modules may be mounted remote from the DDCP.
 - 2. Shall communicate with the DDCP over a pair of twisted cables.
 - 3. Operator shall have the ability to manually override automatic or centrally executed commands at the DDC Controller via local, point discrete, on-board hand/off/auto operator override switches for digital control type points and gradual switches for analog control type points.
 - 4. **All BMCS control modules shall have Hand Off Auto (HOA) switches on all outputs for HVAC and electrical, including digital outputs.**

2.11 TERMINAL EQUIPMENT CONTROLLERS

- A. Provide for control of each piece of equipment, including, but not limited to, the following:
 - 1. Variable Air Volume (VAV) boxes
 - 2. Constant Air Volume (CAV) boxes
 - 3. Dual Duct Terminal Boxes
 - 4. Unit Conditioners
 - 5. Variable Refrigerant Volume DX System
 - 6. 100% Outside Air Split System
 - 7. Room Pressurization
 - 8. Fan Coil Units
- B. Include the following items:
 - 1. All input and outputs necessary to perform the specified control sequences.
 - a. Analog outputs shall be industry standard signals such as 24V floating control.
 - 2. Sufficient memory to accommodate point database, operating programs, local alarming and local trending.
 - 3. All databases and programs shall be stored in non-volatile EEPROM, EPROM and PROM, or minimum of 100-hour battery backup shall be provided.

4. Return to full normal operation without user intervention after a power outage of unlimited duration.
5. Operation programs shall be field selectable for specific applications.
6. Specific control strategy requirements, allowing for additional system flexibility.
7. Controllers that require factory changes of all applications are not acceptable.

2.12 ELECTRONIC DAMPER ACTUATORS

- A. Two position damper operators:
 1. Spring return to full travel position.
 2. Built in auxiliary switches (motor end switches)
 - a. Switch shall be fully adjustable so that cut-in/cut-out points may be preset at any point within angular travel of the motor.
 3. Minimum torque 60-in-lb
- B. Modulating damper operators:
 1. Sized with sufficient reserve power to provide smooth modulating action and tight close off against the system pressure
 2. Select the operator with available torque to exceed the maximum required operating torque by not less than 50%
 3. Minimum torque 100 in-lb

2.13 ETHERNET CARD

- A. Ethernet Card:
 1. Local area network connection interface card.

2.14 CONTROL CABINETS

- A. Fully enclosed NEMA 1 for indoors, NEMA 4 for outdoors.
 1. Powder coat painted on all sides
 2. Cabinet with continuously piano type hinged door
 3. Locking latch
 4. All locks shall use a common key
 5. Devices on the panel face must be identified with engraved nameplates.
 6. Panels or termination panels must be identified with engraved nameplates.
 7. Provide enamel beige finish and extruded aluminum alloy frame UL 50 certified.

2.15 REFRIGERANT MONITOR

- A. Infrared Halogen Gas monitoring system for low level continuous monitoring of numerous CFC, HFC and HCFC halogen gases used in most refrigeration and air conditioning systems.
- B. Two years parts and labor warranty.
- C. Analyzer:
 1. Microprocessor based
 2. Infrared (IR) sensor technology
 3. Sensing down to 1 (PPM)
 4. Monitor multiple compounds
 5. Automatic calibration
 6. Synchronous 2 wave length infrared filterometer
 7. Insensitive to vibration and temperature variations.
 8. Response Time: Min.5 sec / Max. 90 sec.
 9. Sampling Mode in Auto and Manual operation
- D. Multi-Point Sampling System:
 1. Minimum of six sample points

2. Adjustable sampling time, with optional skip and hold features for each point.
 3. Sample lines up to 500' in length
 4. Three stage alarms for each point
 5. Flow loss and malfunction indicators
 6. Individual relay contacts for each set of channel alarms.
 7. Infrared detection
- E. Alarming and Display:
1. Digital display in PPM/PERCENTAGE
 2. Provide a 0-10V and 4-20mA output for direct input into the Building Management System or Direct Digital Control System.
 3. Adjustable three level alarm for each point shall and be supplied with common alarm output contacts.
 4. Provide local digital indication of PPM level for each sample point.
 5. Loss of any sample flow
 6. Identify alarm point by flashing display and actual PPM.
 7. Automatic zero mechanism and malfunction indicators.
 8. Silence audible alarm switch with re-activation after adjustable time delay.
- F. Power requirement:
1. 120 VAC
- G. Audible sound pressure level of at least 15Dba above the operating ambient noise level within machine room and providing a distinctive strobe type visual alarm both inside and out side machine room at each entrance. Ceiling mounted rotating beacon in center of machine room. Strobes shall be provided immediately adjacent to and outside of each refrigeration machinery room exit. A clearly identified switch of the break-glass type shall be provided immediately adjacent to and outside of each refrigeration machinery room exit.
- H. Acceptable manufacturers:
1. General Analysis Corporation
 2. Yokogawa Corporation
 3. MSA
 4. Sherlock
 5. Vulcain

2.16 AUTOMATIC CONTROL VALVES

- A. Pressure ratings: Minimum 125 psig or 1.25 times maximum system operating pressure.
- B. Construction:
1. 2" and smaller:
 - a. Screwed.
 - b. Bodies and internal parts: Bronze, stainless steel or other approved corrosion-resistant metal.
 2. 2-1/2" and larger:
 - a. Flanged.
 - b. Bodies: Cast iron or cast steel.
 - c. Seats and parts exposed to fluid: Bronze, stainless steel or other approved corrosion-resistant metal.
 3. Characterized port ball valves are acceptable for VAV terminal units only.
- C. Modulating straight through water valves: Equal percentage contoured throttling plugs.
- D. Three Way Mixing Valves: Linear throttling plugs allowing total flow through valve to remain constant regardless of position.
- E. Sizes: By Automatic Control System Manufacturer for fully modulating operation.
1. Minimum pressure drop: Equal to pressure drop of coil or exchanger.

2. Maximum pressure drop: 5.5 psi.
3. Relief and bypass valves: Sized according to pressure available.
4. 2-position valves: Line size.
5. Manual by-pass operator.
- F. Electronic Actuator:
 1. Direct coupled installation
 2. Visual and electronic stroke indicator
 3. Die-cast aluminum housing
 4. Manual override
 5. Self-lubricating bearing and gear train
 6. Automatic calibration
 7. Automatic duty cycle protection
 8. Overload and stall protection
 9. Non-spring return
 10. Floating /0-10 VAC / 4-20mA operation
 11. UL approved
 12. Provide smooth modulating action and tight close off against the system pressure.
 13. Torque to exceed the maximum required operating torque by not less than 50%.
 14. Actuator input signal shall be compatible with output DDC controller.
 15. Provide weatherproof enclosure (exterior use).
 16. Damper actuators not acceptable for valves.
- G. Cooling Tower By-Pass and Chiller / Cooling Tower Isolation Valves & Actuators:
 1. Valve Bray (Series 3L or NYL)
 - a. Line Size Valve
 - b. Under-cut disk for smooth operation
 - c. Full Lug Valve
 - d. Cast Iron Body
 - e. EPDM - Seat
 - f. 416 Stainless Steel Stem
 - g. Nylon Coated Ductile Iron Disc
 - h. Disc-to-stem connection shall utilize a double "D" or key design requiring no screws or pins to connect stem to disc.
 2. Electronic Actuator: Bray (Series 70)
 - a. Fully configurable without need for software or handheld settings device
 - b. Direct Mount
 - c. Solid state speed control
 - d. Visual and electronic stroke indicator.
 - e. Anti-Condensation Heater (exterior actuators)
 - f. Die-cast aluminum housing.
 - g. Manual override by means of hand wheel
 - h. Self-lubricating bearing and gear train.
 - i. All steel self-locking output gearing to be provided
 - j. Continuous Duty Rated Motor
 - k. Overload and stall protection.
 - l. Floating /0-10 VAC / 4-20mA operation.
 - m. Mechanical Travel stops
 - n. UL approved.
 - o. Smooth modulating action.
 - p. Tight close off against the system pressure.
 - q. Sized to exceed 150% of the maximum required operating torque of the valve while under the maximum rated shut-off pressure

- r. Actuator input signal shall be compatible with output DDC controller.
 - s. Provide weatherproof enclosure
 - t. Damper actuators not acceptable for valves.
- H. Variable Primary Flow By-Pass Control Valve:
- 1. Modulating straight through control valve with equal percentage contoured throttling plug and electronic operator.
 - 2. Maximum pressure drop: 10 psi
 - 3. Sized for minimum flow of one chiller
 - 4. Torque to exceed the maximum required operating torque by not less than 150%.

2.17 DIFFERENTIAL PRESSURE SWITCHES

- A. Wet/wet differential pressure switch
 - 1. Integral Mounting Frame
 - 2. Watertight, dust-tight, and corrosion resistant enclosure.
 - 3. Wetted materials of brass and flouroelastomer.
 - 4. Externally adjustable set point
- B. Approved manufacturer:
 - 1. Square D #9012GGW4
 - 2. Dwyer #DXW-11-153-1
 - 3. Carrier #HK06ZC033

2.18 TEMPERATURE LOW LIMIT SWITCH

- A. Responsive to the coldest 1' section of its length.
 - 1. Double pole single throw switch
 - 2. 20' capillary
 - 3. Line voltage with bellows actuated switch
 - 4. Auto reset for outdoor installation
 - 5. Manual reset for indoor installation

2.19 TEMPERATURE AND HUMIDITY SENSORS

- A. Space Temperature Sensors
 - 1. Thermistor with resistance of 10,000 ohms at 77°F.
 - 2. Accuracy shall be +/-1/2°F.
 - 3. Range of 45° to 95° F operating range.
 - 4. Provide manufacturers calibration certificate.
 - 5. Flush Mounted
 - a. Stainless steel flush mount sensor, submit sample for review.
 - 6. Location and height to be approved by Architect/Engineer prior to installation.
- B. Space / Duct Humidity Sensor
 - 1. Capacitance element in the space or duct as required and output a 4 to 20 MA signal proportional to 0 to 100% RH to the DDC.
 - 2. Capacitance element shall be field replaceable and not require calibration.
 - 3. Accuracy shall be +/-2% in the range from 20 to 95% RH.
 - 4. Relative humidity sensors shall have the sensing element of inorganic resistance media.
 - 5. Provide locking metal covers suitable for institutional use. Submit sample for review.
 - 6. Provide manufacturers calibration certificate.
 - 7. Provide metal guards in the following locations:
 - a. Corridors

- b. Cafeteria
 - c. Kitchen.
 - d. Gymnasium.
 - e. Dressing Rooms.
 - f. Industrial Labs.
- C. Duct Temperature Sensors
- 1. Range of 20° to 120°F.
 - 2. Single point sensing of temperature.
 - 3. Averaging elements of sufficient length to sense temperature across 2/3 duct width.
 - 4. Averaging elements of sufficient length to provide accurate, representative indication and control.
 - 5. Averaging elements of sufficient length to prevent variances in temperature or stratification.
- D. Liquid Immersion Temperature Sensors
- 1. Platinum type resistance temperature detector (RTD).
 - 2. Match sensor range to medium being monitored.
 - a. Hot water range 30° to 250°F.
 - b. Chilled Water 20° to 70°F.
 - 3. Furnish stainless steel wells for installation by Mechanical Contractor.
 - 4. Locate all sensors in field with Owner/Engineer present.
 - 5. System accuracy for liquid temperature sensing shall be +/-1/2°.
 - 6. Sensors must be removable from wells.
- E. Outside Air Temperature and Humidity Sensor
- 1. Temperature
 - a. Range of -40° to 140°F.
 - b. Accuracy shall be +/-0.9°F
 - c. Encapsulated into Type 304 stainless steel tubes with low conductivity moisture proofing material and lag extension for thickness of insulation.
 - 2. Humidity
 - a. Capacitance element in the space or duct as required and output a 4 to 20 MA signal proportional to 0 to 100% RH to the DDC.
 - b. Accuracy shall be +/-2%
 - c. Range from 20 to 95% RH.
 - d. Relative humidity sensors shall have the sensing element of inorganic resistance media.
 - 3. Weatherproof sun shield consisting of multiple white plastic plates to reduce the thermal effects of the sun and increasing air flow between the plates.
 - 4. Sensor shall be mounted a minimum of 6" from all building structures.
 - 5. Minimum of 8' long leads.
 - 6. Provide manufacturers calibration certificate.
 - 7. Provide with a 5-year warranty
 - 8. Manufactured by ACI Model # A/-RH2-AN-O-SUN---NIST
- F. Freezer / Cooler Sensors
- 1. Thermistor with resistance of 10,000 ohms at 77°F.
 - 2. Accuracy shall be +/-1/2°F.
 - 3. Range of -40°F to 210°F.
 - 4. Provide manufacturers calibration certificate.
 - 2. Die cast aluminum construction
 - 3. Liquid tight wire connector to isolate sensor chamber from exterior temperature

influence.

4. 1/2" NPT threaded hub
5. Mamac Systems Model #TE-205-F-12
6. Reuse existing wiring penetrations through cooler or freezer where possible. If existing penetrations through cooler or freezers cannot be reused, seal existing holes with silicon such that opening is airtight.
7. All new penetrations into the cooler or freezer body shall be sealed airtight using silicon. This shall include screw holes and wiring penetrations.

2.20 CURRENT SENSITIVE RELAYS

- A. Ensure compatibility with VFD applications for variable speed motor status.
 1. Provide with adjustable set point.
 2. Relays must be mounted and not hung by power wires thru CT.
 3. Provide split-core type current sensors.
 4. Loop powered.
 5. LED Status.
 6. Acceptable Manufacturer: Veris Industries / Hawkeye
 7. Relays shall close status contacts in response to current flow in power leads to the equipment being monitored.
 8. To be used on towers, vertical turbine pumps, exhaust fans and direct drive equipment only.

2.21 DIFFERENTIAL PRESSURE TRANSDUCER

- A. Transducers to convert differential pressures to 4-20 MA analog outputs.
 1. Solid state pressure sensor with accuracy of +/- 1% of calibration range.
 2. Factory calibrated and have zero and span trimmers for field calibration.
 3. Range shall be selected to match the medium being monitored.
 4. Pressure snubbers to protect from pressure pulses and a 3-way bypass / valve assembly to protect the transducer from overpressure damage during start-up.
 5. LCD Display
 6. Acceptable Manufacturer: Rosemount 1151 or 3051 Pressure Transmitter

2.22 FLOW DIFFERENTIAL PRESSURE SWITCH

- A. The pressure sensing element shall be of the convoluted diaphragm type for sensitivity to system differential pressure.
 1. Select the pressure range based on the sensed differential pressure.
 2. The unit shall be protected against overpressure to the full static pressure rating.
 3. Accuracy: +/- 2% of full scale.
- B. Switch assembly.
 1. Reed switch.
 2. NEMA-4 enclosure.
 3. Threaded boss conduit entrance.
 4. SPST action.
 5. Voltage and rating as required for the control circuit.
- C. Wetted parts shall be made of type 303 stainless steel.
- D. Install an isolation valve in each sensing pipe leg to permit servicing without shutting the system down.

2.23 ELECTRIC REMOTE BULB THERMOSTAT

- A. Two position remote bulb thermostat:
 1. Bimetal controlled.

2. Sealed mercury switches.
3. Provide specified control action.
4. Adjustment can be made by removing unit cover.
5. Element with capillary length as required for the location.

2.24 ELECTRIC SPACE THERMOSTAT

- A. Two position space thermostat.
1. Single Pole switch actuated by bi-metal sensing element.
 2. Range shall be 60°F to 90°F.
 3. Removable external knob adjustment means.

2.25 HIGH STATIC PRESSURE SWITCH

- A. With manual reset switch
1. Approved manufacturer: Cleveland AFS-460.

2.26 INSERTION FLOW SENSORS

- A. Electromagnetic Flow Meter
1. Retractable hot tap flow sensor
 2. Accuracy: +/- 1% of full scale
 3. Electromagnetic
 4. Custom thread-o-let 400 psi / 250 degree F rated.
 5. Line size from 1-1/4 to 72 inch
 6. Metering range from 0.3 to 15 f/sec.
 7. Remote NEMA 4 wall mounted LCD display
 8. Field Pro Software & Communicator
 9. Warranty two years
 10. Approved Manufacturer Onicon Flow Meter F3500 or FT3500

2.27 CONTROL DAMPERS

- A. Opposed blade dampers:
1. Frames of 13-gauge galvanized sheet metal.
 2. Provisions for duct mounting.
 3. Damper blades not exceeding 8" in width.
 4. Blades of two sheets of 16-gauge galvanized sheet metal.
 5. Blades suitable for high velocity performance.
 6. Bearings of nylon or oil-impregnated, sintered bronze.
 7. Shafts of 1/2" zinc plated steel
 8. Leakage does not exceed 1/2% based on 2000 fpm and 4" static pressure.
 9. Replaceable resilient seals along top, bottom and sides of frame and blade edge.
 10. Submit leakage and flow characteristics data with shop drawings.
 11. Linkage shall be concealed out of the air stream within damper frame.
 12. Acceptable Model is Ruskin Model CD60.

2.28 PHOTO CELL CONTROL

- A. Light Sensitive Resistor:
1. 4-20 output or switch
 2. On = 3.0 / fc. Off 10.0 / fc
 3. UL Approved

2.29 DRAIN PAN FLOAT SWITCH

- A. Rated at 10 Amps:

1. Shuts off equipment if water level becomes too high.
2. DPDT Contacts.

2.30 BY-PASS AUTOMATIC SHUT-OFF TIMERS

- A. Rated at 10 Amps, 125 VAC:
1. Shuts off equipment with timed switch
 2. White decorated timer
 3. Without hold feature
 4. Time Cycle 60 minutes

2.31 TEMPERATURE/CO₂ SENSOR

- A. Sensor combo in one housing, Temperature and CO₂.
- B. Provide combo temperature/CO₂ sensor in the following locations:
- a. Each Classroom
 - b. Library
 - c. Cafeteria
 - d. Gymnasium
- C. 0-2,000 ppm CO₂
- D. CO₂ sensor shall have a self-calibration feature.
- E. Temperature accuracy shall be +/-1/2°F.
- F. Temperature range shall be 32° to 120° F
- G. Location and height to be approved by Architect/Engineer prior to installation.
- H. Internal RJ11 Communication jack at sensor for communications.
- I. Provide metal guards in the following locations:
- a. Corridors
 - b. Cafeteria
 - c. Kitchen.
 - d. Gymnasium.
 - e. Dressing Rooms.
 - f. Industrial Labs.
- J. Color to be approved by Architect / Owner, submit sample for review.

2.32 AIR FLOW SENSING SWITCH

- A. The pressure sensing element shall be of the convoluted diaphragm type for sensitivity to system positive, negative, or differential pressure.
1. Select the pressure range based on the sensed differential pressure.
 2. The unit shall be protected against overpressure to the full static pressure rating.
 3. Accuracy: +/- 2% of full scale
- B. Switch assembly:
1. Reed switch
 2. Field adjustable setpoint
 3. Threaded boss conduit entrance
 4. SPST Action
 5. Voltage and rating as required for the control circuit

2.33 HVAC SHUTDOWN STATION

- A. Shutdown Switch:
1. Yellow Mushroom Button within a clear plastic cover
 2. Latches when depressed
 3. Twist reset
 4. Sign "HVAC SHUTDOWN"

5. Manufactured by STI Model # SS2231HV-EN

2.34 CARBON MONOXIDE MONITORING SYSTEM

- A. Provide and install a manual reset Carbon Monoxide Detector located within the boiler room. The Carbon Monoxide Detector and the boilers and gas water heaters shall be interlocked so that the burners will not operate when the level of CO in the room rises above 50ppm. The Carbon Monoxide detector shall disable the boiler's or gas water heater's burner upon loss of power to the detector.
- B. Carbon Monoxide Sensor with two year warranty by U.S. Draft Co. Model CGM-605 with model XB expansion module or Greystone Model CMD5B series.
 1. Provided with pre-programmed dry contacts to shut down equipment during unsafe operation.
 2. NEMA 1 Enclosure
 3. Complies with Texas State Boiler Code 65.603-2015
 4. Additional features shall include 0-10 VDC control signal out, visual alarm and audible alarm.
 5. Provide expansion board for additional equipment interlocks.

PART 3 - EXECUTION

3.1 REPLACEMENT OF EXISTING BMCS SYSTEMS

- A. Complete replacement of the existing Building Management and Control Systems at this campus shall include the following:
 1. Remove all existing control devices and replace with new.
 2. Remove all existing wiring and replace with new.
 3. Replace all of the existing control valves at each coil including but not limited to AHUs, FCUs, and zone terminal units.
 4. Replace all of the existing dampers and damper actuators on exhaust fans, terminal units, outside air intake and relief hoods or etc.
 5. Remove all existing BMCS control cabinets and provide new.
 6. Existing control conduits may be reused. All existing control conduit being abandoned shall be removed.
 7. New wiring shall not be routed in the same conduit or pathway as any high voltage wiring.
 8. The owner shall be given first right of refusal on all existing control devices.
 9. All exhaust fans, outside air intakes, and relief vents shall be equipped with motorized dampers upon completion of project. Provide new dampers and actuators.
- B. The new BMCS system shall maintain control of all equipment and devices currently on the BMCS system. The existing building control system points list is available upon request and contains all point to be control upon completion of this project.
- C. It is the responsibility of the contractor to ensure all equipment is under control of a BMCS system prior to the building system being started and building becoming occupied. This includes intermediate systems startups due to phased construction.
- D. Verify operation of all existing equipment prior to adding existing equipment to new control system. Notify engineer/owner of inoperable equipment.
- E. Contractor is to maintain safety interlocks during all phases of the BMCS installation. This includes providing temporary rough-ins of high static limits to VFD shut downs, freeze stat interlocks to starters/VFDs, etc. The wiring for these rough-ins may be run in a temporary fashion overhead, exposed and unsupported as long as the wiring is not in the path of the normal construction movement in the space. Wires laying on the floor and/or in the path of other workers in not acceptable at any time. These safeties are to be

maintained until the AHUs controls are downloaded, commissioned, and operating in automatic mode per sequence of operations.

- F. **All existing Trane controls that are being removed from project shall be returned to owner. Components shall be stored in a clean and dry environment and delivered to Cyfair ISD Maintenance upon completion of demolition phase.**

3.2 INSTALLATION

- A. The control system shall be installed and final adjustments made by full-time employees of the factory-approved BMCS Building Management Control Subcontractor.
- B. The contractor shall collaborate through Architect / Engineer and Owner to determine the Owner's preference for naming conventions, etc. before entering the data in to the system.
- C. Due to actual operational or space conditions, it may be necessary for the Contractor to make sequence of operation modifications and/or controller adjustments, change the location or type of sensor to obtain proper operation and coverage of the system in each room or space. These change, if requested by the Owner or Engineer, shall be performed at no additional cost to the Owner. Therefore, labor allowances should be made for such changes and adjustments if requested.

3.3 INTERLOCK AND SAFETY CIRCUITS

- A. Close the outdoor air dampers when the related HVAC unit supply or exhaust fan is de-energized:
1. The damper and actuators are specified in this section.
 2. Outdoor air damper shall be fully opened before related air handling unit fan is energized for 100% outside air use.
 3. Provide motorized outside air dampers for the following:
 - a. Supply fans
 - b. AHUs
 - c. Exhaust fans (except kitchen exhaust)
 - d. Outside air intakes
 - e. Relief air hoods
- B. Close the chilled and hot water valves to the coil when the related unit is de-energized.
- C. Interlock each chiller to start its dedicated chilled and condenser water pumps. Interlock pressure differential switch and pump auxiliary contacts in series to chiller safety terminal strip.
1. On shutdown provide a circuit to permit the chilled water pumps and condenser water pumps to run while the chillers pump down as required by the manufacturer.
 2. As per manufacturer's recommendations.
- D. Primary chilled water control:
1. Operating and safety controls are furnished as an integral part of the water-chilling unit and not specified in this section.
 2. Provide pressure differential switch located in the chilled water and condenser water piping to each water-cooled liquid chiller.
 - a) Interlock to prevent operation in the absence of flow.
 - b) This may not be the prime controller to start/stop the chiller.
 - c) Interlock thru pump auxiliary contacts.
 3. Provide a high limit temperature sensor in each primary chilled water pump loop.
- E. Exhaust/Supply Fans:
1. Interlock the related exhaust and supply fans and the related outside air damper.
 2. Interlock the exhaust fans with the related air-handling unit through software. The new BMCS shall integrate all existing fan interlocks.

3. Interlock related exhaust fan for dishwasher with time delay off relay.
 4. Interlock related exhaust fan for kiln with time delay off relay
 5. Interlock kitchen hood related supply and exhaust fans.
 6. Provide additional interlocks as indicated on fan schedule and on drawings.
 7. Interlock electrical and mechanical room exhaust fans with thermostat.
 8. Interlock refrigerant monitor with mechanical room purge system.
 9. Interlock science room related supply and exhaust fans.
 10. Interlock outside air supply fans for VAV air-handling unit with air-handling unit status point.
- F. Cooling Tower Fan Safety Interlock: Provide interlock wiring for the vibration sensor and oil level switch on each cooling tower fan.
- G. Freeze Protection:
1. Provide a freeze protection sequence to ensure proper operation of equipment during a freeze condition not limited to the following:
 - a. Outside Air Handling Units & Supply Fans with heating and cooling coils: If unit is in occupied or unoccupied mode, upon the triggering of software point indicating a freeze condition or the low temperature sensor (freeze stat) indicates a freeze condition, the system will be disabled, close the outside air damper, open both heating and cooling valves to enable full flow condition. If heating coil discharge air sensor indicates a failure to control and is below setpoint then enable software point indicating a freeze condition, disable unit, close outside air damper, and open both heating and cooling valves to enable full flow condition. Ensure HW & CHW pumps are operational.
 - b. Boilers - Enable during a freeze condition.
 - c. Air Cooled Chillers – enable pumps, run cycle for 15 minutes per hour, open all chilled water valves.
 - d. Protect heating water coils downstream of DX cooling coil with freeze protection. If unit is in occupied or unoccupied mode, upon the triggering of software point indicating a freeze condition or the low temperature sensor (freeze stat) indicates a freeze condition, the system will be disabled, close the outside air damper, disable the DX cooling coil. If heating coil discharge air sensor indicates a failure to control and is below setpoint then enable software point indicating a freeze condition.
 2. Temperature low limit switch wired with double pole single throw switch with one switch leg hard-wired to de-energize fan and one switch leg to signal BMCS.
- H. Drain Pan Float Protection:
1. Interlock to shut down unit and close valves.
 2. Cooling Coils mounted above ceiling and in roof mounted units.
 3. Provide for each cooling coil location.
 4. Signal BMCS alarm point
- I. HVAC Shutdown Station:
1. Provide an emergency mushroom style push / pull station shutdown switch in a Administration Area or as directed by Owner / Architect.
 2. Signal the building automation system to de-energize the HVAC equipment.
 3. This is to stop exhaust fans and outside air units immediately.
 4. Other air handling units, chillers and equipment shall be shut down in an orderly manner so as to not damage the equipment.
 5. Once stopped, the system may only be restarted by relatching the emergency push button switch.

- J. Science Room Utility Controllers:
 - 1. Interlock the utility controllers with related air-handling unit through software.
- K. Domestic Water System:
 - 1. Interlock in-line circulating pumps at water heaters with return water pipe mounted thermostat to cycle pump with return water temperature.
 - 2. Interlock high temperature entering water solenoid valve with thermostat on discharge side of tempered water mixing valves.
- L. Condensing Hot Water Boilers:
 - 1. Interlock each boiler to start its dedicated pump.
 - 2. Install communication cable between each boiler and master controller specified by boiler manufacturer.

3.4 GRAPHICS

- A. Furnish as-built drawings indicating finally corrected "as installed" diagram(s) of the complete Building Management Control System.
 - 1. Modification of existing control systems shall be included.
 - 2. These must be as-built and any changes during the warranty period drawings must be revised and updated.
 - 3. Provide final sequence of operation in written format.
- B. Provide a set of the "as installed" diagram(s) of the complete control system laminated in plastic and hung in the main mechanical room or as directed by Owner.
- C. Provide a color-coded floor plan of the building showing the location of each system, and the area served by each AHU or related zone. These must be of professional quality. Floor plan is to hang in main mechanical room near central control panel.
- D. Provide computer graphics for each system.
- E. Provide final graphic room numbers as selected by District. Any changes during the warranty period shall be included.
- F. Provide a summary page for each type of equipment. Summary pages shall be provided for, but not limited to, DDB, EF, AHU, CH, CT, Pumps, and FCU. Summary pages shall include the ability to modify the global set points for each equipment type.
- G. Provide an alarm management and reporting graphical page. This page shall allow user to create, acknowledge and adjust alarms. All alarms shall have the ability to be selectable for remote notifications and control which personnel is notified.
- H. System shall include a graphical page that contains building and system related documents stored for ease of remote access.
- I. System shall include a real time dynamic dashboard to provide real time analysis of conditions and equipment performance.
- J. System shall include a real time dynamic Central Plant Energy / Status dashboard. Dashboard shall display the following at a minimum:
 - 1. Actual Plant operating Tons
 - 2. Total Plant Capacity Available
 - 3. Percent Usage of Available Capacity
 - 4. Current Plant operation KW/Ton
 - 5. Current Chiller KW/Ton
 - 6. Bar Chart indicating energy consumption by plant component (Chillers, CW Pumps, CHW Pumps and Exhaust Fans)
 - 7. Tables for Chillers, Chilled Water Pumps, Condenser Water Pumps, and Cooling Tower Fan. The chart shall indicate S/S, Status, KW Consumption, Alarm Status Running AMPS on Chillers.
 - 7. Trending Graph (Total Chiller KW/Ton and Total Plant KW/Ton)

3.5 IDENTIFICATION

- A. Provide a laminated engraved nameplate on all control panels and devices shown on the "as installed" control diagrams. Coordinate engraving with nomenclature used on the diagrams.
- B. A black-white-black laminated plastic engraved identifying nameplate shall be secured to each terminal cabinet, and control panels. Identifying nameplates shall have ½ inch high, engraved letters.
- C. A red-white-red 2"x8" laminated plastic engraved identifying nameplate shall be secured to each audible/visual alarm and emergency shutdown device. Provide identification and location of each A/V device laminated in plastic and hung at refrigerant monitor with identification, location of devices and proper operation of system in a graphic floor plan with written sequence of operation. Identifying nameplates shall have ½ inch high, engraved letters. A red-white-red 12"x12" laminated plastic engraved identifying nameplate shall be secured to outside of each door to machine room with "A REFRIGERANT LEAK HAS BEEN DETECTED IN THIS BUILDING WHEN AUDIBLE/VISUAL ALARM IS ENABLED. DO NOT ENTER. CONTACT MAINTENANCE DEPARTMENT."

3.6 WIRING FOR BUILDING MANAGEMENT AND CONTROL SYSTEMS

- A. Furnish and install all wire, conduit, raceways and cable systems required for the complete operation of the Building Management and Control System. In addition, furnish, and install all wire, conduit, raceways and cable systems required with the VRF system in the Administration area.
- B. All wiring for the Building Management and Control System is specified in this section and includes, but is not limited to:
 - 1. Wiring of interlock system.
 - 2. Wiring of control instruments.
 - 3. Wiring of control panels.
 - 4. Wiring of related power supplies, i.e. transformers.
 - 5. Wiring of 120 VAC power circuits for control panels and devices.
- C. All materials and methods specified in this section shall comply with the requirements specified in Division 26 of this specification.
- D. All power supply requirements shall be connected to the building electrical distribution system in an approved manner. Do not connect control equipment of circuits common with other building loads or devices.
- E. Temperature control wiring shall be jacketed cables installed with or without conduit as specified below or single conductors installed in conduit. Control wiring shall have minimum 300V insulation for low voltage wiring and 600V insulation for line voltage wiring.
- F. All line voltage control wiring, all low voltage control wiring which is exposed in the central plant, penthouse, and other exposed ceiling spaces; all low voltage control wiring which is routed through concealed inaccessible locations shall be installed in conduit.
- G. All low voltage control wiring which is routed through concealed accessible locations may be run without conduit provided that the wiring run without conduit is properly supported from the building structure on maximum 5' centers and does not depend upon the ceiling grid or the ceiling support system for support. Wiring run in plenum spaces shall be plenum rated. Support all plenum wiring in accessible locations in bridle rings, J-hooks, D rings. Plenum wiring is not to be supported within building structure or attached to conduit raceways. All low voltage wiring must be installed through supports. Wires shall be supported on 5' centers and identified at each termination point and at 50' centers minimum. Install wire parallel or perpendicular to the structural features of the

- building.
- H. Line and low voltage control wiring shall not be installed in the same conduit with control wiring and shall not be installed in the same conduit with power wiring.
 - I. All wiring associated with building management and control system cover shall be as follows:
 - 1. Sensor jacket color, Green
 - 2. LAN communications, Yellow
 - 3. All THHN wiring shall comply with Division 26 insulation color identification

3.7 EXHAUST AND SUPPLY FANS

- A. Provide interlocks as scheduled on the plans unless shown on the electrical drawings.
- B. Provide BMCS override to disable operation of all exhaust and supply fans interlocked and/or specified throughout project.
- C. Provide wall mounted timers for fans indicated in Fan Schedule.
- D. Provide wall mounted local switches for fans indicated in Fan Schedule
- E. Dampers and actuators shall be provided by this contractor and shall not be furnished with the exhaust fan.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
Fan Status	DI	Current Sensitive Relay (EF) Air Flow Sensing Switch (SF)
Outside Air Damper	DO	Electronic Operator

3.8 SCIENCE EMERGENCY PURGE EXHAUST (DEDICATED EXHAUST FAN)

- A. The following requirements are in addition to Article 3.7 above.
- B. Provide an emergency purge push button located in each science as indicated on drawings. When push button is enabled, the fan shall be enabled.

3.9 SCIENCE FUME HOOD EXHAUST (DEDICATED EXHAUST FAN)

- A. The following requirements are in addition to Article 3.7 above.
- B. Fan shall be enabled to run when fume hood switch or switches are toggled to the on position. A single hood may have two switches and either switch shall control fan.

3.10 DISHWASHER EXHAUST

- A. Interlock exhaust fan to operate when dishwasher is operating. Provide 5 minute (adjustable) run time for fan after dishwasher stops.

3.11 BUILDING ELECTRICAL USAGE

- A. Provide digital monitoring of the building KVA and KWH via all meters on main switch gear provided with electrical switchgear by Division 26
- B. Electrical Quality monitoring:
 - 1. Monitor Watts, VA, VAR, Demand, Imbalance, and Power Factor.
- C. Provide a separate graphics page for all Building Level meters. The link to the graphics page shall be categorized under Misc. Equipment.

3.12 CENTRAL PLANT CHILLED WATER SYSTEM ELECTRICAL USAGE

- A. Provide digital monitoring of the building KVA and KWH via all meters on switch gear serving central plant equipment provided with electrical switchgear by Division 26. This shall include all chilled water pumps (primary and secondary), tower fans, condenser water pumps, chillers, etc. The BMCS shall perform all necessary calculations to remove or add meters as required to capture only the chilled water system related components. Provide a separate graphics page that indicates instantaneous chilled water plant power consumption and the trend data for the past 90 days minimum.
- B. Electrical Quality monitoring:
 - 1. Monitor Watts, VA, VAR, Demand, Imbalance, and Power Factor.
- C. Provide a separate graphics page for all Central Plant Chilled Water System electrical switchgear meters. The graphics page shall indicate a panel directory of what is connected to the panel. The link to the graphics page shall be categorized under Misc. Equipment.

3.13 MISCELLANEOUS

- A. Freezer/Cooler Temperature Monitoring:
 - 1. Provide an analog temperature sensor located in the freezer compartment and cooler compartment. The BMCS shall monitor the freezer and alarm when temperature rises above 28°F (adjustable) or falls below -20°F (adjustable). The BMCS shall monitor the cooler and alarm when temperature rises above 50°F (adjustable) or falls below 33°F (adjustable). The BMCS shall have the ability to suppress alarms during scheduled hours (adjustable) during the weekdays. In addition the BMCS shall include the ability to manually override the alarm suppression during holidays.

POINT DESCRIPTION	TYPE	DEVICE
Freezer Alarm	AI	RTD
Cooler Alarm	AI	RTD

- B. MDF/IDF Temperature Sensor: Provide a temperature sensor in each MDF and IDF rooms to monitor space conditions. BMCS shall alarm when temperature is out of setpoint range.

POINT DESCRIPTION	TYPE	DEVICE
MDF/IDF Temperature	AI	Space Sensor

- C. Specialized Storage Rooms: Provide a temperature and humidity sensor in each specialized storage room to monitor space conditions. BMCS shall alarm when temperature and humidity is out of setpoint range.

POINT DESCRIPTION	TYPE	DEVICE
Storage Temperature	AI	Space Temp Sensor

Storage Humidity	AI	Space Humidity Sensor
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D. Outside Air:

1. Provide a temperature sensor and humidity sensor to monitor outside air conditions.
2. The BMCS control system shall reference the nearest airport weather data to verify BMCS sensor accuracy by comparing the local sensor readings to the airport conditions. If the values vary more than 10% (Adjustable) an alarm shall be sent through the BMCS that local sensors are out of range and need to be re-calibrated.

POINT DESCRIPTION	TYPE	DEVICE
Outside Temperature	AI	Thermistor
Outside Humidity	AI	Humidity Sensor

E. Humidity Sensor: Provide a sensor in Library to monitor space conditions.

POINT DESCRIPTION	TYPE	DEVICE
Library Humidity	AI	Temperature Sensor

F. Photocell: Provide a photo sensor mounted on the north side of the building. Location is to be approved by Owner / Architect / Engineer.

POINT DESCRIPTION	TYPE	DEVICE
Photocell	AI	Contact

G. Interior Lighting Control:

Building Management Control System Scope

The lighting control system, as indicated on the electrical drawings lighting control details, will be provided with lighting control system BMCS interface devices via DLM room controllers, refer to Electrical Drawings and Details. The BMCS system shall send a occupied and unoccupied signal to the lighting control system BMCS interface devices based on a BMCS schedule.

The BMCS provider shall provide an additional 8 hours of technician support to ensure the lighting control system is commissioned and operating as described.

Lighting Control System Scope

When the Lighting Control system BMCS interface devices in an area receives an occupied signal from BMCS, the lights in that area shall remain in their current state (typically off) but allow any local switch in that area to control the lighting in that space.

When the Lighting Control system receives an unoccupied signal from BMCS, the lighting control system shall flash the lights, and after a delay, the lights in that area shall

be swept off by the lighting control system. In this unoccupied mode, the lighting control system shall allow any local light switch in that area to allow the lights to be controlled locally for 2-hours upon being switched on by the local switch. After the 2-hours, the lighting control system enable signal shall expire, and the lights shall again flash a warning, and if the local switch is not again activated, the lights shall be turned off by the lighting control system.

POINT DESCRIPTION	TYPE	DEVICE
Interior Lighting Control		DLM Room Controller

H. Exterior Lighting Control

1. Provide individual time/photo-cell and time based control of each lighting contactor specified in Division 26.
 - a. Provide separate control of each contactor.
2. The exterior lights shall be controlled by the BMCS using both a combination of photosensor, time schedules and astronomical sunrise/sunset. The exterior lights shall automatically come on when the sun sets based on the longitude and latitude coordinates of the facility (adjustable +/- 30 minutes). At 11 p.m. (adjustable) the time schedule shall turn off the exterior lights. At 4:00 a.m. (adjustable) the exterior lights shall automatically turn on based on time schedule. Upon sunrise, which shall be based on longitude / latitude of the facility the exterior lights shall turn off.
3. Between sunrise and sunset, photo-sensor shall only deactivate all exterior lighting when ambient light levels are above set point (adjustable).

POINT DESCRIPTION	TYPE	DEVICE
Lighting Contactor	DO	Control Relay
Momentary Control Switch	DI	Switch

I. Tennis Court Lighting Control: The controls for AUTO shall accept a signal from the Building Management Control System (BMCS) for control of the tennis court lighting. The BMCS signal used for the interior lighting Wattstopper controls building occupied/un-occupied state shall enable/disable a BMCS tennis court lighting scheduled. The tennis court lighting shall turn ON 20-minutes prior to sunset and turn off at a scheduled time as directed by Owner. Either a building Wattstopper un-occupied state or a tennis court scheduled turn OFF shall turn the tennis court lights OFF.

J. Utility Usage Metering: Provide a separate graphics page for the following items to allow for quick referencing, all new meters shall be provided and installed by this contractor.

1. Building Water Service - Provide meters, digital monitoring and logging, through the BMCS, of the building domestic water usage meter. Provide separate water meters for each service. Water meters shall have 4-20 mA signal or pulse for conversion by BMCS into water flow rates. BMCS shall log data for use.
2. Kitchen Water Service - Provide meters, digital monitoring and logging, through the BMCS, of the kitchen cold water usage meter and kitchen hot water usage meter.

Provide separate water meters for each service. Water meters shall have 4-20 mA signal or pulse for conversion by BMCS into water flow rates. BMCS shall log data for use.

3. Building Gas Service: Provide meters, digital monitoring and logging, through the BMCS, of the of the building gas meter. Gas meters shall have 4-20 mA signal or pulse for conversion by BMCS into water flow rates. BMCS shall log data for use.
4. Kitchen Gas Service: Provide meters, digital monitoring and logging, through the BMCS, of the of the kitchen gas meter. Gas meters shall have 4-20 mA signal or pulse for conversion by BMCS into water flow rates. BMCS shall log data for use.
5. Kitchen Electrical Service: Provide CT meters, digital monitoring and logging, through the BMCS, of each Current Transformer Meter added to all kitchen electrical panels and equipment. This shall include the normal power and emergency electrical panels. BMCS shall log data for use.
6. Provide a separate graphics page for all building and kitchen meters. The link to the graphics page shall be categorized under Misc. Equipment. Equipment and trended on a 15-minute interval.

3.14 ELECTRICAL DEMAND RESPONSE

- A. BMCS system shall be provided with Automated Electrical Demand Management as described below.
- B. The user shall have 8 levels of adjustment to reduce the electrical demand of the facility. Each level shall be schedulable, respond to a command from the electrical provider, and have a button for instant activation.
- C. The user shall have the following configuration within each configurable level:
 1. Setpoint Relaxation
 2. Outside Air Shutdown
 3. Equipment Shutdown
 4. Chiller Plant State Limit
 5. Chiller Shutdown
- D. Setpoint Relaxation will allow the setpoints to shift away from their current setpoint based on the amount specified in the active demand response level. Outside Air Shutdown will deactivate the outside air equipment. Equipment Shutdown will shut down the HVAC equipment. Chiller Plant State Limit will limit the number of available states the chiller plant can use. A plant state of 0 will shut down the chiller plant. Chiller Shutdown will shut down the chillers but allow the pumps to run maintaining differential pressure setpoint.
- E. All equipment shall be configurable to ignore any or all demand response commands. The user shall have the ability to run a report to adjust each of these parameters.
- F. The Demand Response dashboard shall display all levels and their configuration, the electrical demand of the facility, the current level of reduction scheduled, the button to enable each level, and the average reduction each level is able to achieve.
- G. Support automated notifications of a demand response event scheduled, threshold met, strategies executed and strategies released to normal.

3.15 TERMINAL UNIT COORDINATION

- A. Equipment furnished and installed in this section.
 1. Automatic temperature control card (DDC).
 2. Damper Actuator
 3. Flow Measurement tubing, taps and grommets.

3.16 VARIABLE VOLUME DUAL DUCT AIR HANDLING UNITS (AHU-B1, C1, C3, C4, D2,

D4, D5, E1, E2, E4, E5, G2, G3, G4, H1, H5, J6)

- A. Units consist of a chilled water coil, a hot water coil, a fan, and a variable speed drive. The outside air to these units is only preheated in winter. Controls shall be as follows:
1. An electronic averaging duct sensor in the cold duct shall, acting through the DDC System, modulate the chilled water valve to maintain desired setpoint. The cold deck discharge air temperature setpoint shall be reset between 53°F and 60°F (adjustable) based on the units return air temperature of 78°F to 70°F respectively (adjustable)
 2. An electronic averaging duct sensor in the hot deck duct shall, acting through the DDC System, modulate the hot water valve to maintain desired setpoint. The hot deck setpoint will be reset inversely such that when the outdoor air temperature is 20°F (adjustable) or below, the hot deck setpoint will be 95°F (adjustable): and when the outdoor air temperature is 75°F or above the hot deck will at its minimum of 75°F (adjustable)
 3. The unit shall be started and stopped from the BMCS system.
 4. An electronic duct static pressure sensor shall be located in the cold duct at a position approximately 2/3 the distance from the fan in the longest duct run. Location is to be approved by Engineer and coordinated with Section 23 05 93. The sensor shall transmit a signal to the supply fan motor speed controller, and modulate the fan speed to maintain a supply duct static pressure. A high limit static pressure sensor with manual reset, located at the fan discharge, shall de-energize the supply fan when sensing pressure above duct construction capabilities. Fan start-up shall be initiated at minimum air speed.
 5. A Pre Heat temperature sensor shall monitor unit's pre heat air temperature and modulate the pre heat control valve to maintain the pre heat air temperature setpoint of 55°F (adjustable)
 - a. Provide a temperature low limit switch located on the discharge side of the hot water preheat coil or the entering side of the cooling coil to de-energize the air handling unit and supply fan, close the outside air damper, open the hot water valve 100%, start the boiler and hot water pump, signal an alarm to the BMCS when the temperature drops below 32°F. Device shall be manual reset.
 6. An air flow measuring station shall monitor the OA delivered to the unit and modulate the OA damper to maintain OA volume.

POINT DESCRIPTION	TYPE	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Air Flow Sensing Switch
Discharge Air Temperature (2)	AI	Duct Temperature Sensor, One Each Deck
PHW Coil Leaving Air Temp.	AI	Averaging Duct Thermistor
HW Coil Leaving Air Temp.	AI	Averaging Duct Thermistor
CHW Coil Leaving Air Temp.	AI	Averaging Duct Thermistor

POINT DESCRIPTION	TYPE	DEVICE
Return Air Temp.	AI	Averaging Duct Thermistor
PHW Valve	AO	Electronic Operator
HW Valve	AO	Electronic Operator
CHW Valve	AO	Electronic Operator
Air Flow Volume	AI	Air Flow Monitor
Duct Static Pressure (2)	AI	Static Pressure Sensor, One Each Deck
Outside Air Damper	AO	Electronic Operator
Fan Speed	AO	Variable Frequency Drive
Freeze Status	DI	Temperature Low Limit Switch

3.17 VARIABLE VOLUME DUAL DUCT AIR HANDLING UNITS (AHU-D1, D3)

- A. Units consist of a chilled water coil, a hot water coil, a fan, and a variable speed drive. The outside air to these units is not treated. Controls shall be as follows:
1. An electronic averaging duct sensor in the cold duct shall, acting through the DDC System, modulate the chilled water valve to maintain desired setpoint. The cold deck discharge air temperature setpoint shall be reset between 53°F and 60°F (adjustable) based on the units return air temperature of 78°F to 70°F respectively (adjustable)
 2. An electronic averaging duct sensor in the hot deck duct shall, acting through the DDC System, modulate the hot water valve to maintain desired setpoint. The hot deck setpoint will be reset inversely such that when the outdoor air temperature is 20°F (adjustable) or below, the hot deck setpoint will be 95°F (adjustable); and when the outdoor air temperature is 75°F or above the hot deck will at its minimum of 75°F (adjustable)
 3. The unit shall be started and stopped from the BMCS system.
 4. An electronic duct static pressure sensor shall be located in the cold duct at a position approximately 2/3 the distance from the fan in the longest duct run. Location is to be approved by Engineer and coordinated with Section 23 05 93. The sensor shall transmit a signal to the supply fan motor speed controller, and modulate the fan speed to maintain a supply duct static pressure. A high limit static pressure sensor with manual reset, located at the fan discharge, shall de-energize the supply fan when sensing pressure above duct construction capabilities. Fan start-up shall be initiated at minimum air speed.
 5. A Pre Heat temperature sensor shall monitor unit's pre heat air temperature and modulate the pre heat control valve to maintain the pre heat air temperature setpoint of 55°F (adjustable)
 - a. Provide a temperature low limit switch located on the discharge side of the hot water preheat coil or the entering side of the cooling coil to de-energize the air handling unit and supply fan, close the outside air damper, open the hot water valve 100%, start the boiler and hot water

pump, signal an alarm to the BMCS when the temperature drops below 32°F. Device shall be manual reset.

6. An air flow measuring station shall monitor the OA delivered to the unit and modulate the OA damper to maintain OA volume.

POINT DESCRIPTION	TYPE	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Air Flow Sensing Switch
Discharge Air Temperature (2)	AI	Duct Temperature Sensor, One Each Deck
HW Coil Leaving Air Temp.	AI	Averaging Duct Thermistor
CHW Coil Leaving Air Temp.	AI	Averaging Duct Thermistor
Return Air Temp.	AI	Averaging Duct Thermistor
HW Valve	AO	Electronic Operator
CHW Valve	AO	Electronic Operator
Air Flow Volume	AI	Air Flow Monitor
Duct Static Pressure (2)	AI	Static Pressure Sensor, One Each Deck
Outside Air Damper	AO	Electronic Operator
Fan Speed	AO	Variable Frequency Drive
Freeze Status	DI	Temperature Low Limit Switch

3.18 VARIABLE VOLUME DUAL DUCT AIR HANDLING UNITS (AHU-J3,G5,G6)

- A. Units consist of a chilled water coil, a hot water coil, a fan, and a variable speed drive. The outside air to these units is pretreated (cooled and heated). Controls shall be as follows:
 1. An electronic averaging duct sensor in the cold duct shall, acting through the DDC System, modulate the chilled water valve to maintain desired setpoint. An electronic averaging duct sensor in the hot deck shall, acting through the DDC system, modulate the hot water valve to maintain desired setpoint. A schedule shall be set up for the hot deck temperature based on outside air temperature. The temperature of the hot deck shall modulate between the following criteria. If the temperature outside is 50°F (adjustable) or below, the hot deck temperature shall be 95°F; if the outside temperature is 75°F or above, the hot deck coil shall be deactivated.
 2. The unit shall be started and stopped from the BMCS system.
 3. An electronic duct static pressure sensor shall be located in the cold duct at a position approximately 2/3 the distance from the fan in the longest duct run.

Location is to be approved by Engineer and coordinated with Section 23 05 93. The sensor shall transmit a signal to the supply fan motor speed controller, and modulate the fan speed to maintain a supply duct static pressure. A high limit static pressure sensor with manual reset, located at the fan discharge, shall de-energize the supply fan when sensing pressure above duct construction capabilities. Fan start-up shall be initiated at minimum air speed.

POINT DESCRIPTION	TYPE	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Air Flow Sensing Switch
Discharge Air Temperature (2)	AI	Duct Temperature Sensor, One Each Deck
HW Coil Leaving Air Temp.	AI	Averaging Duct Thermistor
CHW Coil Leaving Air Temp.	AI	Averaging Duct Thermistor
Return Air Temp.	AI	Averaging Duct Thermistor
HW Valve	AO	Electronic Operator
CHW Valve	AO	Electronic Operator
Duct Static Pressure (2)	AI	Static Pressure Sensor, One Each Deck
Fan Speed	AO	Variable Frequency Drive

3.19 DOUBLE DUCT VARIABLE VOLUME TERMINAL UNITS

- A. Each unit shall consist of two pressure independent variable volume dampers, one on each duct inlet connection. Controls shall be as follows:
 - 1. A space temperature sensor shall, through the direct digital control system, modulate the variable volume damper on the cold deck from full open to 40% air flow rate to maintain room setpoint. When heating is required, the temperature sensor shall first modulate the variable volume damper on the hot duct and cold deck while maintaining 40% airflow. If more heating is required, the temperature sensor shall modulate the variable volume damper on the hot deck from 40% to full open to maintain room setpoint.
 - 2. The BMCS Contractor shall furnish the terminal box manufacturer with a controller to be factory mounted. The controller shall display cfm, temperature, and damper position.
 - 3. The BMCS Contractor shall furnish the terminal box manufacturer the control flow diagram for correct mounting of flow measurement devices, wiring of actuators, and terminal equipment controllers.

POINT DESCRIPTION	TYPE	DEVICE
Space Temperature	AI	Temperature

POINT DESCRIPTION	TYPE	DEVICE
Primary Air (2)	AO	Variable Volume Damper Operator
CFM Flow	AI	Control Panel

3.20 SINGLE ZONE AIR HANDLING UNIT (AHU-A1,C2,H3,H4,E3,H6,J7,H2,G1)

- A. This unit is furnished with a chilled water cooling coil and a hot water preheat coil. The outside air to these units is not treated. Control shall be as follows:
 - 1. A room thermistor sensing space temperature shall, acting through the Direct Digital Control Panel, modulate the valve on the cooling coil and the valve on the hot water coil, in sequence, to maintain the desired space temperature. The hot water valve shall be closed prior to modulating the chilled water valve and the the chilled water valve shall be closed prior to modulating the hot water valve. The air-handling unit shall be started and stopped from the BMCS System.
- B. Provide a temperature low limit switch located on the discharge side of the hot water preheat coil or the entering side of the cooling coil to de-energize the air handling unit and supply fan, close the outside air damper, open the hot water valve 100%, start the boiler and hot water pump, signal an alarm to the BMCS when the temperature drops below 32°F. Device shall be manual reset.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Air Flow Sensing Switch
Space Temperature	AI	Space Thermistor
Space Humidity	AI	Humidity Sensor
CHW Valve	AO	Electronic Operator
Preheat HW Valve	AO	Electronic Operator
Heating Coil Leaving Air Temp.	AI	Averaging Sensor
Outside Air Damper	DO	Electronic Operator
Discharge Air Temperature	AI	Duct Thermistor
Freeze Status	DI	Temperature Low Limit Switch

3.21 SINGLE ZONE AIR HANDLING UNIT (AHU-I1,I2,I4,I6,J4)

- A. This unit is furnished with a chilled water cooling coil and a hot water preheat coil. The outside air to these pretreated (cooled and heated). Control shall be as follows:
 - 1. A room thermistor sensing space temperature shall, acting through the Direct Digital Control Panel, modulate the valve on the cooling coil and the valve on the hot water coil, in sequence, to maintain the desired space temperature. The hot

water valve shall be closed prior to modulating the chilled water valve and the the chilled water valve shall be closed prior to modulating the hot water valve. The air-handling unit shall be started and stopped from the BMCS System.

- B. Provide a temperature low limit switch located on the discharge side of the hot water preheat coil or the entering side of the cooling coil to de-energize the air handling unit and supply fan, close the outside air damper, open the hot water valve 100%, start the boiler and hot water pump, signal an alarm to the BMCS when the temperature drops below 32°F. Device shall be manual reset.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Air Flow Sensing Switch
Space Temperature	AI	Space Thermistor
Space Humidity	AI	Humidity Sensor
CHW Valve	AO	Electronic Operator
Preheat HW Valve	AO	Electronic Operator
Heating Coil Leaving Air Temp.	AI	Averaging Sensor
Outside Air Damper	DO	Electronic Operator
Discharge Air Temperature	AI	Duct Thermistor
Freeze Status	DI	Temperature Low Limit Switch

3.22 SINGLE ZONE VARIABLE AIR VOLUME AIR HANDLING UNIT (AHU-A2, J3,J2,J1,G1-01)

- A. This unit is furnished with a chilled water cooling coil, a hot water reheat coil, and a variable frequency drive. The outside air to these pretreated (cooled and heated). Control shall be as follows:
1. A room Thermistor sensing space temperature through the Direct Digital Control Panel shall vary the speed of the fan to maintain room setpoint. The air volume of the fan can range from 100% to 30% (adjustable) of the air quantity specified or to the outside air percentage whichever value is larger. A chilled water coil leaving air temperature sensor through the Direct Digital Control Panel shall modulate the cooling coil control valve to maintain the leaving air temperature as scheduled. When the fan is at minimum speed of its specified air quantity and the room temperature is below the room setpoint, the room Thermistor shall modulate the valve on the cooling coil and the hot water or electric coil in sequence to maintain the desired space temperature. A room humidity sensor shall override the operation of the cooling coil control valve to maintain the relative humidity setpoint in the space. The room temperature sensor shall modulate the hot water or electric reheat coil to maintain the space temperature.

The dehumidification sequence only applies after the fan has reached the minimum fan speed.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Air Flow Sensing Switch
Variable Speed Motor	AO	Variable Frequency Drive
Space Temperature	AI	Space Thermistor
Space Humidity	AI	Humidity Sensor
CHW Valve	AO	Electronic Operator
Reheat HW Valve	AO	Electronic Operator
Cooling Coil Leaving Air Temp.	AI	Averaging Sensor
Discharge Air Temperature	AI	Duct Thermistor

3.23 SINGLE ZONE VARIABLE AIR VOLUME AIR HANDLING UNIT (AHU-F2,A-1-01,F1)

- A. This unit is furnished with a chilled water cooling coil, a hot water reheat coil, and a variable frequency drive. The outside air to these units is not treated. Control shall be as follows:
 - 1. A room Thermistor sensing space temperature through the Direct Digital Control Panel shall vary the speed of the fan to maintain room setpoint. The air volume of the fan can range from 100% to 30% (adjustable) of the air quantity specified or to the outside air percentage whichever value is larger. A chilled water coil leaving air temperature sensor through the Direct Digital Control Panel shall modulate the cooling coil control valve to maintain the leaving air temperature as scheduled. When the fan is at minimum speed of its specified air quantity and the room temperature is below the room setpoint, the room Thermistor shall modulate the valve on the cooling coil and the hot water or electric coil in sequence to maintain the desired space temperature. A room humidity sensor shall override the operation of the cooling coil control valve to maintain the relative humidity setpoint in the space. The room temperature sensor shall modulate the hot water or electric reheat coil to maintain the space temperature. The dehumidification sequence only applies after the fan has reached the minimum fan speed.
- B. Provide a temperature low limit switch located on the discharge side of the hot water preheat coil or the entering side of the cooling coil to de-energize the air handling unit and supply fan, close the outside air damper, open the hot water valve 100%, start the boiler and hot water pump, signal an alarm to the BMCS when the temperature drops below 32°F. Device shall be manual reset.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Air Flow Sensing Switch
Variable Speed Motor	AO	Variable Frequency Drive
Space Temperature	AI	Space Thermistor
Space Humidity	AI	Humidity Sensor
CHW Valve	AO	Electronic Operator
Reheat HW Valve	AO	Electronic Operator
Cooling Coil Leaving Air Temp.	AI	Averaging Sensor
Discharge Air Temperature	AI	Duct Thermistor
Freeze Status	DI	Temperature Low Limit Switch

3.24 FAN COIL UNITS (FCU-B1, C1 thru C16, F1, G1-02, H1, BB1-1 thru BB1-5, BB2-1 thru BB2-5)

- A. Each fan coil unit is furnished with a chilled water coil and hot water coil. Control shall be as follows:
1. A space temperature sensor shall, acting through a terminal equipment controller, modulate the valves on the chilled water cooling coil and hot water reheat coil in sequence to maintain the desired space temperatures.
 2. Start/stop of fan coil unit shall be by terminal equipment controller.
 3. The outside air units providing the outside air shall be activated when the fan coil units are operating during the occupied periods.
- B. On units with Raw OA, provide a temperature low limit switch located on the discharge side of the hot water preheat coil or the entering side of the cooling coil to de-energize the air handling unit and supply fan, close the outside air damper, open the hot water valve 100%, start the boiler and hot water pump, signal an alarm to the BMCS when the temperature drops below 32°F. Device shall be manual reset.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
FCU Status	DI	Air Flow Sensing Switch
CHW Valve	AO	Electronic Operator
HW valve	AO	Electronic Operator

POINT DESCRIPTION	TYPES	DEVICE
Outside Air Damper	DO	Elec. Operator (F1,H1,G1-02 ONLY)
Space Temperature	AI	Space Thermistor
Discharge Air Temperature	AI	Duct Thermistor
Freeze Status	DI	Temperature Low Limit Switch(F1,H1,G1-02 ONLY)

3.25 OUTSIDE AIR HANDLING UNIT CONTROL (OAHU-C5,I3,I5,I7,J5 BB-1)

- A. These units are furnished with a chilled water coil and a hot water heating coil in the PREHEAT position and a wrap around heat pipe system (non controllable). OAHU-I3 is not equipped with a heat pipe. Control shall be as follows:
1. A duct mounted sensor sensing supply air temperature shall, acting through the Direct Digital Control Panel, modulate the valve on the cooling coil and the valve on the hot water coil, in sequence, to maintain the desired discharge air temperature of 55°F. The air-handling unit shall be started and stopped from the BMCS System.
 2. Provide a temperature low limit switch located on the discharge side of the hot water preheat coil or the entering side of the cooling coil to de-energize the air handling unit, close the outside air damper, open the hot water valve 100%, start the boiler and hot water pump, signal an alarm to the BMCS when the temperature drops below 32°F. Device shall be manual reset.
 3. Open OA damper before starting unit. Provide end switch to ensure damper is in the open position in either the manual (hand) or auto position of the motor starter.
 4. An air flow monitor on AHU-J5 only shall monitor the air flow and modulate the Variable frequency drive as required to maintain the air volume for each associated AHU that are in occupied mode.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Current Sensitive Relay
Variable Speed Motor	AO	Variable Freq. Drive (AHU-J5)
Air Flow Volume	AI	Air Flow Monitor (AHU-J5)
Discharge Air Temperature	AI	Duct Thermistor
CHW Valve	AO	Electronic Operator
Outside Air Damper	DO	Electronic Operator
Freeze Status	DI	Temperature Low Limit Switch

POINT DESCRIPTION	TYPES	DEVICE
HW Pre Heat Valve	AO	Electronic Operator

3.26 VARIABLE AIR VOLUME OUTSIDE AIR HANDLING UNIT CONTROL (OAU-G7)

- A. These units are furnished with a chilled water coil and a hot water heating coil in the PREHEAT position. Control shall be as follows:
 - 1. A duct mounted sensor sensing supply air temperature shall, acting through the Direct Digital Control Panel, modulate the valve on the cooling coil and the valve on the hot water coil, in sequence, to maintain the desired discharge air temperature. Reference drawing schedule for discharge temperature. The air-handling unit shall be started and stopped from the BMCS System.
 - 2. Provide a temperature low limit switch located on the discharge side of the hot water preheat coil or the entering side of the cooling coil to de-energize the air handling unit, close the outside air damper, open the hot water valve 100%, start the boiler and hot water pump, signal an alarm to the BMCS when the temperature drops below 32°F. Device shall be manual reset.
 - 3. Open OA damper before starting unit. Provide end switch to ensure damper is in the open position in either the manual (hand) or auto position of the motor starter.
- B. Variable air volume control:
 - 1. Duct static pressure sensor shall be located in the duct at a position approximately 2/3 the distance from the fan in the longest duct run. Location is to be approved by Engineer and coordinated with Section 23 05 93.
 - 2. The static pressure sensors shall, through the DDC panel, accept the signal from the operating control sensor to:
 - a. Transmit a signal to the supply fan motor speed controller.
 - b. Modulate the fan speed to maintain the desired static pressure.
 - c. Coordinate signal with the fan motor speed controller.
 - 3. Install a static pressure high limit safety device to de-energize the system.
 - a. Manual reset.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
AHU Status	DI	Air Flow Sensing Switch
Discharge Air Temperature	AI	Duct Thermistor
HW Coil Leaving Air Temperature	AI	Averaging Duct Thermistor
CHW Coil Leaving Air Temperature	AI	Averaging Duct Thermistor
CHW Valve	AO	Electronic Operator
Outside Air Damper	DO	Electronic Operator
Freeze Status	DI	Temperature Low Limit Switch

POINT DESCRIPTION	TYPES	DEVICE
HW Pre Heat Valve	AO	Electronic Operator
Variable Speed Motor	AO	Motor Controller
Static Pressure	AI	Static Pressure Sensor
High Static Limit	DI	High Static Limit Switch

3.27 OUTSIDE AIR VARIABLE VOLUME TERMINAL UNITS

- A. Each unit shall consist of a pressure independent variable volume damper. The terminal unit's damper shall be interlocked with the associated OAHU supply fan.
 - 1. The Controls Contractor shall furnish the terminal box manufacturer with a controller to be factory mounted. The controller shall display cfm, temperature, and damper position. This information shall be displayed on the terminal unit graphics page.
 - 2. Terminal units serving Dual Duct Air Handling shall modulate to maintain the scheduled OA CFM during all occupied times.

POINT DESCRIPTION	TYPES	DEVICE
Primary Air	AO	Variable Volume Damper Operator
Discharge Air Temperature	AI	Duct Thermistor

3.28 HYDRONIC HEATING SYSTEM

- A. The system consists of two sellers heating water boilers with boiler isolation valves, one PK near condensing boiler with inline circulation pump, boiler system mixing valve and two headered pumps. Control of the hot water heating system is as follows:
 - 1. Upon a call for heat, the lead boiler, isolation valve and building hot water pump shall start and attempt to achieve the building hot water setpoint. The second boiler, isolation valve and building hot water pump shall start if conditions require and the hot water supply water setpoint has not been achieved after a 20 minute delay (adjustable).
 - 2. The hot water mixing valve shall modulate to maintain the building hot water supply setpoint.
 - 3. A temperature sensor sensing outdoor air temperature shall reset the hot water temperature inversely with the outdoor air temperature using the mixing valve at each boiler.
 - a. Maintain 180°F when the outdoor temperature is 20°F.
 - b. Maintain 140°F when the outdoor temperature is 60°F and above.
 - 4. When the building hot water supply temperature drops to a setpoint minus 20°F (adjustable) for a time delay of 15 minutes the controller will start the boiler that has the least operating time. When the building hot water supply temperature rises to a setpoint minus 15°F (adjustable) for a time delay of 15 minutes the controller will stop the boiler with the most operating time.
 - 5. The main boilers, B-1 and B-2, shall be provided with lead/lag sequencing to

- alternate lead boiler on a daily basis.
6. Boiler B-3 shall only operate when the outside air temperature is above 60°F and boiler B-1 and B-2 are off. When there is heating demand (reheat load on any AHU) HWP-1 or HWP-2 will be energized and the respective boiler isolation valve shall open. Boilers B-1 and B-2 shall remain off. Boiler B-3 and HWP-3 will be enabled when the building hot water supply temperature is setpoint minus 10°F (adjustable) and disabled when the building hot water supply temperature reaches setpoint for a period of 15 minutes (adjustable). HWP-3 shall remain on for 30 minutes (adjustable) after B-3 is disabled. If boiler B-3 does not maintain building hot water supply temperature set point and the building hot water supply temperature falls to set point minus 20°F then boiler B-3 and HWP-3 shall be disabled and the lead boilers B-1 and B-2 shall be started.
 7. Enable the boilers throughout the year with an override option to disable the boilers, as Owner requires.

POINT DESCRIPTION	TYPES	DEVICE
Boiler Enable/Disable (Each Boiler)	DO	Control Relay
Boiler Status (Each Boiler)	DI	Safety Relay (2 each)
Boiler Alarm (Each Boiler)	DI	Safety Relay (2 each)
Boiler Isolation Valve (Each Boiler)	AO	Electronic Operator
Pump Start/Stop (HWP-1 & HWP-2)	DO	Control Relay
Pump Status (HWP-1 & HWP-2)	DI	Differential Pressure Switch
Pump Start/Stop (HWP-3)	DO	Control Relay
Pump Status (HWP-3)	DI	Differential Pressure Switch
Building Supply Temperature	AI	Pipe RTD
Building Return Temperature	AI	Pipe RTD
Boiler discharge water Temperature	AI	Pipe RTD
Hot Water Mixing Valve	AO	Electronic Operator
Ambient Temperature	AI	Thermistor

3.29 HYDRONIC AND DOMESTIC BOILER CO MONITOR SYSTEM

- A. This contractor shall provide and wire interlocks from equipment to the CO monitor system. Upon alarm through the sensor all the boiler equipment, i.e. boiler and pumps and domestic water heaters, shall be deactivated. CO monitor shall provide a visual and audible alarm. Provide a sign at each entrance to boiler room to indicate information about system.

- B. Upon Alarm of CO monitor, notify users via text message.
- C. CO Monitor control shall be provided at each room that contains gas fired hydronic boilers or domestic water heaters/boilers.

POINT DESCRIPTION	TYPES	DEVICE
CO Monitor	DI	Control Panel
System Start/Stop	DO	Control Relay

3.30 HYDRONIC BOILER ROOM CONTROL

- A. This system consists of a (2) supply air fans and (2) gas unit heater. Control shall be as follows:
 - 1. Cooling - A space temperature sensor shall, acting through a terminal equipment controller, activate the boiler room supply fan to maintain the desired space cooling temperatures, 80°F (adjustable).
 - 2. Heating - A space temperature sensor shall, acting through a terminal equipment controller, activate the boiler room gas unit heater to maintain the desired space heating temperatures, 50°F (adjustable).
 - 3. Start/stop of supply fan and unit heater unit shall be by terminal equipment controller.

POINT DESCRIPTION	TYPES	DEVICE
Fan Start/Stop	DO	Control Relay
Fan Status	DI	Current Sensitive Relay (EF) Air Flow Sensing Switch (SF)
Outside Air Damper	DO	Electronic Operator
Unit Heater Start/Stop	DO	Control Relay
Space Temperature	AI	Space Thermistor

3.31 CHILLED WATER SYSTEM CONTROL

3.32 CONDENSER WATER CONTROL

- A. The system consists of a three single cell cooling towers with variable speed fans, three condenser water pumps, condenser water isolation valves at pumps, chillers and cooling towers and a condenser water bypass valve. The cooling towers are installed on a common concrete basin and sump. The condenser water pumps are headered and each cooling tower and each chiller, pump and cooling tower shall be provided with condenser water isolation valves. Alternate the lead condenser water pump and tower on a daily basis.
- B. When a chiller is enabled, the respective condenser water pump, chiller condenser water isolation valve, cooling tower isolation valve, and condenser water pump isolation valve are modulated open. The cooling tower fans and the tower bypass valve shall be enabled when any condenser water pump is in operation and will modulate to maintain setpoint of 85°F (adjustable) condenser water supply temperature. The chiller isolation valve will be modulated to maintain the differential pressure necessary for the condenser water design

- flow, verify with chiller manufacturer. The cooling tower fans shall modulate as necessary to maintain condenser water basin temperature (adjustable).
- C. Based on the outdoor ambient air temperature and relative humidity the BMCS shall calculate the ambient wet bulb temperature. The condenser water set point temperature to be equal to the sum of the wet bulb temperature and the cooling tower approach temperature. The range of acceptable condenser water temperatures shall be set as recommended by the chiller manufacturer.
 - D. Provide full automatic control of the entering condenser water temperature on initial chiller start-up.
 - E. Close the two way cooling tower isolation valve, two way chiller condenser water and two way condenser water pump isolation valve when chiller, pumps or towers are disabled.
 - F. The variable frequency drives on the condenser water pumps shall be utilized for soft start and balancing only.

POINT DESCRIPTION	TYPE	DEVICE
Start/Stop Pump (Each Pump)	DO	Control Relay
Start/Stop (Each Tower)	DO	Control Relay
Status (Each Tower Fan)	DI	Current Switch
Vibration Alarm (Each Tower)	DI	Vibration Switch
Low Oil Level Alarm (Each Tower)	DI	Oil Level Switch
CT speed (Each Tower)	AO	Variable Frequency Drive
Tower Bypass Valve	AO	Electronic Operator
Pump VFD (Each pump)	AO	Variable Frequency Drive
Status (Pumps)	DI	Differential Pressure Switch
Chiller Differential Water Press. (Each chiller)	AI	Pressure Differential Sensor
Cooling Tower Isolation Valve (Inlet Each Tower)	AO	Electronic Operator
Chiller Condenser Water Isolation Valve (Each Chiller)	AO	Electronic Operator
Condenser Water Pump Isolation Valve (Each Pump)	AO	Electronic Operator
Condenser Water Supply Temp.	AI	Pipe Thermistor
Condenser Water Return Temp.	AI	Pipe Thermistor
Condenser Water Basin Temp.	AI	Pipe Thermistor

3.33 REFRIGERANT MONITORING / VENTILATION CENTRAL PLANT APPLICATIONS

- A. Install refrigerant monitor in the central plant and other locations as required by code. Monitor the concentration of refrigerant through an analog input signal through the BMCS. Install (2) sensors at each chiller at opposite ends. Alarm levels of refrigerant concentrations are provided in the Code. Refrigerant levels shall be available at the BMCS.
- B. Install audible and visual alarms in the area served, at locations as required by code. Audible sound pressure level of at least 15DBa above the operating ambient noise level within machine room and provide a distinctive strobe type visual alarm both inside and outside machine room at each entrance. Ceiling mounted rotating beacon in center of machine room. Strobes shall be provided immediately adjacent to and outside of each refrigeration machinery room exit. Provide visual and audible device installed at locations as per local code.
- C. Provide a clearly identified switches of the break-glass type immediately adjacent to inside and outside of each refrigeration machinery room exit for emergency and activation of the emergency exhaust system and equipment shutdown i.e. chillers and pumps thru safety circuits upon alarm. Mechanical equipment shall be shut down in an orderly manner so as not to damage the equipment. Label switches / buttons per Code.
- D. Provide a separate emergency ventilation buttons located on the inside the building adjacent to each refrigeration machinery room exit for activation of the central plant emergency ventilation system. Upon alarm either through the refrigerant monitor, by manually pushing the central plant emergency exhaust button or pressing the glass break type switch, the emergency exhaust fan shall be modulated to full speed via the VFD. Label switches / buttons per Code.
- E. Activation of emergency exhaust and equipment shutdown shall signal an alarm to the BMCS and signal the audible and visual alarms in the area served.
- F. During normal plant operation the plant exhaust fan shall operate via the VFD at minimum speed as scheduled to provide general plant exhaust.

POINT DESCRIPTION	TYPE	DEVICE
Refrigerant Monitor / Sensors	AI	Control Panel
Emergency Shut	DI	Break Glass Switch
Emergency Ventilation	DI	Emergency Ventilation Button
Fan Start/Stop	DO	Control Relay
Fan Status	DI	Current Switch
Variable Speed Motor	AO	Motor Controller
System Start/Stop	DO	Control Relay

3.34 HYDRONIC UNIT HEATERS

- A. Heater is furnished with a fan and a hot water coil. Controls shall be as follows:

1. A space temperature sensor with an adjustable setpoint on the sensor shall, acting through a terminal equipment controller, activate the unit and modulate the hot water valve to maintain the desired space temperatures.
2. Start/stop of fan coil unit shall be by terminal equipment controller.

POINT DESCRIPTION	TYPES	DEVICE
Start/Stop	DO	Control Relay
Space Temperature	AI	Space Thermistor
HW valve	AO	Electronic Operator

3.35 ELECTRIC UNIT HEATERS

- A. An electric thermostat shall activate the unit and stage the electric coil to maintain room setpoint.

3.36 CHEMICAL TREATMENT SYSTEM

- A. Monitor water treatment power circuit and alarm contacts from water treatment controllers. Provide with cooling tower systems only.

3.37 CHEMICAL TREATMENT SYSTEM

3.38 DECTRON NATATORIUM DEHUMIDIFICATION UNIT (NAHU-01)

- A. The Dehumidification unit shall have a factory furnished sequencing panel with BACnet interface. The BAS contractor shall provide and install wiring to the BACnet interface and provide programming to monitor the system via BACnet. The BAS shall monitor all points listed in "Equipment Control Points" and any additional points required to accomplish sequences of operation. In addition, BAS subcontractor shall acquire points list from the Pool Unit manufacturer representative and provide points list to owner and allow owner to choose desired available points for implementation. The natatorium dehumidification unit shall be controlled by factory furnished controls with BACnet interface. Refer to equipment specifications for sequence of operation. The BAS shall have read/write capability and display all available points on the BAS system graphic (coordinate all available equipment control points with Dehumidification Equipment Representative prior to bid). BAS contractor shall furnish and install all communication wiring and associated conduit between indoor pool unit and remote outdoor fluid-cooler / condensing unit. Dehumidification unit shall be provided with internal web application used to monitor the equipment remotely by end user as well as pool Dehumidification manufacturer service team and shall be web-based, connected to the internet. Contractor shall furnish and install Ethernet cable and conduit for the control panels at each unit. Units below 90 Ton will require (1) Ethernet drop, Units 90 Tons and above have dual control panels which will require (2) Ethernet drops (One at each panel). A static IP address, provided by Cy-Fair ISD, will be required for each control panel. Coordinate internal pool unit control system application with Owner and provide full demonstration and training of software and equipment.

- B. Equipment Control Points:

Space Temperature – AI
 Space Temperature Setpoint – (1) AO (BACnet via BAS)

Space Humidity – AI
Space Humidity Setpoint – AO (BACnet via BAS)
Pool Temperature Setpoint – (2) AI (BACnet via BAS)
Pool Water in Temperature – (2) AI (BACnet via BAS)
Pool Water Out Temperature – (2) AI (BACnet via BAS)
Supply Air Temperature – AI (BACnet via BAS)
Evaporator Coil Temperature – (2) AI
Reheat Coil Temperature – (1) AI (BACnet via BAS)
Unit Status – (6) DI (Modes: Service, Purging, Dehumidification, AC, Heating, and Pool Heat)
Supply Fan Status – DI
Unit Start/Stop – DO (Hardwired to BAS)
Return Air Temperature – AI (BACnet via BAS)
Return Air Humidity – AI (BACnet via BAS)
Outdoor Air Temperature – AI (BACnet via BAS)
Modulated Heat (% Output or Capacity) – AI (BACnet via BAS)
Reheat Capacity (% Output) – AI (BACnet via BAS)
Exhaust Fans (% Output) – AI (BACnet via BAS)
Outdoor Air Damper 1 (% Open) – AI (BACnet via BAS) Only if Controlled Directly by Seresco Unit
Outdoor Air Damper 2 (% Open) – AI (BACnet via BAS) Only if Controlled Directly by Seresco Unit
Purge Mode Enable – DI (BACnet via BAS)
Compressor Pump – DI (BACnet via BAS)
Available Alarms (BACnet via BAS)
Supply Blower Overload – DI
Exhaust Fan Overload – DI
No Airflow – DI
Freezestat – (2) DI
Dirty Filter – DI
Voltage Fault – DI
Purge Alarm – DI
Pool Water Flow Fault – (2) DI
Compressor Faults – Total of (14) DI
Outdoor Air Condenser Overloads – (2) DI

3.39 HEATING WATER BOILER SYSTEM - (N-B-01)

- A. The heating water system is a non-condensing boiler hot water system with primary circulating pump and constant flow secondary pump. The boiler system shall be controlled by a sequencing panel provided by the boiler manufacturer equipped with a BACnet interface card for each boiler. The BAS contractor shall provide and install a BACnet interface to each boiler to communicate with the sequencing panel to request the heating water system and monitor pertinent data from the boilers such as but not limited to leaving water temperature, status, alarm, etc. The BAS shall control the pumps. BACnet interface shall be able to have remote read/write capability by end user; acquire all available points from boiler manufacturer.
- B. Equipment Control Points:

Building HW supply temperature – AI
Building HW return temperature – AI
Building HW Return Flow Meter - AI
Boiler supply temperature – AI (each Boiler)
Boiler status – DI (each Boiler)
Boiler alarm – DI (each Boiler)
HW Pump status (each pump) – DI

Boiler enable – DO (each Boiler)
 HW pump start/stop (each pump) – DO
 HW Pump speed control (each pump) – AO

C. Heating Water System Activation

The heating water pump shall be available 24/7 for heating from any equipment it supplies with heating water. A current switch shall prove status to the BAS and shall alarm at the central site if the contacts are not made within 20 seconds (adjustable). Once the heating water pump has proven positive flow, the BAS shall request the boiler system to run. If the hot water supply temperature is less than 100°F (adjustable) or the building hot water pump status is not indicating the building hot water pump is running, the BAS control module shall broadcast that hot water is not available. HW Pumps shall be rotated weekly to maintain equal runtime.

D. Heating Water Temperature Reset: The heating water shall have a ratio Reset based on outside air temperature and the following schedule:

Outside Air Temp	Less than 50°F	Hot Water Temp	140°F
Outside Air Temp	Greater than 70°F	Hot Water Temp	100°F

E. Freeze Protection

When the outdoor air temperature drops to 34°F (adjustable) or below, the BAS shall open the hot water valves for 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 88°F (adjustable) while running the boiler only until the low ambient temperature ceases to exist or the building start-up time arrives.

3.40 POOL WATER HEATING SYSTEM – (N-B-02)

A. Equipment Control Points:

Pool HW Return Flow Switch– AI
 Boiler return temperature - AI
 Boiler supply temperature – AI
 Boiler status – DI
 Boiler alarm – DI
 HW Pump status– DI
 Boiler enable – DO
 HW pump start/stop (each pump) – DO
 HW Pump speed control (each pump) – AO
 Boiler Temperature Reset - AO
 Pool leaving water temperature - AI
 Pool entering water temperature - AI
 Circulating pump status- DI
 Boiler hot water mixing valve – (3) AO
 Circulating Pump on/off – DO – Interlocked with Boiler

B. Heating Water System Activation

The heating water pump shall be available 24/7 for heating from any equipment it supplies with heating water. A current switch shall prove status to the BAS and shall alarm at the central site if the contacts are not made within 20 seconds (adjustable). Once the heating water pump has proven positive flow, the BAS shall request the boiler system

to run. The Boiler is to be commanded on in order to maintain the temps as below in the HW Temperature reset table. The 3-way modulating control valve is to control based upon Boiler HWS Temp.

C. Pool HW Temperature Control

The filtered pool water shall be circulated through the boiler. The BAS shall monitor the boiler entering and leaving water temperatures. The filter system bypass valve shall normally remain in the bypass position. The BAS shall command the filter system bypass valve to force flow through the boiler and the boiler control loop shall be enabled. The 3-way hot water mixing valve shall be modulated to maintain the leaving water temperature setpoint of 84°F (adjustable). When the system is calling for heat, the BAS shall enable the boilers. The boiler controls shall energize the boiler circulating pump. (Refer to Heating Water System sequence of operation).

D. Heating Water Temperature Reset: The heating water shall have a ratio Reset based on outside air temperature and the following schedule:

Outside Air Temp	Less than 50°F	Hot Water Temp	180°F
Outside Air Temp	Greater than 70°F	Hot Water Temp	160°F

E. Freeze Protection

When the outdoor air temperature drops to 34°F (adjustable) or below, the BAS shall open the hot water valves for 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 88°F (adjustable) while running the boiler only until the low ambient temperature ceases to exist or the building start-up time arrives.

3.41 PACKAGED ROOFTOP UNIT WITH GAS HEAT – N-RTU-01

A. All controls devices external to units shall be provided by the RTU manufacturer and installed by the control's 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.

B. Equipment Control Points:

- Supply Air Temperature – AI
- Supply Air Temperature Cooling & Heating Setpoints – (2) AO
- Supply Duct Static Pressure – AI
- Supply Duct Static Pressure Setpoint – AO
- Evaporator Coil Temperature – AI
- Evaporator Coil Temperature Setpoint – AO
- Fan Status – DI
- Outside air damper – AO
- DX Cooling Capacity – AI
- Hot Gas Reheat Capacity – AI
- Static pressure high limit - DI

Gas Heating Capacity – AI
Unit Start/Stop – DO (Hardwired to BAS)

- C. 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.
- D. 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.
- E. Air Volume Control
While the rooftop unit is active, the factory mounted controller shall maintain the duct static pressure setpoint sent from the BAS 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 factory mounted controller shall monitor the high static limit switch and shall send an alarm to the BAS for display at the central site. The static pressure high limit switch must be manually reset. Supply Air Temperature and Dew Point Control. The outside air temperature and relative humidity sensors shall control the unit mode of operation. When the outside air temperature is above 55°F, the unit shall be placed in dehumidification priority mode. During dehumidification priority mode, 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 supply air temperature cooling setpoint of 68°F (adj.). When the outside air temperature is below 55°F, the unit shall be placed in heating mode. During heating mode, the natural gas heater shall modulate to maintain the supply air temperature heating setpoint of 72°F (adj.).
- F. 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.

3.42 NATATORIUM HEAT EXCHANGER SYSTEM

- A. System consists of tube and shell heat exchangers with hydronic hot water on one side and pool water on the other side. There are two heat exchangers that require different temperatures to be maintained, one for main swimming pool and one for the warmup pool. The main swimming pool and the warmup pool each have a dedicated pool water pumps and a shared hydronic hot water pump. Control of the hydronic hot water heating system is as follows:
 - 1. Energize the natatorium heat exchanger system and hot water heating system whenever there is a call for pool water heating from either of the Pool temperature sensors.
 - a. Monitor pool water temperature for each the main swimming pool and warmup pool. Sensor shall be in pool water supply piping from pool filtration pump prior to taps for pool heating loops.
 - b. The boiler controller shall control all functions and sequencing of the hot water heating boiler.
 - 2. Upon a call for heating in the pool, the heat exchanger control valve on the hot

water side shall modulate based on the leaving water temperature from the heat exchanger on the pool water side of the heat exchanger. In addition, the pool water pump shall be energized and the mixing valve shall be modulated to meet the pool water temperature setpoint.

POINT DESCRIPTION	TYPE	DEVICE
Pool Water Pump Start/Stop (Warm Up)	DO	Variable Frequency Drive
Pool Water Pump Status (Warm Up)	DI	Current Sensitive Relay
Pool Water Pump Start/Stop (Main)	DO	Variable Frequency Drive
Pool Water Pump Status (Main)	DI	Current Sensitive Relay
Hot Water Pump Start/Stop (Hydronic)	DO	Variable Frequency Drive
Pool Water Pump Status (Hydronic)	DI	Current Sensitive Relay
Warm Up Pool Temperature	AI	Pipe Thermistor
Main Pool Temperature	AI	Pipe Thermistor
Hot Water Control Valve	AO	Electronic Operator (Each HX)
HX Pool Water Entering Temp.	AI	Pipe Thermistor (Each HX)
HX Pool Water Leaving Temp.	AI	Pipe Thermistor (Each HX)
Pool Water Control Valve	AO	Electronic Operator (Each HX)

3.43 – 3.50 RESERVED

3.51 START-UP AND POINT VERIFICATION

- A. Final startup and point verification shall include the following information.
 - 1. Field panel checkout:
 - a. Verify enclosure is not mounted on vibrating surface.
 - b. Verify class I and class II wiring is separated within enclosure.
 - c. Check for shorts/grounds/induced voltages/proper voltages.
 - d. Verify proper point terminations in accordance with as-builts.
 - e. Verify that all modules are in proper place and addressed.
 - f. Verify proper power voltage.
 - g. Load database and programming.
 - h. Startup the panel.
 - i. Point and device checkout.
 - 2. Analog input point checkout:
 - a. Verify the correct wiring terminations per the design documentation package, at the field panel. Verify that all wiring and terminations are

- neat and dressed.
 - b. Verify the point address by checking that the analog input instrument is wired to the correct piece of field equipment. Do this by altering the environment at the sensing element or by disconnecting one of the wires at the sensor, and verifying that the reading at the field panel has reacted to this change.
 - c. Verify the point database to be correct, (i.e., alarmability, alarm limits, slope/intercept, engineering units, etc.). Verify that the correct change of value (COV) limit has been defined.
 - d. Verify the sensor has the correct range and input signal. (i.e., 20-120°F, 4 - 20 ma). Verify that the device is mounted in the correct location and is wired and installed correctly per the design documentation package.
 - e. Set-up and/or calibrate any associated equipment (i.e., panel LCD meters, loop isolators, etc.). Verify that these auxiliary devices are mounted in the correct location and are wired and installed correctly per the design documentation package.
 - f. Verify the correct reading at the field panel using appropriate MMI devices. Verify that any associated LCD panel meters indicate the correct measured value.
3. Digital input point checkout:
- a. Verify the device is correctly wired and terminated as shown in the design documentation package. Verify that all wiring and terminations are neat and properly secured.
 - b. Verify the point address by verifying that the digital input is correctly terminated at the controlled piece of equipment.
 - c. Verify the point database is correct (i.e., point name, address, alarmability, etc.).
 - d. Set-up and/or calibrate the associated equipment, i.e. smoke detector, high/low temp detector, high/low static switch, flow switch, end switch, current relay, pressure switch, etc. is mounted in the correct location, and is wired and installed correctly per the control system installation drawings.
 - e. With the controlled equipment running or energized as described in the digital output checkout procedures, verify the correct operation of the digital input point and associated equipment by putting the digital input monitored equipment into its two states. Verify that the proof or status point indicates the correct value at the operator's terminal and that the status led is giving the proper indication in each mode of operation (on/off).
4. Digital output point checkout:
- a. Verify that device is correctly wired and terminated as shown in the design documentation package.
 - b. Verify that the correct voltage is utilized in the circuit.
 - c. Verify the point database to be correct (i.e. point name, address, etc.).
 - d. Check and verify that the end device responds appropriately to the digital output(s).
 - e. After verifying the set-up and operation of any associated digital input/proof points, check and verify correct operation of the logical point and associated equipment by commanding the point to all possible states (i.e. off, on, fast, slow, auto, etc.). Verify that the defined proof delay is adequate for all modes of operation.
 - f. If any interlocked equipment exists that has independent hand-off-auto or auxiliary control wiring, verify correct operation of same. Also check

- that any interlocked equipment such as EP switches for damper operation or exhaust and return fans are wired correctly and operate correctly.
- g. Verify that the controlled piece or pieces of equipment cannot be caused to change state via the digital output if an associated hand-off-auto switch is in the hand/on or hand/off mode of operation, unless specified as a fireman's override point etc.
5. Analog output point checkout:
- a. Verify the correct wiring or piping terminations per the design documentation package, at the field panel. Verify that all wiring and piping terminations are neat and dressed.
 - b. Insure that the correct output device(s) are installed per the Control System Installation Drawings. (i.e., I/P or P/I transducers, transformers, power supply, etc.). Verify that these devices are installed, wired and piped correctly. Verify that any configuration jumpers are in the proper settings for the required application. Verify related transformers are fused in accordance with installation drawings.
 - c. Verify the point database to be correct. Verify that the correct COV limit has been defined.
 - d. Verify the point address by checking that the analog output is wired and/or piped to the correct output transducer and/or equipment.
 - e. Verify that the controlled device is calibrated (i.e., 3-8PSI valve, 8-13 PSI damper motor, 4-20 ma variable frequency drive, etc.) and is in the correct location, and is wired or piped and installed correctly per the design documentation package. If the controlled device is not calibrated, then a three-point (high, low and mid-point) calibration procedure must take place. Verify proper operation of the end device. When calibration has been verified, ensure that installation drawings, point database, and PPCL have been updated.
 - f. Set-up and or calibrate any associated equipment, (i.e., panel LCD meters, loop isolators, pneumatic gauges, etc.). Also verify that these auxiliary devices are mounted in the correct location, and are wired or piped and installed correctly per the design documentation package.
 - g. After verifying the set-up and operation of any associated equipment check for the correct operation of the logical point and associated equipment by commanding the analog output to the top and bottom of its range. Verify that the control device(s) responded appropriately as indicated by the design documentation package. Check to insure that all network terminals, host console devices, etc. can also command these outputs.
 - h. Check that all pneumatic gauges, pilot positioners and LCD panel meters indicate the correct values.
6. Terminal equipment controller checkout:
- a. Load program database
 - b. Enable programs
 - c. Verify sequence of operations
7. Programming checkout:
- a. Provide checkout for each system and sequence of operation.
 - b. The following are sample sequence of operations tests. The intent of these procedures is to provide a plan of action to verify system operations via block checks of the project specific sequence of operations. The procedures may be used in this format, or one procedure to a page should more detail be required. The procedures outlined below should be verified for accuracy, and may be modified to meet your

- c. specific requirements.
 - c. Description of Test: AHU Alarm Checkout. Verify AHU-1 discharge air temperature alarming is operational and is received at the designated terminal.
 - d. Input to Trigger Test: Change discharge temperature high alarm limit through software to a value below the current discharge temperature (discharge temperature - 10°F).
 - e. Expected Outcome: A high temperature alarm will be received per the Alarm Definition Report at its designated terminal.
 - f. Provide signoff sheet with indication for test Pass, Fail, Date of test and Initials for signoff.
8. Workstation checkout:
- a. Verify the operation of all trunk interface equipment.
 - b. Verify all workstation software, including options, based upon the installation instructions for the PC.
 - c. Perform software backup (site, options, etc.)
 - d. Complete workstation configuration report for owner signoff.
 - e. Provide verification that all graphics have been created, as required by project bid documents.

3.52 TESTING AND ACCEPTANCE

A. General:

1. After completion of installation and start-up procedures, commence the specified 3-phase verification and testing sequence leading to final acceptance.
 - a. Follow in the order specified.
 - b. Each testing phase shall be satisfactorily completed before entering the next phase.
2. Prior to entering each phase of the sequence, submit for approval, a written agenda describing in detail the procedure to be followed to meet the requirements for each specified verification, test or demonstration.
3. Submit for approval, a sample of the form on which the test will be reported.
 - a. Identify project.
 - b. Provide a list of all points, arrange in numerical order of point addresses.
 - 1) Show point descriptor and location of each.
 - 2) Indicate DDC panel that processes each point.
 - 3) Use the list as a basis for the specified report form.
 - c. Signatures of participants and observers.
 - d. Results.
 - e. Description of adjustment or corrections of points in error.
 - f. Date.
4. Provide schedule of tests. Estimate dates of significant events.
5. Test, calibrate and adjust each point in the system as specified.
6. Provide documentation of all tests and verifications as specified.
7. Provide trend reports indicating proper control of all points for an extended period of time.

B. Phase 1 - Testing, Calibrating, and Adjusting:

1. Operate each analog point in the entire system.
 - a. At a point in the upper quarter of its range.
 - b. At a point in the lower quarter of its range.
 - c. At its operating point.
2. Provide personnel and diagnostic instruments at both the central and remote locations.

3. Provide testing stimulants for alarms.
 4. Use digital meters of double the accuracy of the instruments being calibrated.
 5. Provide an approved test device for simulating high and low temperatures.
 6. When the function is performed, read values at the central control and observe the actual function at the field instrument.
 7. Exercise each binary point and observe indication at console and simultaneously observe operation in the field.
 8. Submit an operation report for each point in the system, in approved format, and describe any corrective or adjusting action taken.
 9. Test all power transducers with a Dranetz Power Analyzer.
- C. Phase 2 - Equipment and Point Verification:
1. Verify calibration or function of each point.
 - a. Verify analog points at operating value.
 - b. Record on specified form.
 - c. Make approved adjustments to out of tolerance points.
 - 1) Identify these points for ready reference.
 2. After verification procedure in completed:
 - a. Verify corrected points.
 - b. Record on specified form.
 - c. Points requiring correction.
 - 1) Replace sensor or actuator if electrical measurements indicated components are out of specified tolerance.
- D. Phase 3 - Software Verification:
1. Submit agenda and report format for software demonstrations.
 2. Demonstrate to the Owner and the Engineer that all software programs and automatic control sequences function as specified.
 3. Demonstrate compliance with response time specifications.
 - a. Simulate normal heavy load conditions.
 - b. Initiate at least ten successive occurrences on normal heavy load conditions as specified, and measure response time of typical alarms and status changes.
 4. Provide written documentation of demonstration, signed by representatives of the Contractor and Engineer.
- E. Provide the following reports to Engineer at final completion of all Testing:
1. List of all points.
 2. List of all points currently in alarm.
 3. List of all disabled points.
 4. List of all points in over-ride status.
 5. List of all points currently locked out.
 6. List of user accounts and access levels.
 7. List all weekly schedules.
 8. List of holiday programming schedules.
 9. List of limits and deadbands.
 10. System diagnostics reports including, list of DDC panels on line and communicating, status of all DDC terminal units device points.
 11. List of programs.
 12. Provide trend data reports to ensure proper operation and sequence control of BMCS.
- F. Substantial Completion of the BMCS will not occur until completion and acceptance of all testing and acceptance procedures.

3.53 TRAINING

- A. The contractor shall provide factory-trained instructor to give full instruction to designated personnel in the operation of the system installed. Instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach. The contractor shall provide all students with a student binder containing product specific training modules for the system installed. All training shall be held during normal working hours of 8:00 am to 4:30 PM weekdays.
- B. Provide 40 hours of training for Owner's designated operating personnel. Training shall include:
 - Explanation of drawings, operations and maintenance manuals
 - Walk-through of the job to locate control components
 - Operator workstation and peripherals
 - DDC controller and ASC operation/function
 - Operator control functions including graphic generation and field panel programming
 - Operation of portable operator's terminal
 - Explanation of adjustment, calibration and replacement procedures
 - Student binder with training modules
- C. Since the Owner may require personnel to have more comprehensive understanding of the hardware and software, additional training must be available from the Contractor.

3.54 PROJECT MANAGEMENT

- A. Provide a designated project manager who will be responsible for the following:
 - 1. Construct and maintain project schedule.
 - 2. Authorized to accept and execute orders or instructions from General Contractor, Owner / Architect & Engineer.
 - 3. Attend project meetings as necessary to avoid conflict and delays.
 - 4. Make necessary field decisions relating to this section.
 - 5. Coordination / Single point contact.
 - 6. Have Internet access for project management.

END OF SECTION

SECTION 23 09 34
COORDINATION OF BUILDING MANAGEMENT AND CONTROL SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. The Building Management and control System for the facility is being replaced. The items listed below shall be furnished and/or installed by this contractor.

PART 2 - PRODUCTS

- A. Products provided by the Building Management and Control System (BMCS) Contractor.
 - 1. Control Valves
 - 2. Dampers
 - 3. Wells for sensors installed in piping system
 - 4. Flow Meters

PART 3 - EXECUTION

3.1 COORDINATION

- A. Coordinate with the Building Management and Control System (BMCS) Contractor.
 - 1. Provide project-scheduling information to the BMCS Contractor to allow ample time for purchase of equipment and devices.
 - 2. Schedule periodic project meetings to review progress and coordination issues.
 - 3. Submit a written report, to the Architect/Engineer, on a monthly basis stating status of coordination effort.
- B. The BMCS contractor will submit shop drawings to this contractor for review and coordination processing.

3.2 INSTALLATION

- A. This Contractor will be responsible for the following:
 - 1. Installation of control valves for HVAC equipment.
 - 2. Installation of dampers for HVAC equipment.
 - 3. Installation of temperature sensor wells in piping.
 - 4. Installation of pressure taps in piping system.
 - 5. Installation of flow meter taps in piping system.
- B. Install the above material under the direction of the Building Management and Control System (BMCS) Contractor.

END OF SECTION

SECTION 23 20 00
HVAC PIPE AND PIPE FITTINGS - GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install pipe and pipe fittings for piping systems specified in Division 23 - Mechanical.

1.2 RELATED WORK

- A. Division 23 Mechanical:
 - 1. Earthwork.
 - 2. Valves, Strainers and Vents.
 - 3. Vibration Isolation.
 - 4. Insulation.
 - 5. Other Piping Sections

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. The particular type of pipe and fittings for each system is specified in the individual sections.

2.2 JOINTS

- A. Make screwed joints using machine cut USASI taper pipe threads. Apply a suitable joint compound to the male threads only. Ream the pipe to full inside diameter after cutting. All-thread nipples are not permitted.
- B. Dissimilar Metals. Make joints between copper and steel pipe and equipment using insulating unions or couplings such as Crane Company #1259; EPCO as manufactured by EPCO Sales, Inc.; or an approved equal.
- C. Solder joints.
 - 1. Prior to making joints, cut pipe square and ream to full inside diameter. Clean exterior of pipe and socket. Apply a thin coat of suitable fluxing compound to both pipe and socket, and fit parts together immediately.
 - 2. Heat assembled joint only as required to cause the solder to flow. Run the joint full, slightly beaded on the outside, and wipe to remove excess solder.
 - 3. Use silver brazing alloy or Sil-Fos on refrigerant piping and on underground piping. Use lead free solder on all other copper piping.
- D. Make welded joints as recommended by the standards of the American Welding Society. Ensure complete penetration of deposited metal with base metal. Provide filler metal suitable for use with base metal. Keep inside of fittings free from globules of weld metal. The use of mitered joints is not approved.
- E. Flanged.
 - 1. Prior to installation of bolts, center and align flanged joints to prevent mechanical pre-stressing of flanges, pipe or equipment. Align bolt holes to straddle the vertical, horizontal or north-south centerline. Do not exceed 3/64" per foot inclination of the flange face from true alignment.
 - 2. Use flat-face companion flanges only with flat-faced fittings, valves or equipment. Otherwise, use raised-face flanges.
 - 3. Install gaskets suitable for the intended service and factory cut to proper dimensions. Secure with manufacturers recommended gasket cement.
 - 4. Use ANSI nuts and bolts, galvanized or black to match flange material. Use ANSI 316 stainless steel nuts and bolts underground. Tighten bolts progressively

- to prevent unbalanced stress. Draw bolts tight to ensure proper seating of gaskets.
5. Use carbon steel flanges conforming to ANSI B16.5 with pipe materials conforming to ASTM A 105 Grade II or ASTM A 108, Grade II, ASTM A 53, Grade B. Use slip-on type flanges on pipe only. Use welding neck type flanges on all fittings. Weld slip-on flanges inside and outside.
 6. Keep flange covers on equipment while fabricating piping. Remove when ready to install in system.
- F. Mechanical Joints: Provide a stuffing box type mechanical joint adapted to use gasket, cast iron gland and bolts. Coat bolts with bitumastic enamel. Use joint parts similar in design to one of the following:
1. Doublex Simplex Joint manufactured by the American Cast Iron Pipe Company, Birmingham, Alabama.
 2. U.S. joints manufactured by the United States Pipe and Foundry Company, Burlington, New Jersey.
 3. Boltite Joint manufactured by the McWane Cast Iron Pipe Company, Birmingham, Alabama.
 4. Flexlamp manufactured by the National Cast Iron Pipe Company, Birmingham, Alabama.

2.3 UNIONS

- A. Use 150 lb. standard (300 lb. WOG) malleable iron, ground joint unions with bronze seat. Provide flanged joints on piping 2-1/2" and larger.
1. Where pipe material of different types join, use a dielectric union. Union shall be threaded, solder or as required for its intended use.

2.4 BRANCH CONNECTIONS

- A. Pipe 2" and Smaller: For threaded piping, use straight size reducing tee. When branch is smaller than header, a nipple and reducing coupling or swagged nipple may be used.
- B. 2-1/2" through 36": For welding piping, when branch size is the same as header size, use welding tee. For threaded branch connections, use 3000 lb. full coupling or Thread-o-let welded to header.

2.5 GASKETS

- A. High Temperature Piping: Provide 1/16" thick ring gaskets of aramid reinforced SBR such as Garlock #3200 or 3400 or equal by Advanced Products and Systems.
- B. Other Piping: Provide ring rubber gaskets, Garlock #7992 or equal by Advanced Products and Systems. Use 1/8" thick cloth reinforced neoprene gaskets. For smaller than 6", use 1/16" thick gasket.

2.6 FLOORS AND CEILING PLATES

- A. 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.

2.7 DOMESTIC MANUFACTURE

- A. All piping material, pipe and pipe fittings shall be manufactured in the United States of America.

PART 3 - EXECUTION

3.1 PIPE FABRICATION AND INSTALLATION

- A. Make piping layout and installation in the most advantageous manner possible with

respect to headroom, valve access, opening and equipment clearance, and clearance for other work. Give particular attention to piping in the vicinity of equipment. Preserve the required minimum access clearances to various equipment parts, as recommended by the equipment manufacturer, for maintenance.

- B. Cut all pipes to measurement determined at the site. After cutting pipe, remove burrs by reaming. Bevel plain ends of ferrous pipe.
- C. Install piping neatly, free from unnecessary traps and pockets. Work into place without springing or forcing. Use fittings to make changes in direction. Field bending and mitering is prohibited. Make connections to equipment using flanged joints, unions or couplings. Make reducing connections with reducing fittings only.
- D. Install piping without tapping out of the bottom of pipe.

3.2 WELD

- A. Weld and fabricate piping in accordance with ANSI Standard B31.1, latest edition, Code for Pressure Piping.
- B. Align piping and equipment so that no part is offset more than 1/16". Set fittings and joints square and true, and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.
- C. Do not permit any weld to project within the pipe so as to restrict flows. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.
- D. Do not split, bend, flatten or otherwise damage piping before, during or after installation.
- E. Remove dirt, scale and other foreign matter from inside piping before tying into existing piping sections, fittings, valves or equipment.
- F. Bevel ends of ferrous pipe.

3.3 OFFSETS AND FITTINGS

- A. Due to the small scale of drawings, the indication of offsets and fittings is not possible. Investigate the structural and finish conditions affecting the work and take steps required to meet these conditions.
- B. Install pipe close to walls, ceilings and columns so pipe will occupy minimum space. Provide proper spacing for insulation coverings, removal of pipe, special clearances, and offsets and fittings.

3.4 SECURING AND SUPPORTING

- A. Support piping to maintain line and grade, with provision for expansion and contraction. Use approved clevis-type or trapeze-type hangers connected to structural members of the building. Single pipe runs to be supported by approved clevis type hangers. Multiple pipe runs to be supported by approved trapeze type hangers. Do not support piping from other piping or structural joist bridging. Review structural drawings for additional information.
- B. Provide supports both sides and within 12" of each horizontal elbow for pipe 6" and larger.
- C. Support vertical risers with steel strap pipe clamps of approved design and size, supported at each floor. Support piping assemblies in chases so they are rigid and self-supported before the chase is closed. Provide structural support for piping penetrating chase walls to fixtures. On chilled water pipe supports shall be outside the insulation.
- D. Where insulation occurs, design hangers to protect insulation from damage. Pipe saddles and insulation shields, where required, are specified in the appropriate insulation section and are sized in accordance with the schedule on the drawings.
- E. Install trapeze hangers, properly sized, to support the intended load without distortion. Use hangers with 1-1/2" minimum vertical adjustment.

- F. Use electro-galvanized or zinc plated beam clamps if acceptable to the structural engineer, threaded rods, nuts, washers and hangers. All hanger rods shall be trimmed neatly so that no more than 1 inch of excess hanger rod protrudes beyond the hanger nut. Use only on beams as directed by the Structural Engineer.
- G. At outdoor locations, all supports, brackets and structural members shall be hot-dipped galvanized.
- H. Provide hangers within 3' of pipe length from all coil connections.
- I. Support spacing: As recommended by the project structural engineer and support manufacturer, but not more than listed below. Not to exceed spacing requirements of smallest pipe.

Pipe Size	Copper & Steel Max. Support Spacing, Ft.	Cast Iron Max. Support Spacing, Ft.	Minimum Rod Diameter, Inches
1" & smaller	6		3/8
1-1/4" & 1-1/2"	8	5	3/8
2"	10	5	3/8
3"	10	5	1/2
4" & 5"	10	5	5/8
6" and above	10	5	3/4

3.5 PIPE SUPPORTS

- A. Provide P1001 or P 5000 Unistrut metal framing members and appurtenances for pipe support. Hot-dip galvanized members and appurtenances when located outside. Sagging of pipes or supports is not acceptable.
- B. Adjustable clevis hangers shall be used for single pipe supports; Anvil Fig. 260. When oversized clevis is used, a nipple shall be placed over the clevis bolt as a spacer to assure that the lower U-strap will not move in on the bolt. Provide adjustable clevis with a nut / washer above and below the hanger on the support rod. Ring type clevis hangers are not acceptable.
- C. Provide Anvil Figure 45 galvanized or primed and painted channel assembly for trapeze hangers.

3.6 PIPE SUPPORTS ON ROOF

- A. Support condensate drain pipe on roof with Portable Pipe Hanger Model PP-10 with roller and fully adjustable height throughout pipe run. Base material shall be high density / high impact polypropylene with UV inhibitors and anti-oxidants. Provide with hot dip galvanized rod finish and framing. Nuts and washers shall be hot dip galvanized.

3.7 PIPE STANDS

- A. Refer to Pipe Stand detail included in drawings for additional information.
- B. All ground mounted pipe stands shall be steel construction and hot dipped galvanized after fabrication.
- C. All pipe stand bases shall be anchored, leveled and grouted to ensure equal weight distribution.

3.8 ANCHORS

- A. Provide anchors as required. Use pipe anchors consisting of heavy steel collars with lugs and bolts for clamping to pipe and attaching anchor braces. Install anchor braces in the most effective manner to secure desired results. Do not install supports, anchors or similar devices where they will damage construction during installation or because of the

weight or the expansion of the pipe. When possible, install sleeves in structural concrete prior to pouring of concrete.

3.9 FLOOR PENETRATIONS

- A. At locations where pipe passes through floors, provide watertight concrete curb around penetration.

3.10 PIPE SLEEVES

- A. Sleeves through masonry and concrete construction:
 - 1. Fabricate sleeves of Schedule 40 galvanized steel pipe.
 - 2. Size sleeve large enough to allow for movement due to expansion and to provide continuous insulation.
- B. Sleeves through gypsum wall construction.
 - 1. Fabricate sleeves of 16 gauge galvanized sheet metal.
- C. Sleeves through elevated slab construction.
 - 1. Fabricate sleeves of Schedule 40 galvanized steel pipe with welded center flange in floor.
- D. Extend each sleeve through the floor or wall. Cut the sleeve flush with each wall surface. Sleeves through floors shall extend 2" above floor lines for waterproofing purposes. Slab on grade floors shall not be sleeved except where penetrating waterproofing membrane or insect control is required.
- E. Caulk sleeves water and air tight. Seal annular space between pipes and sleeves with mastic compound to make the space water and air tight.
- F. For sleeves below grades in outside walls, provide Thunderline Link-Seal or Advance Product and System Interlynx, with 316 stainless steel nuts and bolts, with cast iron pressure plate.
- G. Provide chrome plated escutcheon plates on pipes passing through walls, floors or ceilings exposed to view. At exterior walls, stainless steel sheet metal is to be used.
- H. For sleeves through fire and smoke rated walls, seal with a UL through-penetration firestop, rated to maintain the integrity of the time rated construction. Install in accordance with the manufacturer's installation instructions. Comply with UL and NFPA standards for the installation of firestops. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.

3.11 ISOLATION VALVES

- A. Provide piping systems with line size shutoff valves located at the risers, at main branch connections to mains for equipment, to isolate central plant, and at other locations.

3.12 DRAIN VALVES

- A. Install drain valves at low points of water piping systems so that these systems can be entirely drained. Install a line size drain valve for pipes smaller than 2" unless indicated otherwise. For pipes 2-1/2" and larger, provide 2" drain valves unless indicated otherwise. Drain valves shall be plugged when not in use and at completion.

3.13 CLEANING OF PIPING SYSTEMS

- 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. Flush the chilled and hot water systems utilizing the filter feeders.
- B. 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.

- C. 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.
- D. 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.
- E. Dispose of water in approved manner.
- F. Phase Two: Cleaning of Piping Systems. Remove, without chemical or mechanical damage to any system component, adherent dirt (organic soil), oil, grease, (hydrocarbons), welding and soldering flux, mill varnish, piping compounds, rust (iron oxide) and other deleterious substances not removed by initial flushing. Chemical shall be equal to Nalco 2578 prepping compound. Insert anti-foam compound as necessary. Circulate for 48 hours or as recommended by the manufacture. Dispose of water in approved manner. Flush system and replace with clean water. Verify compatibility of chemicals used with existing chemical treatment program on remodel projects.
- G. 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.
- H. Submit status reports upon completion of each phase of work on each system.
- I. Special requirements, if any, are specified in the sections on each type of piping or in the section on Water Treatment Systems.

3.14 TESTING

- A. Test piping after installation with water hydrostatic pressure of 1-1/2 times operating pressure (150 psig minimum) and carefully check for leaks. Repair leaks and retest system until proven watertight.
- B. Do not insulate or conceal piping systems until tests are satisfactorily complete.
- C. If any leaks or other defects are observed, suspend the test and correct the condition at once. Repeat testing until leaks are eliminated and the full test period is achieved.
- D. The satisfactory completion of testing does not relieve the Contractor of responsibility for ultimate proper and satisfactory operation of piping systems and their accessories.

3.15 PIPE MARKERS

- A. Identify interior exposed piping and piping in accessible chases or plenums with Opti-Code Brady Pressure Sensitive Adhesive Pipe Markers, consisting of pipe marker and direction of flow arrow tape. Clean pipe prior to installation. Background colors of markers, arrows and tape for each type of system shall be the same. Meet ANSI/OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.
- B. Identify exterior and mechanical room piping with Snap Around pipe markers through 4-inch pipe and Strap Around markers 5-inch pipe and larger. Pipe markers consisting of pipe marker and direction of flow arrow tape; 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. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.
- C. Install identification in the following locations:
 - 1. both sides of penetrations through walls, floors and ceilings.

2. Close to valves or flanges.
 3. Intervals on straight pipe runs not to exceed 50 feet
 4. Apply marker where view is obstructed.
- D. Pipe markers shall meet or exceed the specifications of the ASME A13.1 "Scheme for Identification of Piping Systems".

END OF SECTION

SECTION 23 21 13
HOT WATER AND CHILLED WATER PIPING, VALVES AND APPURTENANCES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install heating water and chilled water piping, valves and appurtenances, including fittings and strainers. Domestic hot water piping is specified in the Domestic Water Piping and Appurtenances section.

1.2 RELATED WORK

- A. Division 23 Mechanical:
 - 1. Pipe and Pipe Fittings - General
 - 2. Valves, Strainers and Vents
 - 3. Vibration Isolation
 - 4. Insulation

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. For pipe 2" and less in diameter, provide pipe conforming to ASTM A 53, Grade A or B, or ASTM A106 schedule 80 seamless, or electric-resistance welded black steel pipe. Furnish 150 lb. screwed malleable iron fittings conforming to ANSI B 16.3 for chilled water. Provide fittings conforming to ANSI B 16.4 for hot water.
- B. For pipe 2-1/2" in diameter and larger, provide pipe meeting the requirements of ASTM A 53, Grade A or B, or ASTM A 106 schedule 80 seamless, or electric-resistance welded black steel pipe with standard weight seamless steel welded fittings, satisfying ASTM A 234, Grade WPA or WPB, ANSI B16.9.

2.2 VALVES

- A. Refer to Section 23 05 23.
- B. Refer to Building Management and Control System.

2.3 WATER SPECIALTIES

- A. Pressurized Expansion Tanks shall be precharged steel tank with a replaceable heavy duty Butyl rubber bladder. The tank shall have a 1-1/2" system connection, drain, and a standard tire valve to facilitate on-site charging of the tank. The tank shall be fitted with lifting rings and a floor mounting skirt for vertical installation. The tank must be constructed in accordance with Section VIII of ASME Boiler and Pressure Vessel Code and stamped 125 PSI working pressure.
 - 1. Acceptable manufacturers: Bell & Gossett, Taco, Wessels, John Wood Company, and Wheatley.
- B. Pressure Reducing Valves shall be diaphragm operated with brass body, low inlet pressure check valve and inlet strainer. The strainer shall be easily removed without system shutdown. The valve seat, strainer, and stem must be removable and of non-corrosive material.
 - 1. Acceptable Manufacturers: Bell & Gossett, Armstrong, Taco, and Wheatley.
- C. Automatic Air vents shall be float actuated high capacity air vent designed to purge free air from the system and provide shutoff at pressures up to 150 psig at a maximum temperature of 250 degrees F. The design of the high capacity air vent shall prevent air from entering the system if system pressure should drop below atmospheric pressure. The high capacity air vent shall purge free air at pressures up to 150 psig during normal system operation. The high capacity air vent shall be constructed of cast iron and fitted with components of stainless steel, brass, and EPDM.
 - 1. Acceptable Manufacturers: Bell & Gossett, Armstrong, Taco, and Wheatley.

- D. Air and Dirt Separators shall be a full flow coalescing type combination air eliminator and dirt separator. The separator shall be designed for full flow high volume systems. The inlet and outlet connections shall be the same as adjoining pipe. Vessel shall be fabricated steel, rated for 150 psig working pressure, stamped and registered in accordance with ASME Section VIII, Division 1 for unfired pressure vessels, and include two equal chambers above and below the inlet and outlet nozzles. The vessel shall include copper or stainless steel coalescing medium to aid in the separation of air and dirt in the system entrained water. Air elimination efficiency shall be 100% free air, 100% entrained air, and a minimum of 99.6% dissolved air at the installed location. Dirt separation efficiency shall be a minimum of 80% of all particles 30 micron and larger within 100 passes. Unit shall be provided with a separate venting chamber to prevent system contaminants from harming the float and venting valve operation.
1. Acceptable manufacturer shall be Spirovent Series HV by Spirotherm, TACO High Velocity 4900, Thrush High Velocity.

PART 3 - EXECUTION

3.1 TESTING

- A. Test all piping systems to assure they are absolutely leak free.
- B. Apply a hydraulic pressure 1-1/2 times the operating pressure, 150 psig minimum, and check for leaks. Maintain test for a minimum of 24 hours. The piping system must remain absolutely tight during this period. The satisfactory completion of any test or series of tests will not relieve the contractor of responsibility for ultimate proper and satisfactory operation of piping systems and their accessories. The test should be observed by the Architect / Engineer before pressure is removed and water drained.

3.2 AIR HANDLING UNIT PIPING

- A. Provide a minimum of 12" of straight pipe at all coil piping connections.

3.3 AIR SEPARATOR

- A. Install full size drain to nearest floor drain.
- B. Install air vent drain to nearest floor drain.

END OF SECTION

SECTION 23 21 23 HVAC PUMPS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. General characteristics for pumps specified in Division 23 - Mechanical.

1.2 RELATED WORK

Requirements for pumps are specified in other sections of Division 23 - Mechanical, including the following:

- A. Division 23 Mechanical - Electrical Provisions of Mechanical Work.
- B. Section 23 05 48 HVAC Vibration Isolation
- C. Section 23 05 50 Noise Control for Mechanical Systems

1.3 PUMP SELECTION

- A. Select pumps conservatively for scheduled conditions. Furnish pumps that have reasonably high efficiencies, with peak efficiency at or near rated conditions. Select pumps that will operate stably at 15' suction lift despite substantial reduction in head or substantial increase in delivery.
- B. If the pumps proposed are not considered suitable, submit manufacturer's data on other pumps, for review.
- C. Scheduled design flow, design head, pump efficiency, and motor horsepower are the minimum acceptable.
- D. The pump curve shall rise continuously from maximum flow to cut-off.
- E. Shut-off head approximately 10 percent greater than design head, unless otherwise indicated in pump schedules.
- F. Pump brake horsepower shall not exceed the motor horsepower rating over the entire operating range from shut-off to run-out.
- G. Select the pump for operation at or near peak efficiency.
- H. Cavitation-free at all points on the curve.
- I. Impeller diameter shall not exceed 90 percent of the maximum published diameter.
- J. Pumps shall be suitable for parallel operation. Where pumps are operated in parallel, individual pumps shall be capable of stable operation with only one pump operating in the system. Submit pump curves with single and multiple pumps operating on system curve for approval.

1.4 PUMP SIZE AND TYPE

- A. Provide motor-driven pumps of the type and speed scheduled. Select pumps that are not overloaded throughout the entire range of pump operation. Provide pump connection sizes as indicated.
- B. The head capacities indicated in the schedules are listed for bidding purposes only. Calculate the operating head at each pump; take into consideration the actual routing of the various lines, pressure drops in heat exchangers and coils, exact lengths of pipe, fittings, etc. Submit these calculations, together with copies of manufacturer's performance curves, as shop drawings on each pump. Clearly mark the curves for each pump to indicate the diameter of the impeller and the selection point.

1.5 CERTIFIED DATA

- A. Submit factory certified pump curves showing pump performance characteristics with pump and system operating points plotted. Curves shall include as a minimum, flow (gallons per minute), head (feet of water), all available impeller diameters (inches),

efficiency (percent), net positive suction head required (feet of water), brake horsepower, pump size and pump model. When multiple pumps are operating in parallel, show pump curves for one pump running, two pumps running, and so on. Show pump curves with system curve plotted.

1.6 DELIVERY OPTIONS

- A. Manufacturer shall provide quick shipment options to minimize product lead times.

PART 2 - PRODUCTS

2.1 VERTICAL IN-LINE (VIL) PUMPS

- A. Pump Construction:
1. Pump casing, cast iron with 125 psig ANSI/PN16 flanges for working pressure below 175 psig at 150°F and ductile iron with 250 psig ANSI / PN25 flanges for working pressure to 375 psig at 150°F.
 2. Suction and discharge connections shall be flanged and the same size and shall be drilled and tapped for seal flush and gauge connections.
 3. Impeller: Bronze, fully enclosed type; dynamically balanced, two-plan balancing is required where installed impeller diameter is less than 6 times the impeller width.
 4. Shaft: Provide 316 stainless steel pump shaft.
 5. Coupling: Rigid spacer type of high tensile aluminum alloy. Coupling is to be designed to be easily removed on site to reveal a space between the pump and motor shafts sufficient to remove all mechanical seal components for servicing and to be replaced without disturbing the pump or motor.
 6. Mechanical seals shall be stainless steel multi-spring inside or outside balanced type with Viton secondary seal, carbon rotating face and silicon carbide stationary seat. Provide 316 stainless steel glad plate. Provide factory installed flush line with manual vent.
 7. Split coupled pumps shall be provided with a lower seal chamber throttle bushing to ensure seals maintain positive cooling and lubrication.
 8. Provide seal flush supply line to the mechanical seal with a 50 micron cartridge filter and sight flow indicator to suit the working pressure encountered. Filters shall be changed by the installing contractor after system is flushed and on a regular basis until turned over to the Owner.
 9. Supply in the flush line to the mechanical seal a maintenance free sediment separator with sight flow indicator.
 10. Natatorium pumps shall utilize a cast 316 stainless steel impeller and a ductile iron casing with fusion bonded epoxy coating to withstand corrosion caused by chlorinated water.
- B. Single stage, single or double suction type, with pump characteristics which provide rising heads to shut off. Refer to pump schedule for pump flows and heads and motor speed, enclosure, efficiency and power requirements and other system conditions.
- C. Pump Motor:
1. Premium efficiency
 2. Totally enclosed fan cooled
 3. Cast iron frame and end plate
 4. (2) Forge steel lifting eye
 5. Over-sized conduit box with ground lug
 6. So sized with relation to the pump impeller that the brake horsepower

requirements will not overload the motor at any point on the pump curve.

7. Critical speed of the pump shall be at minimum 115% of the operating speed listed in the pump schedule.
8. Designed for Variable Frequency Drive Application
9. Greaseable bearings rated for a minimum of 200,000 hours.
10. Minimum Efficiency

3 hp	1800 rpm	89.5%
5 hp	1800 rpm	90.2%
7.5 hp	1800 rpm	91.7%
10 hp	1800 rpm	91.7%
15 hp	1800 rpm	92.4%
20 hp	1800 rpm	93%
25 hp	1800 rpm	93.6%
30 hp	1800 rpm	94.1%
40 hp	1800 rpm	94.5%
50 hp	1800 rpm	94.5%
60 hp	1800 rpm	95%
75 hp+	1800 rpm	95.4%

D. Data plates:

1. Provide the pump with a nameplate constructed of 300 series stainless steel securely fastened to pump casing with stainless steel pins.
2. Locate the nameplate for easy visibility.
3. Clearly stamp the rating conditions and other data below, as a minimum, on the nameplate.
 - a. Manufacturer, address, telephone number
 - b. Pump model number
 - c. Pump serial number
 - d. Size (including impeller diameter scheduled in inches)
 - e. Type
 - f. Equipment designation as listed on the pump schedule.
 - g. Flow scheduled (gallons per minute)
 - h. Dynamic head scheduled (feet of water)
 - i. Efficiency (percent)
 - j. Shut-off head (feet of water)
 - k. Speed (rpm)
 - l. Brake horsepower
 - m. Maximum brake horsepower with rated impeller
 - n. Rotation
 - o. Maximum allowable pressure (psig)

E. The schedule on the drawing sets forth the type of pump and GPM required.

1. The head capacities and horsepower are for bidding purposes only.
2. Make pump selection based on actual system calculations.

F. Acceptable manufacturers:

1. Bell & Gossett
2. Armstrong Series 4300
3. Aurora
4. Taco

5. Grundfos
6. Patterson

2.2 HORIZONTAL PUMPS

- A. Pump Construction:
1. Cast iron, designed for 175 psi working pressure
 2. Bronze case wear rings
 3. Grease lubricated ball bearings selected for an average life of 200,000 hours; pressure grease fittings
 4. Flexible coupled – tire coupling element, Dura-Flex type
 5. Hot Dipped galvanized drip-rim structural steel base extending past the pump flanges allowing all condensation to be accumulated. Galvanized integral drain pan.
 6. Falk all-metal center dropout spacer coupling
 7. Totally enclosed metal or high-impact polyethylene plastic (Orange Peel) coupling guard per ANSI B15.1, Section 8 and OSHA 1910.219
 8. Suction and discharge flange gauge ports
 9. Fully enclosed bronze impeller keyed to the shaft
 10. 304 Stainless steel shaft minimum
- B. End suction pump volute with integrally cast pedestal support foot for back pullout to allow pump to be serviced without disturbing the system piping. Pumps utilizing pedestal mounted bearing frames in lieu of volute will not be accepted.
- C. Bearings:
1. Conform to Anti-Friction Bearing Manufacturers Association (AFBMA) Standards
 2. Ball or roller bearing pillow block type
 3. Self-aligning
 4. AFBMA L50 rating of 200,000 hours
- D. Provide each pump with an internally flushed mechanical seal. If external flush line is required, provide sediment filter for each line.
1. Use seal materials suitable for the pumped liquid
 2. Renewable bronze or stainless shaft sleeve
- D. Paint entire unit with two coats of machinery enamel after completion of installation.
- F. Pump Motor:
1. Premium efficiency
 2. Totally enclosed fan cooled
 3. Cast iron frame and end plate
 4. Forge steel lifting eye
 5. Over sized conduit box with ground lug
 6. So sized with relation to the pump impeller that the brake horsepower requirements will not overload the motor at any point on the pump curve
 7. Designed for Variable Frequency Drive Application
 8. Provide with factory installed shaft grounding rings by AEGIS.
 9. Minimum Efficiency

3 hp	1800 rpm	89.5%
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5 hp	1800 rpm	90.2%
7.5 hp	1800 rpm	91.7%
10 hp	1800 rpm	91.7%
15 hp	1800 rpm	92.4%
20 hp	1800 rpm	93%
25 hp	1800 rpm	93.6%
30 hp	1800 rpm	94.1%
40 hp	1800 rpm	94.5%
50 hp	1800 rpm	94.5%
60 hp	1800 rpm	95%
75 hp+	1800 rpm	95.4%

- G. Data plates:
1. Provide the pump with a nameplate constructed of 300 series stainless steel securely fastened to pump casing with stainless steel pins.
 2. Locate the nameplate for easy visibility.
 3. Clearly stamp the rating conditions and other data below, as a minimum, on the nameplate.
 - a. Manufacturer, address, telephone number
 - b. Pump model number
 - c. Pump serial number
 - d. Size (including impeller diameter scheduled in inches)
 - e. Type
 - f. Equipment designation as listed on the pump schedule.
 - g. Flow scheduled (gallons per minute)
 - h. Dynamic head scheduled (feet of water)
 - i. Efficiency (percent)
 - j. Shut-off head (feet of water)
 - k. Speed (rpm)
 - l. Brake horsepower
 - m. Maximum brake horsepower with rated impeller
 - n. Rotation
 - o. Maximum allowable pressure (psig)
- H. The schedule on the drawing sets forth the type of pump and GPM required.
1. The head capacities and horsepower are for bidding purposes only.
 2. Make pump selection based on actual system calculations.
- I. Acceptable manufacturers:
1. Bell & Gossett
 2. Armstrong
 3. Aurora
 4. Taco
 5. Grundfos
 6. Patterson

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install the pumps in accordance with Manufacturer's "Installation, Start-up and Service Instructions".

1. Provide a minimum of 24" access space around pumps for service.
 2. Install pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place. Install stainless steel drain pan with trough under chilled water pumps only.
 3. Provide air cock and drain connection piped to floor drain.
 4. Lubricate pumps prior to start-up.
 5. Install condenser water pumps to ensure a full flooded suction.
 6. Paint entire unit with two coats of machinery enamel after completion of installation.
 7. Provide a spool piece between the suction diffuser and the suction side of the pump minimum length 8" face to face.
 8. Provide pressure taps with valves on each side of the pump.
 9. Install hot water circulator horizontally, properly supported to wall, in an accessible location for testing and maintenance at a height not to exceed 60" above finished floor. Install line size Ernst bronze rotating wheel, flow indicator with double window, downstream of circulator.
 10. Reference section 23 05 13 Article 3.1 paragraph D for motor wiring connectors.
- B. Provide a line size isolation valve and strainer on the pump suction and a line size silent check valve and balancing valve on the pump discharge. Provide an automatic air vent off the pump casing. For base mounted pumps, provide a drain line the full size of the base connection and extend it to and terminate it over the nearest floor drain.
- C. Support piping adjacent to the pump such that no weight is carried on the pump casing. Decrease from pipe size with eccentric reducer on suction side and concentric increaser on discharge side.
- D. Ensure pumps:
1. Operate at specified system fluid temperatures without vapor binding and cavitation.
 2. Are non-overloading in parallel and individual operation.
 3. Operate within 25 percent of midpoint of published maximum efficiency curve.
- E. Refer to pump detail on the Contract Drawings for piping accessories to be provided.

3.2 MANUFACTURER START-UP SERVICE ALIGNMENT

- A. After installation, the pumps and motors are to be aligned by the manufacturer or their representative utilizing a dial indicator. After completion, a formal report must be submitted by the Manufacturer to the Engineer prior to final acceptance. This report must include pump serial number, location, beginning and final alignment at a minimum.
1. Technicians, as required, shall be trained and experienced in the work they perform (contractor start-up / alignment is unacceptable).
- B. Before starting pumps, but after connecting piping:
1. Align shafts and coupling with a precision dial indicator alignment instrument to the minimum tolerances .004 (TIR) per inch of coupling radius or as recommended by the manufacturer, whichever is the greater.
 2. Tabulate the actual pump alignment reading with manufacturer's minimum tolerances.
 3. Submit readings for approval.
 4. Include the approved readings in the Owner's Maintenance Manual.

3.3 FINAL PUMP FLOW CALIBRATION

- A. Based on the results of the final phases of the test and balance sequences, if the flow of the unthrottled pump is more than 10% above the scheduled values:
1. Request detailed instructions from the pump manufacturer for the correct

- impeller diameter.
- 2. Trim the impeller to the diameter recommended by the manufacturer, employing precision machinery.
- B. Enter the information on the final configuration of the pump in the Owner's Manual.
 - 1. Modify the pump nameplate to reflect the correct head and flow data and the impeller diameter.

3.4 SPARE PARTS

- A. Provide the following spare parts and material to the Owner for his use after the warranty period.
 - 1. An extra packing box rebuild kit and 5 packing rings for each condenser water pump.
 - 2. An extra mechanical seal for each vertical inline pump.
 - 3. A set of bearings for each horizontal pump.

END OF SECTION

SECTION 23 23 00
REFRIGERANT PIPING AND APPURTENANCES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install copper tubing, valves, strainers and sight glass for refrigerant piping.

1.2 RELATED WORK

- A. Division 23 Mechanical.
 - 1. Pipe and Pipe Fittings
 - 2. Piping Insulation

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. Furnish refrigerant piping of Type K hard-drawn copper tubing with sweat-type, wrought copper fittings. Cast fittings are not permitted.

2.2 SERVICE VALVES

- A. Provide angle or globe service valves, with sweat connections. Use packed-type, wrench operated, valves with gasketed seal cap and back seat feature. Furnish valves designed for refrigerant service, in conformance with the ARI code.
- B. Place service valves at the inlet and outlet of each compressor, on both sides of each strainer and solenoid valve, and as otherwise shown and specified.

2.3 SOLENOID VALVES

- A. Furnish pilot-operated, floating-piston solenoid valves suitable for operation with refrigerant.
- B. Use valves with a bronze body and sweat-type connections.
- C. Provide stainless steel stem and plunger assembly and a stainless steel piston.
- D. Furnish sealed and moisture proof solenoid coils.
- E. Use electrical characteristics of 115 volt, 60 Hertz.

2.4 SIGHT GLASSES

- A. Provide suitable moisture and liquid sight glass in the liquid line leaving the condenser or receiver.

2.5 FILTER DRYER

- A. Furnish replaceable core liquid line filter dryer.
- B. Provide filter dryer constructed to permit the removal of the core element without removing the filter dryer from the line.

PART 3 - EXECUTION

3.1 BRAZING

- A. During the brazing process, dry nitrogen shall be purged through the tubing to prevent oxides from forming.

3.2 PRESSURE TEST

- A. After refrigeration and piping system items are installed, charge the system with dry nitrogen and test to 450 psig.
 - 1. Test joints with a Halide torch or an electronic leak detector.
 - 2. Repair leaks and retest each system until proved tight.

3.3 EVACUATION AND DRYING

- A. After refrigerant system has been pressure-tested, connect a suitable vacuum pump and evacuate piping system, including lines and equipment.
 - 1. Maintain a vacuum as high as practicable for long enough to evaporate the moisture in the system (at least 48 hours).
 - 2. Check the humidity within the system with a wet bulb indicator, and maintain the vacuum until the wet bulb temperature is reduced to -40°F. After the system has been evacuated and dried, break the vacuum by charging proper refrigerant into the system.

3.4 PIPE SIZE

- A. Pipe shall be routed and sized per condensing unit manufacturer's instructions.

END OF SECTION

SECTION 23 25 13
CIRCULATING WATER SYSTEM CHEMICAL TREATMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide equipment, chemicals and treatment materials for the complete water treatment system.
- B. Determine which chemicals to use from the results of a water sample analysis taken from the building domestic water supply.
- C. Provide water treatment products, holding reservoirs, equipment and labor for testing, cleaning, flushing and dispensing products to achieve the required water quality for each system specified.
 - 1. Closed chilled and hot water systems
 - 2. The cooling tower condenser water system
- D. Entire existing chilled water system shall be fully cleaned and flushed prior to the operation of chillers.
- E. Test all existing closed and open water systems and provide report to Owner and Engineer.

1.2 SERVICE AND SUPPLIES

- A. All work shall be performed by a qualified, full-time, Water Program Manager.
 - 1. Specialist in the field of industrial water treatment.
 - 2. Facilities include water analysis laboratory, development facilities and service department.
- B. Provide a water treatment test set for each system (pH, alkalinity, hardness, chloride) for field use including test equipment and reagents as required for specific use with the treatment products employed.
- C. Where specialized supplementary testing or control equipment is required, provide appropriate items.
- D. Provide a water management and service program for a period of one year beginning at substantial completion. Make routine visits bi-weekly during first two months of operation and monthly during the remainder of the specified period.
- E. Routing Services
 - 1. Check and adjust water treatment system operation.
 - 2. Instruct, train and advise operating personnel.
 - 3. Check efficiency of chemicals and chemical applications.
 - 4. Replenish chemicals and replace expendables.
 - 5. Clean or replace filter in feeder.
- F. Chemically clean the piping system.
- G. Provide a complete laboratory analysis of water samples. Insert in the Owner's manuals.
- H. Provide review of report figures in the field water testing.

1.3 QUALITY ASSURANCE

- A. Acceptable program manager shall have:
 - 1. Research and development facilities.
 - 2. Regional laboratories capable of making water analysis.
 - 3. A service department and qualified technical service representatives located within a reasonable distance of the project site.
 - 4. Service representatives who are registered Engineers or factory-certified technicians with not less than 5 years of water treatment experience with the water treatment system manufacturer.

- B. Ensure that all products, packaging, blow-down or other effluents do not violate local, state, or federal laws or regulations. Use only chemicals that are registered, when required, with the U.S. Department of Agriculture or the U.S. Environmental Protection Agency and that are labeled as required by law.
- C. Provide electrical products that have been tested, listed and labeled by Underwriters Laboratories and comply with the National Electrical Manufacturers Association Standards.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Nalco Water – Ecolab (Danny Short 832-823-9716)

2.2 CLOSED CHILLED AND HOT WATER SYSTEM

- A. Side stream stainless steel filter feeders in the hot water and chilled water systems:
 - 1. Rated at 40-gpm capacity.
 - 2. Operating conditions: 200 psig and 250°F.
 - 3. Single filter cartridge.
 - 4. Cartridge #:
 - a. NALCO 231-FMPIC405HT
 - b. WATTS #FMPIC405HT
 - 5. Fabricated hot dipped galvanized steel support legs and frame. Refer to detail drawing for requirements.
 - 6. Provide sufficient quantity of filter cartridges for warranty period. Minimum of two additional cartridges provided to owner.
 - 7. Provide (2) two drains for filter housing. (1) clean water drain, (1) dirty water drain.
- B. Acceptable Manufacturers: Side Stream Cartridge Filter Housing
 - 1. NALCO #231-FMJCH40
 - 2. WATTS #FMJCH40
- C. Treatment chemicals:
 - 1. Furnished as a concentrated liquid in 5 gallon pails
 - 2. A corrosion inhibitor of the nitrite-borate type equal to Nalco 2534.
 - 3. Maintained at a nitrite residual of 600 – 800 ppm in chilled loops and 1000-1500 in hot loops.
 - 4. With effective copper and black iron corrosion inhibitors.
 - 5. Form a protective film to prevent corrosion and scale formation.
 - 6. Have colored dye to indicate presence.
 - 7. Compatible with all system elements.
- D. Multiple chemicals used in a common system shall be compatible.

PART 3 - EXECUTION

3.1 INSTALLATION/START-UP

- A. In accordance with manufacturer's recommendations.
- B. Anchor the chemical filter feeder to a concrete housekeeping pad using wedge type expansion anchors.
- C. Clean and flush closed loops systems.
 - 1. Clear water flush systems before introducing chemical cleaners.
 - 2. Chemical cleaner shall be introduced into the systems to remove construction related oils, greases, threading compounds, and silt.
 - 3. Chemical Cleaner shall passivate and pre-film pipe system.

3.2 WATER ANALYSIS

- A. The chemical treatment agency shall provide the services of a testing laboratory to perform a site water analysis. As a minimum, conduct the following tests in accordance with ASTM standards and to the satisfaction of the Owner/Architect/Engineer.
 - 1. Silica in water and wastewater.
 - 2. Acidity or alkalinity of water.
 - 3. Iron in water.
 - 4. Hardness of water.
 - 5. Ph of water.
 - 6. Particulate and Dissolved Matter, Solids or Residue in Water.
 - 7. Turbidity in water.
 - 8. Corrosivity of water in absence of heat transfer.
 - 9. Standard practices for sampling water.
- B. Take water samples in accordance with ASTM.
- C. Prepare a test report in accordance with ASTM for each of the tests conducted.
- D. Submit the test reports to the Architect/Engineer.

3.3 CHEMICAL TREATMENT

- A. The chemical treatment agency shall provide complete services necessary for chemically cleaning and treatment the following systems:
 - 1. Chilled water.
 - 2. Hot water.
- B. The chemical treatment agency shall provide, but not be limited to the following:
 - 1. Equipment and installation.
 - 2. Chemicals.
 - 3. Analytical and testing work.
 - 4. Inspection.
 - 5. Calculations.
 - 6. Assistance to the trade installing the piping.
 - 7. Instruction to Owner.
- C. Determine which chemicals to use from the results of site water analysis. Provide the chemical necessary to achieve the desired water condition.
- D. Examine and supervise flushing and pipe cleaning operations and verify that the systems are clean, free of debris and rust and other construction materials before starting water treatment.
- E. After the piping has been flushed, cleaned, rinsed and charged with chemicals, then start-up and operate the chemical treatment equipment to provide steady, stable characteristics for the systems treated.
- F. During construction, instruct the Contractor in the field piping and wiring of chemical feeding equipment. If such piping and wiring details are not shown on the Contract Drawings, then provide all equipment, piping, wiring, instrumentation and chemicals to provide a complete and operating system without additional cost.
- G. After the chemical treatment is functioning as intended, the chemical treatment agency shall demonstrate to the Architect/Engineer the chemical treatment operation.

3.4 OWNER TRAINING

- A. A chemical treatment agency, in conjunction with the chemical treatment equipment manufacturer's factory representative, shall train the Owner to operate and maintain the chemical treatment system as a whole and in part for each piece of equipment.
- B. Furnish to the Owner a chemical treatment administration manual covering the chemical treatment program for each of the systems treated. The manual shall include, but not be

limited to:

1. Name, address and telephone number of the chemical treatment agency and each of the equipment manufacturers.
2. Operation and maintenance manuals.
3. Test reports.
4. Chemical data sheets.
5. A narrative describing the chemical treatment program for each of the systems being treated.

3.5 TESTING AND INSPECTION

- A. After the systems have been accepted, the chemical treatment agency shall visit the site every month during the warranty period.
- B. During each visit:
 1. Check and adjust the chemical treatment equipment.
 2. Check the chemistry of the treated system to confirm the chemicals are maintaining the system as intended.
 3. Advise and instruct the Owner on operational changes made to the chemical treatment program.
 4. Take a water sample of each system being chemically treated and have the samples tested by a testing laboratory. Prepare a report for each water sample and submit it to the Owner. Include in the test report the changes that need to be made to the chemical treatment program.
 5. Maintain complete records of the treatment program for each system at the project site. Keep the records in a hardbound manual with the building manager. A second copy shall be maintained by the agency for the agency's records.
- C. Routine visits must be coordinated with the Owner.
- D. Send copy of monthly report to Engineer for Verification.

END OF SECTION

SECTION 23 31 13 DUCTWORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Duct construction, support and accessories. Dimensions shown on the drawings are free area dimensions.

1.2 RELATED WORK

- A. Division 23 Mechanical
 - 1. Air Devices
 - 2. Air Handling Units
 - 3. Insulation
 - 4. Terminal Units
 - 5. Fan Coil Units
 - 6. Fans
 - 7. Testing, Balancing and Adjusting (TAB) of Environmental Systems
- B. Division 9 – Finishes, Painting and Color Coding

1.3 QUALITY ASSURANCE

- A. The intent of ductwork specifications is to obtain superior quality workmanship resulting in an installation that is absolutely satisfactory in both function and appearance. Provide ductwork in accordance with the specifications for each type of service.
- B. An approved contractor for this work under this division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, skill, and the organization to provide a practical working system.
 - 2. Able to furnish evidence of having contracted for and installed not less than 5 systems of comparable size and type that have served their owners satisfactorily for not less than 5 years.
- C. Duct cleaning: Oil film on sheet metal should be removed before shipment to site. On-site, inspect ducts to confirm that no oil film is present. Remove any oil. If ducts contain dust and dirt, clean them immediately, prior to substantial completion and prior to using the ducts to circulate air. HVAC system components or duct work may only be cleaned, coated, or have applied to its surface disinfectants, pesticides or biocides that are registered and particularly labeled for use in HVAC systems by state and federal EPA.

1.4 GUARANTEE

- A. Guarantee ductwork for 1 year from the date of substantial completion. The guarantee covers workmanship, noise, chatter, whistling, or vibration. Ductwork shall be free from pulsation under conditions of operation.

1.5 CONTRACTOR COORDINATION

- A. Erect ducts in the general locations shown, but conform to structural and finish conditions of the building. Before fabricating any ductwork, check the physical conditions at the job site and make necessary changes in cross sections, offsets, and similar items, whether they are specifically indicated or not.
- B. Coordinate location of ductwork with structural members and Architectural drawings and requirements.

1.6 SHOP DRAWINGS AND SAMPLES

- A. Submit shop drawings of all ductwork layouts, including enlarged plans and elevations of

all air handling equipment, and submit details of duct fittings, including particulars such as gauge sizes, welds, and configurations prior to starting work.

- B. Submit product data and sealing materials to be used.
- C. Submit sound attenuation data.
- D. Submit shop drawings in plan, elevation and sections, and three-dimensional view showing equipment in mechanical equipment areas.

PART 2 - PRODUCTS

2.1 STANDARDS AND CODES

- A. Except as otherwise indicated, sheet metal ductwork material and installation shall comply with the latest edition of SMACNA HVAC Duct Construction Standards. Air distribution devices (such as dampers) included in this specification shall comply with the latest applicable SMACNA Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems and NFPA 90A.

2.2 DUCT MATERIAL AND CONSTRUCTION

- A. Except for the special ducts specified below use lock forming quality prime galvanized steel sheets or coils up to 60" wide. Stencil each sheet with gauge and manufacturer's name. Stencil coils of sheet steel throughout on 10' centers with gauge and manufacturer's name. Provide certification of duct gauge and manufacturer for each size duct.
- B. Rectangular low and medium pressure duct constructed of sheet metal in accordance with the latest edition of SMACNA HVAC Duct Construction Standards.
- C. Medium pressure oval and round ductwork shall be spiral seam. Spiral lock-seam SMACNA Type RL-1. Fittings shall be welded construction.
 - 1. Galvanized
- D. Low pressure round ducts shall be shop fabricated with snap lock longitudinal seams. Ducts shall be constructed for a minimum of 2" w.g. static pressure.
- E. Dishwasher Hood Exhaust System: Welded 304 Stainless steel.
- F. Shower Area Exhaust Systems: Welded 304 Stainless steel.
- G. Kitchen exhaust duct: Welded Black steel, minimum 16 gauge

2.3 ACOUSTICAL DUCT

- A. Duct and fittings:
 - 1. Double wall acoustically treated.
 - 2. Annular space packed with fiberglass insulation.
 - 3. Perforated metal liner to provide specific acoustic impedance
 - 4. Insulation 1.0 pcf. 1 inch thick
 - 5. United McGill Acousti-K27 spiral lockseam or approved equal
 - 6. Material as indicated below:
 - a. Paintable Galvanized Steel
- B. Pressure rating and tests as specified for single wall ductwork.

2.4 DUCT SEALING OF SEAMS AND JOINTS

- A. Follow seal classification as indicated in Table 1-2 of SMACNA "HVAC AIR DUCT LEAKAGE TEST MANUAL". Use seal class A for 4" w.g. static. All longitudinal and transverse joints and seams shall be sealed by use of a fireproof, non-hardening, and non-migrating elastomeric sealant. With the exception of continuously welded joints and machine made spiral lock seams, joints and seams made air tight with duct sealer.
 - 1. Indoor applications – Foster 32-14
 - 2. Outdoor applications – Foster 32-17

2.5 FLEXIBLE DUCT LOW PRESSURE

- A. Construction:
 - 1. Continuous galvanized spring steel wire helix, with reinforced metalized cover
 - a. The fabric shall be mechanically fastened to the steel helix without the use of adhesives.
 - 2. UL 181 Class I air duct label
 - 3. Reinforced vapor barrier jacket
 - 4. Rated for use at system pressure (6" wc minimum)
 - 5. Flexible duct connections from lateral taps to variable volume boxes or terminal boxes shall be rated at twice the maximum pressure rating of the medium pressure system.
- B. Fire hazard classification:
 - 1. Flame spread rating 25 maximum.
 - 2. Smoke developed rating 50 maximum.
- C. Thermal characteristics:
 - 1. R-6 BTU/hr/sq. ft./°F (when located in a conditioned plenum)
 - 2. R-8 BTU/HR/Sq.Ft./°F (when located in an unconditioned plenum)
 - 3. 2" minimum wall thickness insulation with 1" overlap
- D. Acceptable manufacturers:
 - 1. Flexmaster
 - 2. Peppertree Air Solutions

2.6 FLEXIBLE DUCT MEDIUM/HIGH PRESSURE

- A. The duct shall be constructed of a heavy coated fiberglass cloth fabric supported by helical wound galvanized steel. The fabric shall be mechanically fastened to the steel helix without the use of adhesives.
- B. The internal working pressure rating shall be at least as follows with a bursting pressure of at least two times the working pressure:
 - Positive: 12" w.g.
 - Negative: 5" w.g.
- C. The duct shall be rated for a velocity of at least 5500 fpm.
- D. Suitable for operating temperature range of -20°F to +250°F.
- E. Factory insulate the flexible duct with fiberglass insulation.
 - 1. R-6 BTU/hr/sq. ft./°F (when located in a conditioned plenum)
 - 2. R-8 BTU/HR/Sq.Ft./°F (when located in an unconditioned plenum)
 - 3. 2" minimum wall thickness insulation with 1" overlap
- F. Cover the insulation with a fire retarding polyethylene vapor barrier jacket having a permeance of not greater than 0.10 perms when tested in accordance with ASTM E96, Procedure A.
- G. Acceptable manufacturers:
 - 1. Flexmaster
 - 2. Peppertree Air Solutions

2.7 FIRE DAMPERS

- A. Fire dampers for required wall ratings that are 95% minimum free area. Provide Type B or Type C UL dampers for low, medium and high-pressure rectangular, square or round ducts. Dampers shall be activated by a fusible link designed to react at 165°F. Install per manufactures recommendations to provide a UL assembly. Provide sealed sleeve to meet

- desired leakage performance.
- B. Acceptable Manufacturers:
1. Ruskin
 2. Prefco Products
 3. Air Balance
 4. Greenheck, Inc.
 5. Nailor Industries
 6. Pottorff
 7. Price

2.8 CEILING RADIATION DAMPERS

- A. Ceiling Radiation Dampers at location shown on plans constructed and tested in accordance with the current edition of UL555C of a minimum 22 gauge (0.8) blades, hinged in the center and held open with a 165° fusible link. Maximum blade height in the open position shall be 10" overall regardless of damper area. Maximum distance between blades held in the open position shall be 1-1/4" for units not requiring blade insulation and 1/4" for units with sheetrock blade insulation. Blades requiring radiation protection insulation shall utilize sheetrock. Refractory Ceramic or Mineral Wool Fiber is not allowed in the air stream. Radiation insulation outside of the air stream shall be Mineral Wool Fiber only. Ceramic Fiber Material is not approved for use. Units shall be constructed of a minimum 20-gauge (0.9) frame welded at all seams.
- B. Acceptable Manufactures
1. Ruskin
 2. Prefco
 3. Air Balance
 4. Phillips
 5. Safe-Air
 6. Nailor Industries

2.9 WALL LOUVERS

- A. Coordinate with Architectural Drawings.
- B. All louver frames shall be a minimum of 0.08" extruded aluminum. All blades shall be a minimum of 0.081" extruded aluminum. Beginning point of water penetration at 0.01 oz/sq.ft. Shall be a minimum of 800 ft/min.
- C. Provide all louvers with removable aluminum bird screen with 1/4" mesh.
- D. All louvers shall be certified to meet the wind zone requirements of project location.
- E. Acceptable manufacturers:
1. American Warming and Ventilation
 2. Arrow
 3. Greenheck
 4. NCA
 5. Pottorff
 6. Ruskin

2.10 FLUES FOR POWER EXHAUST AND HIGH EFFICIENCY BOILERS AND WATER HEATERS

- A. Double wall air insulated positive pressure chimney equal to Metalbestos, Van-Packer, Schebler or Metal-Fab. Chimney shall be rated for 550°F maximum flue gas temperature and with a UL tested pressure rating of 40 inches w.c. The interior pipe shall be constructed of AL 29-4C stainless steel and the exterior pipe shall be constructed of 304 stainless steel. Stack system shall be complete with a one inch air gap between inner liner

and outer cover. Chimney shall be constructed and installed per UL-1738 and NFPA-211. All accessories shall be made by the same manufacturer and designed to be a part of a positive pressure chimney system.

2.11 DUCT LINING

- A. Duct lining shall be 1" thick, 1-1/2 lb. density, flexible lining coated on the air stream side to reduce attrition. Liner shall be Schuler Lina-Coustic, Certain-Teed Ultralite, or equal meeting requirements of NFPA 90-A. Provide I.A.Q. rated liner.

2.12 VOLUME DAMPERS

- A. Manual balancing dampers that meet or exceed the following minimum construction standards:
 - 1. Frame 16-gauge
 - 2. Blades 16-gauge
 - 3. Bearings corrosion resistant
 - 4. Concealed linkage
 - 5. Opposed blade dampers
- B. Acceptable manufacturer:
 - 1. Ruskin Model MD-35 or approved equal, by
 - 2. Arrow
 - 3. American Warming and Ventilating
 - 4. Nailor Industries
 - 5. Pottoroff

2.13 ACCESS DOORS

- A. Round spin-in door of galvanized steel.
 - 1. Fire proof sealing gaskets and quick fastening locking devices
 - 2. Insulated door
 - 3. Conform to the requirements of the NFPA
 - 4. Identification and use of each access door
 - 5. UL label to match the construction in which it is installed
 - 6. Cable attached to door and outer frame
 - 7. Low leakage Access Door
- B. Acceptable Manufacturer
 - 1. Flex master, Inspector Series
 - 2. Approved Equal

2.14 COMBINATION FIRE/SMOKE DAMPERS

- A. Combination fire/smoke dampers meeting the following requirements:
 - 1. Each combination fire/smoke damper shall be 1-1/2 hour fire rated under UL Standard 555, 4th Edition, and shall be further classified by Underwriters Laboratories as a leakage Rated Damper for use in smoke control systems under the latest version of UL555S, and bear a UL label attesting to same. The damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this specification. Testing and qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be Leakage Class II.
 - 2. The damper frame shall be a minimum of 16 gauge, galvanized steel, formed into a structural hat channel shape with tabbed corners for reinforcement, as approved

- in testing by Underwriters Laboratories. Bearings shall be integral high surface area non-electrolytic materials construction to incorporate a friction free frame blade lap seal, or molybdenum disulfide impregnated stainless steel or bronze oilite sleeve type turning in the damper frame. The dampers shall be opposed blade type. The blades shall be constructed with a minimum of 16-gauge galvanized steel. The blade edge seal material shall be able to withstand 450°F. The jamb seals shall be flexible stainless steel compression type.
3. As part of the UL qualification, dampers shall have demonstrated a capacity to operate (open and close) under HVAC system operation conditions, with pressures of at least 4" water gauge in the closed position, and 2,000 fpm air velocity in the open position.
 4. Each combination fire/smoke damper shall be equipped with a controlled 7 to 15 second heat-actuated release device. The electric EFL shall close and lock the fire/smoke damper during test, smoke detection, power failure or fire conditions through actuator closure springs. To prevent duct and HVAC component damage, the damper shall at all times be connected to the actuator for controlled closure in not less than 7 seconds and no more than 15 seconds. Instantaneous damper closure is unacceptable. After exposure to high temperature of fire, the damper must be inspected prior to reset to ensure proper operation. Release temperature is 165°F.
 5. Provide UL555S qualified electric actuator at 120 VAC.
 6. Provide air-foil type blades.
- B. Provide integral sleeves
- C. Acceptable Manufacturers:
1. Ruskin
 2. Air Balance, Inc.
 3. Greenheck, Inc.
 4. Nailor Industries
 5. Pottoroff
 6. Price

2.15 SMOKE DAMPERS

- A. Smoke dampers meeting the following requirements.
1. Each smoke damper shall be classified by Underwriters Laboratories as a leakage Rated Damper for use in smoke control systems under the latest version of UL555S, and bear a UL label attesting to same. The damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this specification. Testing and qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be Leakage Class II.
 2. The damper frame shall be a minimum of 16 gauge, galvanized steel, formed into a structural hat channel shape with tabbed corners for reinforcement, as approved in testing by Underwriters Laboratories. Bearings shall be integral high surface area non-electrolytic materials construction to incorporate a friction free frame blade lap seal, or molybdenum disulfide impregnated stainless steel or bronze oilite sleeve type turning in the damper frame. The dampers shall be opposed blade type. The blades shall be constructed with a minimum of 16 gauge, galvanized steel. The blade edge seal material shall be able to withstand 450°F. The jamb seals shall be flexible stainless steel compression type.
 3. As part of the UL qualification, dampers shall have demonstrated a capacity to

- operate (open and close) under HVAC system operation conditions, with pressures of at least 4" water gauge in the closed position, and 2,000 fpm air velocity in the open position.
4. Provide UL555S qualified electric actuator at 120 VAC.
 5. Provide air-foil type blades.
- B. Provide integral sleeves.
- C. Acceptable Manufacturers:
1. Ruskin
 2. Air Balance, Inc.
 3. Greenheck, Inc.
 4. Nailor Industries
 5. Pottoroff
 6. Price

2.16 DIFFUSER FITTINGS LOW PRESSURE TAPS

- A. Fitting shall meet or exceed the following minimum construction standards:
1. Conical with a base diameter two inches larger than the tap diameter.
 2. Construct fitting and damper of galvanized steel in accordance with ASTM A 527, G90 finish.
 - a. Fitting with a 3/16-inch high stop bead approximately 2-1/2-inches from the discharge end of the fitting
 - b. Provide the fitting with a butterfly damper, damper rod, end bearings and heavy duty locking quadrant.
 - c. Size the length of the straight section of the fitting to match the damper blade diameter. Center the damper blade in the straight section.
 3. Match the fitting body gauge to the SMACNA duct gauge, but not less than:
 - a. Through 8 inches: 26 gauge; Damper blade 22 gauge
 - b. 10 inches and 12 inches: 24 gauge; Damper blade 22 gauge
 - c. 14 inches and 16 inches: 22 gauge; Damper blade 22 gauge
 - d. 18 inches and 20 inches: 20 gauge; Damper blade 20 gauge
 4. Fasten damper blade to a 3/8 X 3/8 continuous square rod with minimum (2) galvanized U-bolts.
 5. Support the damper rod to the fitting with airtight nylon end bushings / bearings.
 6. Provide the damper with a self-locking regulator and handle.
 7. Provide a 2" sheet metal stand-off to extend the regulator.
 8. Flex duct grip area – 2 inches behind retaining bead
 9. Flex duct retaining bead – 1 inch from end
 10. Conical length of at least 3 inches
 11. Barrel length of at least 9 inches

2.17 AUXILIARY DRAIN PANS

- A. Galvanized steel, same gauge and same bracing or cross breaks as a duct with same dimensions. Sides of pan turned up to 1-1/2", all joints soldered watertight. Pan is to be large enough to complete cover drip lines of unit.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Use construction methods and requirements as outlined in SMACNA HVAC Duct Construction Standards as well as SMACNA Balancing and Adjusting publications, unless indicated otherwise in the specifications. Refer to details on the drawings for additional information.

- B. Reinforce ducts in accordance with recommended construction practice of SMACNA. Provide additional reinforcement of large plenums as required to prevent excessive flexing and or vibration.
- C. Cross break or bead sheet metal for rigidity, except ducts that are 12" or less in the longest dimension.
- D. Where ducts pass through walls in exposed areas, install suitable escutcheons made of sheet metal angles as closers.
- E. At locations where ductwork passes through floors, provide watertight concrete curb around penetration.
- F. Support ducts where passing through floors with galvanized steel structural angles of adequate bearing surface.
- G. Metal or lined ductwork exposed to view through grilles, registers, and other openings shall be painted flat black. Do not install grilles, registers, or similar items until painting is complete.
- H. Fire Dampers shall be installed per manufacturer's recommendations to create a UL rated assembly.
- I. Install end bearing at all location where damper shaft penetrates duct wall.
- J. Clean duct to remove accumulated dust. Ducts shall be closed on ends between phases of fabrication to assure that no foreign material enters the ducts.

3.2 DUCTWORK

- A. Construct rectangular ducts and round ducts in accordance with the latest SMACNA HVAC Duct Construction Standards. Use the static pressure specified on the air handling unit schedule or fan schedules as a minimum for duct construction. All ductwork between the variable volume air handling units and the terminal units shall be constructed to the medium pressure ductwork specification.
- B. Provide adjustable, galvanized splitter-dampers, pivoted at the downstream end with appropriate control device at each supply duct split.
- C. For branch ducts wider than 18", and when shown on drawings provide extractors with an appropriate control device at each rectangular zone or branch supply duct connection. Provide controllers for extractors. Branch ducts shall have a 45° angle in the direction of flow. Do not provide extractor at branch ducts to sidewall registers where the registers are within 10 feet of the main duct.
- D. Shop manufactured curved blade scoops may be used for branch duct takeoffs up to 18" wide. Taper scoop blade to the end, to prevent any sagging that may cut into, or damage duct liner if specified during operation.
 - 1. Construct shop manufactured scoops and splitter blades of galvanized sheet metal 2 full gauges heavier than equivalent sheet metal gauge of branch duct (up to 16 gauge).
 - 2. Check extractors, scoops and splitter blades thoroughly for freedom of operation. Oil bearing points before installing.
- E. Use pushrod operator with locking nut and butt hinges assembly.
- F. Provide opposed-blade volume dampers with an appropriate control device in each of the following locations:
 - 1. Return air ductwork
 - 2. Outside air branch duct
 - 3. Exhaust branch duct
 - 4. Exhaust connections to hoods except kitchen grease hoods or equipment
 - 5. In each zone at multi-zone unit discharge installed downstream of duct mounted re-heat coils
 - 6. At each outside air and return air duct connection to plenum of constant volume

- units
7. At discharge side of constant volume boxes
 8. Where otherwise indicated or required for balancing coordinate location of additional dampers required by TAB Contractor.
 9. Provide multi-blade dampers when blade width exceeds 12". Provide end bearing where damper shaft penetrates duct wall.
- G. Elbows:
1. Rectangular: Where square elbows are shown, or are required for good airflow, provide and install single-wall or airfoil turning vanes. Job-fabricated turning vanes, if used, shall be single-thickness vanes of galvanized steel sheets of the same gauge metal as the duct in which they are installed. Furnish vanes fabricated for the same angle as the duct offset. The use of radius elbows with a centerline radius of not less than 1-1/2 times the duct width may be provided in lieu of vaned elbows where space and air flow requirements permit.
 2. Round Oval Duct. Provide elbows with a centerline radius of 1-1/2 times the duct diameter or duct width. For round ducts, furnish smooth elbows or 5 piece, 90° elbows and 3 piece, 45° elbows.
- H. For control devices concealed by ceilings, furring, or in other inaccessible locations, furnish extension rods and appropriate recessed-type Young regulators, mounted on the surface of the ceiling or the furring, unless specified, or shown otherwise. Provide with chrome plated cover plates. Use only one mitered gear set for each control device.
- I. Install streamline deflectors at any point where dividing a sheet metal duct around piping or where other such obstruction is permitted. Where such obstructions occur in insulated ducts, fill space inside streamliner and around obstructions with glass fiber insulation.
- J. Insulated Flexible Duct:
1. Install in accordance with manufacturer's instructions, and the terms of its UL listing. Duct shall not exceed 6' in length. Make connections by use of sheet metal collars and stainless steel circular screw clamps. Clamps shall encircle the duct completely and be tightened with a worm gear operator to the point that will provide an airtight connection without unnecessary deformation of the duct. Provide one clamp on flexible duct and one clamp on external insulation. Vapor barrier jacket shall be tucked inside to conceal insulation material.
 2. Construct bends over 45° with sheet metal elbows.
- K. Duct Supports:
1. Horizontal ducts up to 40". Support horizontal ducts up to and including 40" in their greater dimension by means of #18 U.S. gauge galvanized iron strap hangers attached to the ducts by a minimum of two locations per side by means of screws, rivets or clamps, and fastened to inserts with toggle bolts, beam clamps or other approved means. Place supports on at least 8' centers. Use clamps to fasten hangers to reinforcing on sealed ducts.
 2. Horizontal ducts larger than 40". Support horizontal ducts larger than 40" in their greatest dimension by means of hanger rods bolted to angle iron trapeze hangers. Place supports on at least 8' centers in accordance with SMACNA Standards.
 3. Support vertical ducts where they pass through the floor lines with 1-1/2" x 1-1/2" x 1/4" angles for ducts up to 60". Above 60", the angles shall be increased in strength and sized on an individual basis considering space requirements.
 4. Supports shall be suspended from structural or by independent support. Do not support from structural bridging. Upper attachments should be selected with a safety factor of 4 or 5 times actual load conditions and subject to Engineers approval. Double wrap straps over open web of joist.
- L. Branch connections for medium pressure ductwork shall be made with a conical lateral.

Field installed conical branch ducts shall be minimum 20-gauge galvanized sheet metal, "Everdur" welded and coated with "Galvabar".

3.3 PLENUMS

- A. Return air plenums shall be rectangular galvanized sheet metal ductwork.
- B. Fabricate plenums upstream of fan of 16-gauge material.
- C. Fabricate plenums upstream of filters minimum 18-gauge material.

3.4 FLEXIBLE CONNECTIONS

- A. Where ducts connect to fans or air handling units that are not internally isolated, make flexible airtight connections using "Ventglas" fabric. The fabric shall be fire-resistant, waterproof and mildew resistant with a weight of approximately 30 ounces per square yard. Provide a minimum of 1/2" slack in the connections, and a minimum of 2-1/2" distance between the edges of the ducts. Also, provide a minimum of 1" slack for each inch of static pressure on the fan system. Fasten fabric to apparatus and to adjacent ductwork by means of galvanized flats or draw bands. Where connections are made in outdoor locations, seal fabric to metal with mastic.

3.5 ACCESS DOORS

- A. Install ductwork access doors as noted below, arranged for convenient access. Stencil each door for specific use. Install access doors in each of the following locations:
 - 1. Fire Dampers
 - 2. Smoke Dampers
 - 3. Smoke/fire Dampers
 - 4. Outside Air Dampers
 - 5. Duct Mounted Coils (up-stream and downstream)
 - 6. Control Dampers
- B. Size access door 1" smaller than ductwork.
 - 1. Available Sizes: 8", 10", 12", 18", 24"
- C. Construct access door air tight, and conform to recommendations of NFPA and SMACNA.
- D. Demonstrate suitability of access for the intended purpose. Install multiple access doors as required.

3.6 DUCT LINING

- A. Install glass fiber acoustical lining where shown on drawings. Secure to duct surfaces with Foster 85-62 / 85-60 or Childers CP-125-1 / CP-127 adhesive and sheet metal fasteners on 12" centers. Coat exposed edges and leading edges of cross-joints with adhesive.
- B. Provide metal nosing that is either channeled or "Z" profiled or are integrally-formed from the duct wall securely installed over transversely oriented liner edges facing the air stream at fan discharge and at any interval of lined duct preceded by unlined duct.
- C. Refer to Insulation & Liner Detail on drawings for locations requiring liner to be installed.
- D. Do not install liner in multi-zone unit ductwork.

3.7 SEALING OF SEAMS AND JOINTS

- A. Seal supply, return, exhaust and outside air duct systems.

3.8 FLUES

- A. Provide and install flues for all gas fired equipment.

- B. Refer to plans for all related locations.
- C. Contractor is responsible for coordinating stack sizing, stack drains, stack test ports, stack termination fittings and all other required fittings with the selected equipment manufacturers.
- D. All fittings and accessories shall be manufactured by the flue manufacturer. The flue shall be installed per manufacturer's instruction.
- E. Terminate flues at height above roof to prevent flue gas from entering the building.

3.9 DISHWASHER HOOD EXHAUST SYSTEM

- A. All material and fittings shall be 304 Stainless steel, welded joints, watertight construction. Grade horizontal duct 1/4" per lineal foot to drain toward the washer.

3.10 SHOWER AREA EXHAUST SYSTEM

- A. All material and fittings shall be 304 Stainless steel, welded joints, watertight construction. Grade horizontal duct 1/4" per lineal foot slope down to grille connection. Install in accordance with Fig. 2-21 of SMACNA HVAC Duct Construction Standards.

3.11 KITCHEN EXHAUST DUCT

- A. All material and fittings shall be minimum 16 gauge, coated black steel to prevent rusting. All seams and joints in the kitchen exhaust duct, and penetrations of the hood enclosure to its lower outermost perimeter that directs and captures grease-laden vapors and exhaust gases shall have a liquid tight continuous external weld. All ducts shall be installed without forming dips or traps that might collect residues. Provide 18" x 18" or equal area at each elbow and as required for cleaning access, in direction of air flow. UL Listed access panel shall be located on the vertical wall of the duct 1-1/2" from the bottom of duct and shall be fitted with two handles, grease and air tight fitting access door and latch. All interior surfaces of ducts shall be accessible for cleaning and inspection purposes. Duct shall maintain minimum 1/4" per lineal foot slope to the exhaust hood. Provide duct over lay at the roof curb for a complete seal. Install kitchen exhaust system per local authority. In the absence of a local authority, the requirements of the Uniform Mechanical Code and NFPA 96 shall govern.

3.12 FUME HOOD EXHAUST SYSTEM

- A. All material and fittings shall be 304 stainless steel construction.

3.13 ACOUSTICAL DUCT

- A. Install in the following locations:
 - 1. Where indicated on the drawings

3.14 SCREENS

- A. Furnish and install screens on all duct, fan, etc., openings furnished by the Contractor that lead to, or are, outdoors; screens shall be No. 16 gauge, one-half inch (1/2") mesh in removable galvanized steel frame. Provide safety screens meeting OSHA requirements for protection of maintenance personnel on all fan inlets and fan outlets to which no ductwork is connected.

3.15 CONNECTIONS TO LOUVERS

- A. Make watertight connections to all louvers. Ductwork behind louver shall have watertight soldered joints for a minimum of three feet and be sloped to bottom of louver. Lap duct to be over bottom louver blade where possible.
- B. Where plenums are installed on inside of louver, construct such that bottom of plenum

will lap over bottom blade of louver to drain any water that may enter.

3.16 PLENUMS

- A. Construct plenums with galvanized steel framing members and galvanized sheet steel, cross braced and rigidly braced with galvanized angles. Gauges and bracing shall conform to SMACNA recommendations for ductwork of like sizes. Openings for fans, access doors, etc., shall be framed with galvanized steel angles.
- B. Provide access doors.

3.17 AUXILIARY DRAIN PANS

- A. All condensate producing equipment installed above ceilings and in central plant area shall be provided with a welded stainless steel secondary drain pan installed below equipment entirely and extend a minimum of 4" beyond equipment footprint.
- B. With 3/4" welded nipple.
- C. Piped to local floor drains or floor sinks.

3.18 TESTING OF LOW PRESSURE DUCTWORK

- A. Test ductwork for leaks before concealing. Maximum allowable leakage is 5% of total airflow.
- B. Provide equipment necessary for performing tests, including rotary blower large enough to provide required static pressure at allowed CFM quantity, certified orifice section with proper papers, traceable serial numbers and pressure vs CFM leakage rate scale, U-tube gauge board complete with cocks, tubing, and inclined manometer for leakage rates.
- C. Mains: Test mains after risers and branches are tied in and all equipment set. Close runout connections and place fan in operation. Provide pressure in mains at 1-1/2 times design pressure. Visually inspect joints. Repair leaks detected by sound or touch. Release mains for completion after joints are tight.
- D. Ductwork down stream of terminal boxes, return, exhaust, and outside air ducts are to be visually inspected.

3.19 TESTING OF MEDIUM AND HIGH PRESSURE DUCT

- A. As the project progresses, test the ductwork in sections.
- B. Provide equipment necessary for performing tests, including rotary blower large enough to provide required static pressure at allowed CFM quantity, certified orifice section with proper papers, traceable serial numbers, and pressure vs. CFM leakage rate scale, U-tube gauge board complete with cocks, tubing, and inclined manometer for leakage rates.
- C. Finally as a complete system, test ductwork at a minimum of 2.5" with a maximum allowable leakage of 1% of the total design supply airflow.
- D. Test method as set forth in SMACNA "HVAC Duct Construction Standards".

END OF SECTION

SECTION 23 34 16
FANS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install fans, including centrifugal, axial and propeller types, with supplemental equipment.

1.2 RELATED WORK

- A. Division 23 Mechanical:
 - 1. Ductwork
 - 2. Vibration Isolation
 - 3. Air Balance
 - 4. Electrical Provisions of Mechanical Work

1.3 PERFORMANCE

- A. Provide fan type, arrangement, rotation, capacity, size, motor horsepower, and motor voltage as shown. Fan capacities and characteristics are scheduled on the drawings. Provide fans capable of accommodating static pressure variations of +10% of scheduled design at the design air flow.
- B. Rate fans according to appropriate Air Moving and Conditioning Association, Inc. (AMCA), approved test codes and procedures. Supply fans with sound ratings below the maximums permitted by AMCA Standards. All fans provided must be licensed to bear the Certified Ratings Seal.
- C. Statically and dynamically balance all fans.
- D. Motors shall be sized so that they do not operate within the motor service factor.

1.4 SUBMITTALS

- A. Submit fan performance curves with system operating point plotted on curves.
- B. Submit manufacturer's printed installation instructions.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Cook
- B. Greenheck
- C. Penn Barry Ventilator
- D. Twin City Fans

2.2 PROTECTIVE COATINGS

- A. Manufacturer's Standard. Apply to fans, motors and accessories, the manufacturer's standard prime coat and finish, except on aluminum surfaces or where special coatings are required.
- B. Galvanizing. After fabrication of the parts, hot-dip coat surfaces that require galvanizing. Where galvanizing is specified, a zinc coating may be used. After fabrication, apply the zinc coating and air-dry the coating to 95% pure zinc. Acceptable zinc coatings include Zincilate, Sealube, Amercoat, Diametcoat, or an approved equal.

2.3 SUPPLEMENTAL EQUIPMENT

- A. Motor Covers. Provide weatherproof motor covers for installations out of doors. Apply the same finish as used on the fan.

- B. Belt Drives:
 - 1. Unless otherwise specified for belt-driven fans, equip the fan motors with variable pitch sheaves. Select the sheave size for the approximate midpoint of adjustment and to provide not less than 20% speed variation from full open to full closed. Size drives for 150% of rated horsepower. Key the fan sheave to the fan shaft.
 - 2. Nonadjustable motor sheaves may be used for motor sizes over 15 horsepower, at the Contractor's option. However, if changing a nonadjustable sheave becomes necessary to produce the specified capacity, the change must be made at no additional cost.
 - 3. Provide belt guards and apply the same finish as used on the fan.
 - 4. Oil and heat resistant, nonstatic type belts.
 - 5. Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty, regreasable, ball type, in a pillow block, cast iron housing, selected for a minimum L50 life in excess of 200,000 hours at maximum catalog operating speed.
- C. Safety Disconnect Switch: Provide a factory-wired to motor, safety disconnect switch on each unit.
- D. Relief Vents and Air Inlets: Provide vents and inlets with aluminum frames and 1/2" mesh, galvanized bird screens. Include dampers where shown.
- E. Prefabricated Roof Curbs: Furnish prefabricated roof curbs as detailed. The minimum height is 14". Include a resilient pad on each roof curb so the equipment can be mounted on the top flange for proper seal. Coordinate roof slope and curb to ensure equipment is installed in level position. Provide double shell to protect insulation from damage.
- F. Where motorized damper is scheduled:
 - 1. The motor and damper are specified in the Building Management and Control System Specification.
- G. All fans are to be provided with a durable, deep etched, .025" thick, factory installed aluminum identification plate with the following information. Plates are to be furnished with four mounting holes.
 - 1. Fan mark as indicated on the Contract Drawings.
 - 2. Serial number
 - 3. Model number
 - 4. Capacity (CFM) and static pressure.
 - 5. Motor HP
 - 6. Motor Amps
 - 7. Manufacturer
 - 8. Motor phase
 - 9. Number of Belts/Make/Size
 - 10. Motor volts

2.4 VENTILATION AND EXHAUST FANS

- A. Provide the ventilation and exhaust fans shown on the drawings.
- B. Provide each motor with internal overload protection.
- C. Provide approved safety screen where inlet or outlet is exposed.
- D. Provide duct flanges where required for connections.
- E. Furnish kitchen hood exhaust fans with vented curb extension that meets NFPA 96, cleanout port, grease tap, curb seal, drain connection and hinge kit.
- F. Furnish supply fans with 1" aluminum, washable filter section.

2.5 ROOFTOP VENTILATION AND EXHAUST SYSTEMS

- A. Provide the rooftop ventilation and exhaust systems shown on the drawings.
- B. Provide each motor with internal overload protection.
- C. Components:
 - 1. Aluminum, stainless steel or plastic coated bird guard.
 - 2. Screws and fasteners of stainless steel or nonferrous material.
 - 3. All aluminum construction unless indicated otherwise on fan schedule.
- D. Welded construction, corrosion resistant fasteners, minimum 16 gauge marine allow aluminum.
- E. Aluminum base shall be continuously welded curb cap corners.

2.6 GRAVITY ROOF-TOP INTAKE AND RELIEF VENTS

- A. Provide the rooftop intake and relief vent systems shown on the drawings.
- B. Provide with aluminum, stainless steel or plastic coated bird guard.
 - 1. Screws and fasteners of stainless steel or nonferrous material
 - 2. All aluminum construction
- C. Welded construction, corrosion resistant fasteners, minimum 16-gauge marine alloy aluminum.
- D. Aluminum base shall be continuously welded curb cap corners.

2.7 OSCILLATING AIR CIRCULATOR FAN

- A. three speed CFM Low 1657 – CFM Medium 2060 – CFM High 3100
- B. Totally enclosed motor voltage – 120 Voltage – 60 Hz
- C. Cast Aluminum 20-inch diameter, three blade fan with OSHA Guard
- D. Wall Mounted
- E. Factory wired 10', 3 conductor with ground molded plug
- F. Acceptable Manufacturer: Dayton 4PRV7 or approved equal

2.8 AUXILIARY ANGLE FILTER

- A. Provide a duct mounted inline low velocity angled filter box for the outside air supply systems.
- B. Filter box shall be upstream of any ductwork taps to VAV boxes.
- C. Maximum pressure drop shall be 0.5 inches static pressure.
- D. Provide continuous filter rails and a double wall hinged access door to allow easy filter replacement.
- E. Filter box shall be installed with a maximum height of 6'-0".
- F. Standard sizes 16x20x2, 16x25x2, 20x20x2, 20x25x2 only.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fans according to the manufacturer's instructions and in the locations shown on the drawings.
- B. Do not operate fans or fan powered devices for any purpose until ductwork is clean, filters in place, bearings lubricated and the fan has been run under observation.
- C. Roof mounted fans and gravity roof-top intake and relief vents shall be secured to the curb with stainless steel lag screws at a minimum of 6-inches on center. Follow manufacturer's installation instructions if they are more stringent. Install roof mounted equipment in a level position. Units shall be seated on properly sized curb. Gap between base of the fan and top of the curb shall be sealed with neoprene 1" x ¼" gasket. Gasket shall be glued or attached with pressure sensitive adhesive.
- D. Install curbs and equipment in level position.
- E. Ceiling mounted in-line centrifugal blowers

1. Shall be suspended from structure with 1/2-inch zinc plated all-thread rods secured to structure.
2. Provide sub-structure where required.
3. Mount bottom of fan no more than 18-inches above the finished ceiling height.

3.2 EXTRA MATERIALS

- A. Provide two sets of belts for each fan, not including the set installed on the fans. Tag set to identify fan.

END OF SECTION

SECTION 23 35 13
WOOD CHIP EXHAUST SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide the complete multi-position wood chip exhaust system.
- B. System capacity as scheduled

1.2 REFERENCE STANDARD

- A. The installation, metal gauges, construction methods and support systems shall conform to the following standards:
 - 1. SMACNA Accepted Industry Practice for Industrial Duct Construction.
 - 2. SMACNA Rectangular Industrial Duct Construction Standards
 - 3. Specification for welding of sheet metal (AWS D9.1-80)
 - 4. Industrial ventilation manual

1.3 SUBMITTALS

- A. Submit product data sheets of the vibration isolation.
- B. Submit shop drawings of the entire duct system and components.
- C. Submit shop drawings on structural supports.
- D. Submit fan performance curve.
 - 1. Plot fan volume against static pressure, horsepower and efficiency.
 - 2. Show point of rating based on static requirements of the system.
- E. Submit manufacturer's product data sheets of the equipment.
- F. Submit manufacturer's installation and operating instructions.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- A. Aget
- B. Sternvent
- C. AAF
- D. Donaldson Torit

2.2 DUCTWORK CONSTRUCTION

- A. Conform to the requirements for Class II Ducts.
- B. Elbows shall be machine made, and continuously welded.
- C. Conical lateral branch take-offs and fittings shall be galvanized sheet metal, "Everdur" welded and coated with cold galvanizing compound.
 - 1. Use long sweep elbows at all locations.
- D. With the exception of continuously welded joints and machine made spiral lock seams, make joints and seams air tight with duct sealer and shrink sleeves, or other approved methods.
- E. Provide a factory made slide gate with adjustment at each piece of dust producing equipment and at each floor sweep.
 - 1. Locate within hand reach.

2.3 DUCTWORK OUTDOORS

- A. Ductwork outdoors welded watertight.
 - 1. Coat welded areas with cold galvanizing compound.
- B. Paint with two coats of industrial, fume resistant enamel.
 - 1. Galvanize prime coat.

2.4 MACHINE HOODS

- A. Provide hoods for shop equipment of shapes and sizes recommended by the manufacturer of the dust collection system.
- B. Furnish top and side head hoods with slip joints to permit easy access to heads.
- C. Provide movable head hoods with flexible tubing for machines requiring this type hood.
 - 1. Minimize use of flexible tubing.
- D. Construct hoods and other fabricated equipment of cold rolled steel.
 - 1. Flush welded
 - 2. Ground smooth
- E. Finish:
 - 1. Primary rust preventing under coat
 - 2. Final coat gloss gray with rust and chip retardant properties
 - 3. Coat unit internally and externally

2.5 COLLECTOR

- A. Provide a factory made cyclone collector located where shown on the drawing.
 - 1. With internal baffle construction
 - 2. Dust and chips to be precipitated into the storage bin located below the collector.
- B. Finish:
 - 1. Primary rust preventing under coat
 - 2. Final coat gloss gray with rust and chip retardant properties
 - 3. Coat unit internally and externally
- C. Provide (2) roll-away 55 gallon storage bin/drums.
 - 1. Finished as specified for collector
- D. Mount the cyclone collector on structural steel stand that is a standard component of the manufacturer.
 - 1. Finished as specified for collector
 - 2. Bolt the feet to the concrete slab
- E. Terminate outlet with a weather stack head of 10 gauge galvanized sheet metal mounted on galvanized structural angles.

2.6 EXHAUST FAN

- A. Drive assembly:
 - 1. Sized for 50% overload
 - 2. Matched belts
 - 3. Adjustable pitch motor pulley and fixed pitch fan pulley
 - 4. Cast iron pulleys keyed to the shaft
 - 5. Open drip proof motor
 - 6. Ventilated, steel, weatherproof drive cover
- B. Fan shall be:
 - 1. Statically and dynamically balanced
 - 2. Selected for the design air quantities and pressure of the system
 - 3. Selected to operate at or near its maximum efficiency point when handling the required air quantity and static pressure
- C. Select the motor so that the brake horsepower required to deliver the design air quantity at the system static pressure will not exceed the motor name plate rating.
- D. Fan construction:
 - 1. Standard material handling paddle wheel
 - 2. Non-overloading

- 3. Mount outdoors on the collector stand
- E. Factory mounted and wired combination motor starter / disconnect and controls.

2.7 VIBRATION ISOLATION

- A. Mount the exhaust fan and motor on a common vibration isolating base selected for the fan frequency.
 - 1. Adjustable slide rail for belt tension adjustment
- B. Weatherproof all vibration isolation outdoors.
 - 1. Hot dipped galvanize steel parts
 - 2. Zinc plate bolts
 - 3. Zinc plate and neoprene coat all springs

2.8 SAFETY FEATURES

- A. Explosion Vent – Provide wood dust collector exhaust system must be supplied with explosion vents. Vent area is to be 2.0 sq. ft. per vent. Brixton type latches and guards are to be used. These are to be supplied with the wood dust collector.
- B. Explosion Isolation Valve – Provide exterior rated and coated explosion isolation valve. Provide galvanized angle supports.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The entire installation shall be made in accordance with the manufacturer's recommendations.
- B. Install equipment hoods.

3.2 TESTING

- A. Test the ductwork as specified in the industrial ventilation manual.
- B. Test and balance the air quantity at each machine and floor sweep.

END OF SECTION

SECTION 23 35 16
WELDING FUME EXHAUST SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide the multi-position welding fume exhaust system.
- B. Construct according to the Industrial Ventilation Manual.
- C. System capacity as scheduled.

1.2 SUBMITTALS

- A. Submit product data sheets of the vibration isolation.
- B. Submit a 3' long sample of the flexible exhaust hose, together with product data sheet.
- C. Submit shop drawings of the entire duct system and components.
- D. Submit shop drawings on structural supports.
- E. Submit fan performance curve for each fan.
 - 1. Plot fan volume against static pressure, horsepower and efficiency.
 - 2. Show point of rating based on static requirements of the system.
- F. Submit product data sheets on the electrostatic air cleaner.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Car-Mon
- B. Monoxivent
- C. National
- D. AAF
- E. Systems of Garage Ventilation

2.2 OUTDOOR DUCTWORK

- A. Ductwork outdoors welded watertight.
 - 1. Coat welded areas with cold galvanizing compound.
- B. Paint with two coats of industrial fume resistant enamel.
 - 1. Galvanize prime coat.

2.3 INDOOR DUCTWORK

- A. Tapered galvanized duct system.
- B. 10' long flexible exhaust hoses at each position.
 - 1. Fiberglass/neoprene with coated steel coil.
 - 2. Outside weld proof Mylar coating.
 - 3. Fire proof.
 - 4. Resistant to puncture by hot welding rod.
- C. Four inch diameter fume receptor with screen and magnets for each position.
 - 1. Provide magnets with sufficient strength to support the receptor and hose when suspended from the bottom of a metal plate.

2.4 ELECTROSTATIC AIR CLEANER

- A. Provide high efficiency electrostatic filtration.
 - 1. Solid state voltage limiting power pack.
 - 2. Primary and Secondary status lights.
 - 3. Safety interlock.
- B. Provide a charge neutralizer for the heavy concentrations of metallic particulate in the weld fume.

1. Power supply to activate the ionizing wires on the collector cells.
- C. Provide an inlet filter as specified in Section 23 41 00.
- D. Provide with exhaust fan as specified.

2.5 EXHAUST FAN

- A. Drive assembly:
 1. Sized for 50% overload.
 2. Matched belts.
 3. Adjustable pitch motor pulley and fixed pitch fan pulley.
 4. Cast iron pulleys keyed to the shaft.
 5. Open drip proof motor.
 6. Ventilated, steel, weatherproof drive cover.
- B. Fan shall be:
 1. Statically and dynamically balanced.
 2. Selected for the design air quantities and pressure of the system.
 3. Selected to operate at or near its maximum efficiency point when handling the required air quantity and static pressure.
- C. Select the motor so that the brake horsepower required to deliver the design air quantity at the system static pressure will not exceed the motor nameplate rating.
- D. Fan construction:
 1. Backward inclined wheel.
 2. Non-overloading.
 3. Paint all parts exposed to the air stream with phenolic resin protective coating.

2.6 VIBRATION ISOLATION

- A. Mount the exhaust fan and motor on a common vibration isolation base selected for the fan frequency.
 1. Adjustable slide rail for belt tension adjustment.
 2. Housed adjustable springs.
- B. Weatherproof all vibration isolation outdoors.
 1. Hot dipped galvanize steel parts.
 2. Zinc plated bolts.
 3. Zinc plate and neoprene coat all springs.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation as per manufacturer's recommendations.

END OF SECTION

SECTION 23 36 16
VARIABLE VOLUME TERMINAL UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install variable volume terminal units, including hangers, controls and other required elements.
 - 1. Provide variable volume terminal units where indicated on the drawings.

1.2 RELATED WORK

- A. Division 23 Mechanical.
 - 1. Ductwork.
 - 2. Air Balance.
 - 3. Electrical Requirements for Mechanical Work.
 - 4. Building Management and Control System.
 - 5. Vibration Isolation.

1.3 COOPERATION WITH OTHER TRADES

- A. Coordinate this work with work under Division 26 Electrical, to ensure that intended functions of lighting and air systems are achieved.
- B. Coordinate the primary (input) voltage with the electrical power source. Refer to the Electrical Drawings for specific requirements.

1.4 SUBMITTALS

- A. Submit product data for control devices, terminal boxes, and similar equipment for review prior to placement of purchase order. Submit internal wiring diagrams, installation and operation manual as a complete submittal package.
- B. Submit certified sound power levels for both discharge sound and casing radiated sound in accordance with ARI 880-98 Certification Program. All NC levels shall be calculated using ARI 885-98, Appendix E attenuation factors for mineral ceiling.
- C. Submit for each box the following information:
 - 1. Box size
 - 2. Inlet size
 - 3. Box number
 - 4. Box designation
 - 5. Minimum / Maximum Fan CFM
 - 6. L / R Coil connection
 - 7. GPM
 - 8. NC Level
 - 9. External Static Pressure
 - 10. Scheduled MBH
 - 11. Actual MBH
 - 12. Heating Coil Pressure Drop (ft.)
 - 13. Entering and Leaving Water Temperature
 - 14. Entering and Leaving Air Temperature

1.5 QUALITY ASSURANCE

- A. Make air flow tests and sound level measurements in accordance with applicable ASHRAE Standards 130-96 and ARI 880-98.
- B. Manufacturer shall certify cataloged performance and ensure correct application of terminal units.

- C. Sound power levels to occupied space shall not exceed NC-30 as calculated using ARI 885-98 Appendix E attenuation factors for mineral tile ceiling.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Titus.
- B. Krueger
- C. Price
- D. Nailor
- E. Metalaire

2.2 BOX CONSTRUCTION

- A. Galvanized 20 gauge steel casing with suspension lugs.
- B. Lined with minimum 1.5 PCF / 1" thick fiber free
 1. Flame spread not higher than 25.
 2. Smoke developed rating not higher than 50.
 3. Condensation on the exterior of the box is not approved.
 4. Coat all cut edges of liner with NFPA approved sealant.
 5. Lining shall pass UL 181, NFPA 90A and ASTM C 665.
- C. Provide access to controls, fan compartment, and unit servicing, without disturbing duct connections. Limit the size of access doors to 24 inches. Where required, provide multiple access doors. Gasket each door in the unit casing.
- D. Components shall be constructed of corrosion resistant materials.
- E. Bearings shall not require lubrication.
- F. Casing leakage shall not exceed 2.0% of scheduled design air flow at 3.0" WG interior casing pressure.
- G. Seal casing joints with approved adhesive if required to meet the maximum casing leakage rate.
- H. The maximum overall height of the variable air volume unit shall not exceed available ceiling space.
- I. Maximum static pressure drop of air through terminal box shall be 0.2" w.g.
- J. Maximum velocity through duct inlet shall be 2,000 fpm.
- K. Terminal unit shall be provided with access to the entering side of the coil for coil cleaning.

2.3 COMPONENTS

- A. The entire terminal unit, including the heating coil, shall be designed and built as a single unit.
- B. Provide each unit with a primary variable air volume damper that controls the air quantity in response to a space sensor or building management and control system.
- C. Provide single point electrical connections for the entire unit. Entire assembly shall be UL or ETL Certified, electrical components shall be UL listed and installed in accordance with the National Electrical Code.
- D. The variable air volume units provided by the manufacturer shall be the quietest design available from the manufacturer for the type specified.
- E. Sufficient power for the VAV unit DDC controller, electric actuator and other components necessary to satisfy the sequence of operation. Size each transformer for the total connected load plus an additional 25% of the connected load. Primary and secondary fuses housed in a fuse block.

2.5 PRIMARY AIR DAMPER AND ACTUATOR

- A. The control actuator shall vary the primary air damper in response to the control signal.
 - 1. Damper leakage at shutoff shall not exceed 2.0% at 1" WG pressure.
 - 2. Locate the damper inside the unit.
 - 3. Damper connection to the operating shaft shall be a positive mechanical connection.
 - 4. Damper shall have bearings at all penetrations of inlet tube and terminal housing. Penetration of damper shaft in terminal lining shall have seal at surface of lining to prevent fiber entrainment through rotation of damper shaft.
 - 5. Two damper stop pins shall be provided. One pin shall ensure damper cannot rotate beyond full closed position. One pin shall ensure damper cannot rotate beyond full open position.
 - 6. Inlet tube shall have rolled bead (outward position) prior to penetration point of flow sensor tubing to provide stop point for hard duct and anchor point for flex duct.
 - 7. Flow sensor tubing shall have gaskets at penetration point of inlet tube. 8. Flow sensor shall be center averaging type. Non-center averaging flow sensors are not acceptable.

2.6 AIR FLOW CONTROL

- A. Provide a flow control device that will limit the maximum CFM of the unit to that scheduled on the drawings.
 - 1. Air quantity shall be factory set.
 - 2. Thermostat signal shall reset the flow control device to reduce primary air quantity to match load requirements.
 - 3. Control shall be pressure independent.
 - 4. Each terminal shall incorporate a flow cross sensor with pick-up points connected to a center averaging chamber to ensure the following performance:
 - a. Controller fidelity shall be +/-5% of set volume with a flex inlet configuration and inlet static variation of 0.5" WG to 6.0" WG.
 - 5. Provide flow measuring taps and a flow chart with each unit for field balancing air flow.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Deliver and store products in a clean and dry place. Protect products from the weather, dirt, dust, construction debris and physical damage.
- B. Install each unit in accordance with the manufacturer's printed installation instructions.
- C. Suspend each unit from 1/4" electroplated zinc thread rods secured from structure.
 - 1. Provide sub-structure where required.
 - 2. Mount bottom of terminal unit no more than 18" above the finish ceiling height.
 - 3. Install units so that they are level and plumb.
- D. Install a straight length of rigid ductwork upstream of all boxes. Provide at least 3 primary air inlet diameters of straight ductwork upstream of the primary air inlet connections. Flexible duct connections at boxes are allowed but are not a substitute for the straight run of rigid duct. A maximum of 4' of flexible duct is allowed at each box. All changes in direction shall be made with rigid duct. Seal connection at box, as required to comply with system maximum allowable leakage.
- E. Coordinate the location of each variable air volume unit to ensure proper clearance so that all components are accessible and not blocked by other trades. Provide no less than the code required clearances to electrical components.

- F. Cover and seal the openings of the VAV inlets during construction to prevent the inside from getting dirty. Where VAV units are considered dirty, as determined by the Architect / Engineer / Owner, clean the VAV units with a vacuum machine, and then wipe all surfaces with a cleaning agent, using clean rags.
- G. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- H. All installation shall be in accordance with manufacturer's published recommendations.
- I. Provide clearance for inspection, repair, replacement and service. Ensure accessibility to all terminal unit electrical control panel doors, controllers and operators are located a minimum of 30 inches from all obstructions (walls, pipe, etc.).
- J. Provide ceiling access doors or locate units above easily removable ceiling components.
- K. Support units individually from structure. Do not support for adjacent ductwork. Terminal units shall be supported using unit's hanger brackets and threaded rods.
- L. Provide a duct access door on the leaving side of the heating coil for coil cleaning. Access shall be position within 6" of leaving side of heating coil.

3.2 MISCELLANEOUS CONTROLS

- A. The following equipment items are to be furnished by Building Management and Control System and installed by Terminal Unit manufacturer:
 - 1. Automatic temperature control card (DDC).
 - 2. Damper actuator.
- B. The following equipment items are to be furnished and installed by the Terminal Unit manufacturer:
 - 1. Damper.
 - 2. Multi-point flow sensor.
 - 3. Controller enclosure.
 - 4. Power transformer.
- C. Coordinate the output voltage required by the Building Management and Control System.
- D. Coordinate location of controller enclosure.

3.3 ACOUSTICAL PERFORMANCE TEST

- A. Test each size for each type of variable air volume unit furnished on the project.
- B. Test for radiated noise and discharge noise in all operational modes from minimum to maximum primary air settings; at inlet air pressures of 1 and 2 inches water column, and at primary air settings of 20, 40, 60 and 100 percent.
- C. Testing shall be done by an independent testing laboratory. Sound values submitted shall be certified by the laboratory doing the testing. Testing laboratory must be approved by Engineer. Final testing and approval must be witnessed by Engineer.
- D. Testing procedures shall be in accordance with ASHRAE Standard 130-96 and rated in accordance with ARI 880.
- E. Test the unit complete with damper, coils and controls. The unit shall be operational and represent a final version of the units to be installed on the project.
- F. If the units do not meet sound criteria, modify the units and retest at no additional cost to the Owner until the sound criteria is in accordance with Contract Documents. The variable air volume unit manufacturer shall be held liable for the costs associated with construction delays resulting from failed test, not to exceed the purchase order cost.
- G. Sound Levels: Maximum sound power levels resulting from any box shall not exceed the following:

OCTAVE BAND CENTER FREQUENCY, Hz.

	125	250	500	1000	2000	4000
Radiated SPL db	52	45	40	36	34	33
Discharge SPL db	44	37	31	27	24	22

1. Sound power levels are referenced to 10-12 watts.
2. Box inlet static pressure = 1-1/2"
3. No discounting for roof effect, ceiling attenuation, lined duct, division of flow and other similar effects.

END OF SECTION

SECTION 23 36 17
DUAL DUCT VARIABLE VOLUME TERMINAL UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install dual duct variable volume terminal units with mixing attenuator, including hangers, controls and other required elements.

1.2 RELATED WORK

- A. Division 23 - Mechanical.
 - 1. Ductwork
 - 2. Air Balance
 - 3. Electrical Requirements for Mechanical Work
 - 4. Building Management and Control System

1.3 COOPERATION WITH OTHER TRADES

- A. Coordinate this work with work under Division 26 Electrical, to ensure that intended functions of lighting and air systems are achieved.
- B. Coordinate the primary (input) voltage with the electrical power source. Refer to the Electrical Drawings for specific requirements.
- C. Coordinate multi-point sensor locations with Building Management Control System contractor.

1.4 SUBMITTALS

- A. Submit product data for control devices, terminal boxes, and similar equipment for review prior to placement of purchase order.
- B. Submit for each box the following information:
 - 1. Box size
 - 2. Inlet size
 - 3. Box number
 - 4. Box designation
 - 5. Minimum / Maximum CFM

1.5 QUALITY ASSURANCE

- A. Make air flow tests and sound level measurements in accordance with applicable ASHRAE Standards 130-96 and ARI 880-98.
- B. Manufacturer shall certify cataloged performance and ensure correct application of terminal units.
- C. Sound power levels to occupied space shall not exceed the NC levels specified in 23 05 47 as calculated using ARI 885-98 Appendix E attenuation factors for mineral tile ceiling.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Titus.
- B. Krueger
- C. Price
- D. Nailor
- E. Metalaire

2.2 BOX CONSTRUCTION

- A. Galvanized 20-gauge steel casing with suspension lugs.
- B. Lined with minimum 1.5 PCF / 1.5" thick fiber free thermal and acoustical insulation.
 - 1. Flame spread not higher than 25.
 - 2. Smoke developed rating not higher than 50.
 - 3. Condensation on the exterior of the box is not approved.
 - 4. Coat all cut edges of liner with NFPA approved sealant.
 - 5. Lining shall pass UL 181, NFPA 90A and ASTM C 665.
- C. Provide access to controls without disturbing duct connections. Limit the size of access doors to 24 inches. Where required, provide multiple access doors. Gasket each door in the unit casing.
- D. Components shall be constructed of corrosion resistant materials.
- E. Casing leakage shall not exceed 2.0% of scheduled design airflow at 3.0" WG interior casing pressure.
- F. Seal casing joints with approved adhesive if required to meet the maximum casing leakage rate.
- G. The maximum overall height of the dual duct variable air volume unit shall not exceed available ceiling space.
- H. Maximum static pressure through box shall not exceed 0.2" w.g.
- I. Maximum velocity through inlets should not exceed 2,000 fpm.

2.3 COMPONENTS

- A. Primary variable air volume damper that controls the air quantity in response to a space sensor.
- B. Multi-point airflow sensors at locations as required by Building Management Control System.
- C. Controller enclosure
- D. Mixing attenuator.

2.4 PRIMARY AIR DAMPER AND ACTUATOR

- A. The control actuator shall vary the primary air damper in response to the control signal.
 - 1. Damper leakage at shutoff shall not exceed 2.0% of the maximum scheduled schedule design airflow at 3" WG inlet static pressure and be tested in accordance with ASHRAE 130.
 - 2. Locate the damper inside the unit.
 - 3. Damper connection to the operating shaft shall be a positive mechanical connection.
 - 4. Damper shall have bearings at all penetrations of inlet tube and terminal housing. Penetration of damper shaft in terminal lining shall have seal at surface of lining to prevent fiber entrainment through rotation of damper shaft.
 - 5. Two damper stop pins shall be provided. One pin shall ensure damper cannot rotate beyond full closed position. One pin shall ensure damper cannot rotate beyond full open position.
 - 6. Inlet tube shall have rolled bead (outward position) prior to penetration point of flow sensor tubing to provide stop point for hard duct and anchor point for flex duct.

2.5 AIR FLOW CONTROL

- A. Provide a flow control device that will limit the maximum CFM of the unit to that scheduled on the drawings.
 - 1. Air quantity shall be factory set.
 - 2. Thermostat signal shall reset the flow control device to reduce primary air

- quantity to match load requirements.
3. Control shall be pressure independent.
4. Each terminal shall incorporate a flow cross sensor with pick-up points connected to a center averaging chamber to ensure the following performance:
 - a. Controller fidelity shall be +/-5% of set volume with a flex inlet configuration and inlet static variation of 0.5" WG to 6.0" WG.
5. Coordinate flow sensor locations with Building Management and Controls Contractor.
6. Flow sensor tubing shall have gaskets at penetration point of inlet tube.
7. Flow sensor shall be center averaging type. Non-center averaging flow sensors are not acceptable.
8. Flow sensor tubing to be connected with brass barb fittings.
9. Tubing from air flow sensor to DDC controller shall be Tygon tubing (no exceptions)

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Deliver and store products in a clean and dry place. Protect products from the weather, dirt, dust, construction debris and physical damage.
- B. Install each unit in accordance with the manufacturer's printed installation instructions.
- C. Suspend each unit from 1/4" electroplated zinc thread rods secured from structure.
 1. Provide sub-structure where required.
 2. Mount bottom of terminal unit no more than 18" above the finish ceiling height.
 3. Install units so that they are level and plumb.
- D. Install a straight length of rigid ductwork upstream of all boxes. Provide at least 3 primary air inlet diameters of straight ductwork upstream of the primary air inlet connections. Flexible duct connections at boxes are allowed but are not a substitute for the straight run of rigid duct. A maximum of 4' of flexible duct is allowed at each box. All changes in direction shall be made with rigid duct. Seal connection at box, as required to comply with system maximum allowable leakage.
- E. Coordinate the location of each variable air volume unit to ensure proper clearance so that all components are accessible and not blocked by other trades. Provide no less than the code required clearances to electrical components.
- F. Cover and seal the openings of the VAV inlets during construction to prevent the inside from getting dirty. Where VAV units are considered dirty, as determined by the Architect / Engineer / Owner, clean the VAV units with a vacuum machine, and then wipe all surfaces with a cleaning agent, using clean rags.

3.2 MISCELLANEOUS CONTROLS

- A. The following equipment items are to be furnished by Building Management and Control System and installed by Fan Powered Terminal Unit manufacturer:
 1. Automatic temperature control card (DDC).
 2. Damper actuator.
 3. Discharge air temperature sensor
- B. The following equipment items are to be furnished and installed by the Dual Duct Unit manufacturer:
 1. Damper.
 2. Multi-point flow sensors.
 3. Controller enclosure.
 4. Tubing from air flow cross to DDC controller.
 5. Factory provided external taps for air flow readings with corresponding

- chart/label on box near dampers.
- 6. Mixing attenuator.
- C. Coordinate location of controller enclosure, inlet sensors, wiring of terminal equipment controller and transformer required by the Building Management and Control System contractor.

END OF SECTION

SECTION 23 37 13
AIR DEVICES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install air distribution devices, including grilles, diffusers, registers, dampers, and extractors.

1.2 RELATED WORK

- A. Division 23 Mechanical.
 - 1. Ductwork.
 - 2. Air Balance.
 - 3. Electrical Requirements for Mechanical Work.

1.3 COOPERATION WITH OTHER TRADES

- A. Coordinate this work with work under Division 26 Electrical, to ensure that intended functions of lighting and air systems are achieved.

1.4 SUBMITTALS

- A. Submit product data for outlets, grilles, registers, control devices, and similar equipment for review prior to placement of purchase order.
- B. Submittal shall include performance sheet for each air device type. Performance sheet shall include NC levels, throw, and total pressure loss at various air flows.

1.5 FINISHES

- A. Paint exposed devices with factory standard prime coat, or factory finish coat, as specified.

PART 2 - PRODUCTS

2.1 DIFFUSERS, GRILLES AND REGISTERS - Refer to Drawing Schedule.

- A. Perforated grilles shall not be used for supply air, return air or exhaust air.
- B. Stamped face, Egg Crate (of any material) or door grilles shall not be used.
- C. Acceptable Grilles and Diffusers:
 - 1. Supply Air Diffusers/Grilles
 - a. Lay-in Square Cone, Steel or Aluminum, 360° pattern
 - b. Lay-in Square Plaque, Steel or Aluminum, 360° pattern
 - c. Surface Mount Square Louver Face, Steel or Aluminum, 360° pattern
 - d. Round Cone, Steel or Aluminum, Steel or Aluminum, 360° pattern
 - e. T-Bar Slot, Steel or Aluminum
 - f. Double Deflection (Sidewall), Steel or Aluminum
 - 2. Return Air Grilles
 - a. Louvered face, Steel or Aluminum, 45° deflection, 3/4" blade spacing
Surface or lay-in type

2.2 ACCEPTABLE MANUFACTURERS

- A. Titus.
- B. Krueger.
- C. Nailor Industries.
- D. Metalaire
- E. Price

2.3 ACCESSORIES

- A. Supply Grille Extractors. Provide supply grilles with an air control device capable of positively regulating the volume of air extracted from the supply duct. Select extractors similar to Titus Model AG25, tight-closing in the minimum position. Include a key-operated or worm-gear adjusting mechanism to facilitate positioning from the grille opening. Where adjustment is not accessible at the grille opening, provide a square control rod equipped with a locking quadrant.
- B. Mounting Frames. Provide each grille or register not equipped with a removable core with a companion, all-purpose mounting frame constructed like grille frame to facilitate installation and removal of the grille or register without marring adjacent mounting surfaces.
 - 1. Furnish frames with 1/2" thick sponge rubber gasket to prevent air leakage.
 - 2. Provide a frame that neatly fits the grille. Mounting frames will not be required for grilles or registers mounted directly on exposed ductwork.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Do not install ceilings adjacent to fixtures until installation of fixtures, air supply assemblies, return-air blank-off strips and flexible duct have been approved. Remove and reinstall any part of the installation found incorrect.

3.2 INSTALLATION

- A. Louvered diffuser outlets mount tight against the ceiling. Fasten outlets to ductwork with sheet metal screws.

END OF SECTION

**SECTION 23 41 00
AIR FILTRATION**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install air filters.

1.2 RELATED WORK

- A. Division 23 Mechanical.

1.3 SUBMITTALS

- A. Submit manufacturer's product data sheets and capacity information as specified.
- B. Submit recommended Dirty Filter pressure drop.

PART 2 - PRODUCTS

2.1 MEDIUM EFFICIENCY AIR FILTERS

- A. The filter cells:
 - 1. Pleated media.
 - 2. Disposable type.
 - 3. Contain not less than 4.6 sq. ft. of filtering media per square foot of face area.
 - 4. 18 pleats per linear foot of filter.
 - 5. 2" thick.
- B. Media of reinforced nonwoven cotton fabric treated with adhesive and continuously laminated to a supporting steel wire grid conforming to the configuration of the pleats.
 - 1. Seal the media pack in a water resistant cardboard frame.
- C. Rated average dust spot efficiency of not less than 80%.
 - 1. Average synthetic arrestance in excess of 98% when tested in accordance with the ASHRAE 52-68 test standard.
- D. Filter capable of operating with variable face velocities up to 500 fpm without impairing efficiency.
- E. Initial resistance to air flow:
 - 1. 500 fpm - 0.41" WG.
- F. UL listed with Class II rating.
- G. Air Filter Inc. Astro-Pleat MERV 13 minimum
- H. Provide one spare set for a complete change, in original cartons, for Owner's use during the warranty period.
- I. Standard sizes 16x20x2, 16x25x2, 20x20x2, 20x25x2 only. If 1" filters are only option for equipment, sizes must be standard sizes as listed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install the filters in accordance with the manufacturer's instructions.

END OF SECTION

SECTION 23 57 20 HEAT EXCHANGER

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install a tube and shell water to water heat exchanger as shown.

1.2 RELATED WORK

- A. Division 23 - Mechanical
 - 1. Condensing Water Piping
 - 2. Valves, Strainers and Vents
 - 3. Gauges, Thermometers and Flow Meters

1.3 REFERENCES

- A. ANSI/ASME - Boilers and Pressure Vessels Code.

1.4 REGULATORY REQUIREMENTS

- A. Conform to Section VIII, Division I of the ANSI/ASME Boilers and Pressure Vessels Code for manufacture of heat exchanger and heat exchanger shells.
 - 1. Design pressure of 150 psi at 240°F for both circuits.

1.5 SUBMITTAL

- A. Submit manufacturer's product data sheets and unit capacity information as specified.
- B. Submit manufacturer's installation, start-up and service instructions.
- C. Submit manufacturer's certificate that heat exchanger meets or exceeds specified requirements.
- D. Submit design data in sufficient detail to verify that heat exchanger meet or exceed specified requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Alfa-Laval.
- B. B & G.

2.2 SHELL AND TUBE HEAT EXCHANGER

- A. Construction.
 - 1. Stainless Steel epoxy coated shell, copper tubes and steel heads.
 - 2. All metal surfaces that are in contact with pool water shall be Cupronickel construction.
 - 3. Verify compatibility of material with swimming pool chemicals and designed to be resistant to corrosion from chlorinated water.
- B. The entire assembly shall be bolted together at the factory and tested in accordance with the ASME code.
 - 1. Provide lifting lugs designed to permit lifting of the assembly at its flooded weight.
- C. The entire assembly shall be epoxy coated to provide protection from pool chemicals present within equipment room.

2.3 INSTRUMENTS AND RELIEF VALVES

- A. Provide in the inlet and outlet of each circuit a thermometer.
 - 1. Mounted in brass well.

2. Range: 30°F to 130°F.
- B. Provide in the outlet of the closed circuit an ASME rated temperature and pressure relief valve with full sized drain to the floor.
- C. Inlet and outlet piping connections to heat exchanger shall be flanged and bolted. Groove connections shall not be provided.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install heat exchanger, piping and accessories in accordance with manufacturer's instructions.
- B. Install to permit removal of tubes with minimum disturbance to installed equipment and piping.
- C. Support the heat exchanger from factory assembled structural supports and floor stand.
- D. Pipe relief valves to the nearest floor drain.
- E. Pipe drain valves to the nearest floor drain.

END OF SECTION

SECTION 23 65 27
AIR-COOLED ROTARY SCROLL CHILLER

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and Install a packaged, electric-driven, air-cooled, water chilling unit with multiple scroll compressors complete with controls.

1.2 RELATED WORK

- A. Division 23 - Mechanical
 - 1. Chilled Water Piping
 - 2. Insulation
 - 3. Building Management Control System
 - 4. Vibration Isolation
 - 5. Electrical Provisions of Mechanical Work

1.3 REFERENCES

- A. ANSI/ARI 550/590 - Water Chilling Packages using the Vapor Compression Cycle.
- B. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.
- C. ANSI/ASHRAE 90A - Energy Conservation in New Building Design.
- D. ANSI/ASME SEC 8 - Boiler and Pressure Vessel Code
- E. ANSI/NEMA MG 1 - Motors and Generators.
- F. ANSI/UL 465 - Central Cooling Air Conditioners.
- G. ANSI/AFBMA 9-1978 - Load Ratings and Fatigue Life for Ball Bearings. Bearings must have life of not less than 200,000 hours.
- H. ANSI/NFPA Standard 70 - National Electrical Code (NEC)
- I. ASTM B117 - Standard Method of Salt Spray (Fog) Testing
- J. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- K. ASTM A525 - Zinc (Hot-Dip Galvanized) Coatings on Sheet Steel Products
- L. ASTM D1654 - Evaluation of Painted or Coated Specimens, Subjected to Corrosive Environments.

1.4 PERFORMANCE

- A. Provide performance as scheduled on drawings. Provide factory run test to ensure proper chiller operation. Provide certified documentation to Owner in Closeout Documents.

1.5 WARRANTY

- A. The Chiller manufacturer shall provide a full machine parts, labor, and refrigerant warranty for a period of five (5) years from substantial completion.
 - 1. The warranty shall include, but not be limited to the compressor assemblies including motor, condensers, fans, variable frequency drives, controls, evaporator, condenser, refrigeration system and all other auxiliary components and accessories as well as refrigerant and oils in systems.
 - 2. In the event of failure, provide new or factory authorized rebuilt parts. Shop or job site rebuilt parts are not acceptable.
 - 3. On all manufacturers warranties the chiller manufacturer shall provide a factory certificate listing as a minimum chiller model, serial, and warranty information as specified above. Each chiller tag shall be provided with an individual and unique warranty certificate. Manufacturer's representative warranty letters are not acceptable as an alternative to the original manufacturer's certificates.

4. The chiller manufacturer authorized service agency is required to perform any and all warranty service. Contractor warranty service is not authorized. Warranty work shall be performed with District Representative present.

1.6 PREVENTATIVE MAINTENANCE SERVICE AGREEMENT

- A. Furnish service and maintenance agreement of chillers for a period of 5 years from date of substantial completion. Include quarterly system examinations, required adjustments, and control calibrations. Repair/replace parts in accordance with manufacturer's recommendations. All work performed by manufacturer technicians. Maintenance agreement shall include the following items as a minimum:
 - a. Analyze compressor fault log (quarterly)
 - b. Check IGV operation (quarterly)
 - c. Check controls settings for proper configuration (quarterly)
 - d. Verify transducers and sensors for accuracy (quarterly)
 - e. Analyze controls log and faults (quarterly)
 - f. Confirm correct water flow and pressure drop for evaporator (quarterly)
 - g. Evaluate the test/performance (quarterly)
 - h. Leak test entire unit (quarterly)
 - i. Check and record line voltage (quarterly)
 - j. Inspect power components for signs of overheating (quarterly)
 - k. Check and tighten all electrical components (annually)
 - l. Perform moisture prevention (annually)
 - m. Clean and leak test evaporator (annually)
 - n. Clean the evaporator flow sensor (annually)

1.7 SUBMITTALS

- A. Submit manufacturer's certified computer generated performance and capacity data in accordance with specification requirements.
- B. Submit the following information:
 1. Manufacturer's installation instructions.
 2. Minimum Circuit Ampacity.
 3. Maximum Overcurrent Protection size.
 4. Maximum conductor / Terminal Lug size.
 5. Minimum flow thru evaporator.
 6. Electrical interlocks.
 7. AHRI Chiller Efficiency values at 100%, 75%, 50% and 25%
- C. Submit recommended clearance dimensions for air flow and service.
- D. Submit coordination drawings as specified.
 1. Give consideration to adjacent structures as they affect air flow patterns.
- E. Submit internal wiring diagram of Control Center.
- F. Submit sequence of operation in narrative form.
- G. Submit a letter stating chiller being proposed meets the efficiency requirements of Centerpoint Energy's Score Program listed in Centerpoint Energy's Design Guide: HVAC Recommendations document.
- H. Mark-up a copy of the specifications, indicating in the margin of each paragraph, the following: COMPLY, DO NOT COMPLY, NOT APPLICABLE.

1.8 STORAGE/HANDLING/SHIPPING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Protect units from physical damage. Factory coil shipping covers shall be kept in place until

installation.

- C. Unit controls shall be capable of withstanding 203°F (95°C) storage temperatures in the control compartment for an indefinite period of time.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Carrier
- B. Daikin
- C. Trane

2.2 COMPRESSORS

- A. Provide a minimum of two independently circuited hermetic rotary scroll type compressors with the following:
 - 1. Direct drive, 3600 rpm, suction gas-cooled hermetic motor.
 - 2. Rubber isolation pads.
 - 3. Crankcase heaters.
 - 4. Oil sight glass.
 - 5. Load and unload solenoid valves.
 - 6. Discharge oil separator.
 - 7. Hot gas bypass for compressor unloading.
 - 8. Centrifugal oil pump.
 - 9. Oil charging valve.
- B. Provide capacity modulation from 100% to 25% via compressor cycling.
 - 1. Control to be based upon leaving chilled water.
 - 2. To avoid excessive compressor cycling while maintaining leaving chilled water temperature at desired temperature +/- differential, compressor cycling set points to be separated by a minimum 20% capacity dead band.
- C. Ultra-Low Sound Compressor Control: Chiller manufacturer shall provide the following attenuation package and meet scheduled maximum A-weighted sound pressure level rating of 70dBA at 30' from the condenser coil side of chiller per AHRI. Complete sound attenuation package shall be provided regardless if scheduled dBA is met without.
 - 1. Provide ultra-low sound blanket on a minimum of 100% coverage of each compressor, suction line, discharge line and oil separator.
 - 2. Removable Sound Covers shall be constructed with a Silicone-fiberglass cloth outer jacket, a loaded vinyl barrier septum, fiberglass needle mat (11 lbs./ft.3 density), and a Silicone-fiberglass cloth inner jacket. The covers shall be connected together by means of a cloth straps with "D" rings and Velcro fasteners. The inner and outer jackets shall protect against UV rays, oil and water. Finished Surface Mass – 3 lbs. per sq. ft., to cover compressors and extended components for the specified chiller. Stainless steel wire tie fastening assemblies are not acceptable.
 - 3. Provide detailed ultra-low sound acoustical data with submittal. Data shall include sound pressure rating across each octave band and A-weighted average for chiller as built with attenuation package.

2.3 CONDENSER COILS

- A. Coil shall be microchannel design and shall have a series of flat tubes containing multiple, parallel flow microchannel layered between the refrigerant manifolds. Tubes shall be 9153 aluminum alloy. Tubes made of 3102 alloy or other alloys of lower corrosion resistance shall not be accepted. Long Life Alloy Microchannel shall pass 4500hr salt spray rating uncoated.

- B. Protect all vertical or angled coil sections from hail or physical damage with corrosion resistant louvered hail guard including chiller ends, factory installed to cover compressor and condenser sections.
- C. Field adjustable head pressure based fan cycling controls for each circuit capable of maintaining minimum head pressure down to 20°F unless noted otherwise.
- D. Protect condenser coils during shipping.
- E. Provide condenser coils coated with corrosion resistant epoxy utilizing a dip and bake. Coating shall be flexible and uniformly bonded to all condenser coil surfaces.

2.4 FANS AND MOTORS

- A. Direct Drive Ultra Low Sound propeller type fans.
 - 1. Vertical discharge with sound reduction without performance reduction.
 - 2. Protect fan blades with a heavy-gauge wire guard.
 - 3. Statically and dynamically balanced.
 - 4. Sound reduction engineered heavy-duty molded plastic blades designed to reduce airflow turbulence.
- B. Motors with built in thermal overload protection
 - 1. Permanently lubricated ball bearings.
 - 2. Weatherproof (TEAO or TEFC) motors.

2.5 COOLER/EVAPORATOR

- A. Provide brazed plate and frame direct expansion cooler with:
 - 1. Copper and stainless steel construction
 - 2. 150 psig water side working pressure
 - 3. ASME coded 430 psig refrigerant side working pressure
 - 4. Fully independent refrigerant circuit for each compressor.
 - 5. Serviceable construction including removable heads and field replaceable tubes.
 - 6. Drain and vent connection.
 - 7. Inline strainer on chiller inlet.
- B. Protect cooler with ambient controlled heater cable and minimum 1-1/4" thick flexible elastomeric rubber closed cell insulation. Heater cable to protect evaporator to -20°F (-29°C). Heater cable shall be wrapped helically around the shell under the insulation.
- C. Protect insulation and equipment from abrasion by unit enclosure.
- D. After completion of successful start-up, installing contractor shall seal all openings.
- E. Provide water drain connection, vent and fittings for factory installed leaving water temperature control and low temperature cutout sensors.
- F. Water connections shall be grooved or flanged.

2.6 CASING/ENCLOSURES

- A. House components in minimum 14 gauge galvanized steel frame and mounted on welded structural steel base. Hot-dip galvanized steel frame coating shall be Underwriters Laboratories Inc. (UL) recognized as G90-U, UL guide number DTHW2.
- B. Unit panels, and control panels shall be 14 gauge, finished with a baked on powder paint. Control panel doors shall have door stays. Paint system shall meet the requirements for outdoor equipment of Federal Government Agencies.
- C. Mount starters and disconnects in weatherproof panel provided with full opening access doors. Provide lockable disconnect operating handle external to panel and clearly visible from outside of unit indicating if power is on or off.
- D. Casings fabricated from steel that do not have a Zinc coating conforming to ASTM A 123 or ASTM A525 shall be treated for the prevention of corrosion with a factory coating or paint system. The coating or paint system shall withstand 672 hours in a salt-spray fog test in

accordance with ASTM B 117. Each specimen shall have a standard scribe mark as defined in ASTM D 1654. Upon completion of exposure, the coating or paint system shall be evaluated and rated in accordance with procedures A and B of ASTM D 1654. The rating of failure at the scribe mark shall be not less than six (average creepage not greater than 1/8"). The rating of the unscribed area shall not be less than ten (no failure). Thickness of coating or paint system on the actual equipment shall be identical to that on the test specimens with respect to materials, conditions of application, and dry-film thickness.

2.7 REFRIGERANT CIRCUIT

- A. All units shall have a separate independent refrigerant circuit for each compressor. Twenty & 30 Ton single circuit; 40, 50 & 60 Tons, dual individual refrigerant circuits.
- B. Provide for each refrigerant circuit:
 - 1. Liquid line isolation valve.
 - 2. Filter dryer (replaceable core type).
 - 3. Liquid line sight glass and moisture indicator.
 - 4. Electronic or thermal expansion valve sized for maximum operating pressure. Expansion valves with less than five years of proven field operation are not acceptable.
 - 5. Charging valve.
 - 6. Discharge and oil line check valves.
 - 7. Compressor suction and discharge service valves.
 - 8. Relief valve.
 - 9. Full operating charge of refrigerant and oil.
 - 10. Unit factory leak tested at 200 psig.
 - 11. Provide refrigerant not schedule for phase out.

2.8 CONTROL PANEL

- A. The Control Center.
 - 1. NEMA 3R weatherproof cabinet with hinged lockable outer door.
 - 2. Control system.
 - 3. Solid-state compressor three phase motor protection.
 - 4. Single point field power connection points.
 - 5. Control interlock terminals.
 - 6. Fan motor and control circuit fuses.
 - 7. Individual contactors for each fan motor.
 - 8. Unit power terminal blocks for connection to remove disconnect switch.
 - 9. Power supply terminals for evaporator heater circuit.
 - 10. Dead front panels over line voltage.
 - 11. Control power / circuit transformer.
 - 12. Provide incoming power terminals, sized to accept the feeder conductors.
 - 13. Chiller run and alarm status relay cards.
- B. Microprocessor control system.
 - 1. Stage unit based on leaving water temperature control.
 - 2. Oil differential pressure setpoints.
 - 3. Motor protection.
 - 4. High pressure alarm.
 - 5. Loss of refrigerant alarm.
 - 6. Loss of water flow alarm.
 - 7. Freeze protection alarm.
 - 8. Low refrigerant pressure alarm.
 - 9. Auto start/stop switch.

10. Chilled water setpoint adjustment.
 11. Anti-recycle timer.
 12. Compressor run status.
 13. Password protection.
 14. Low water temperature safety (freeze protection).
 15. Automatic pump down cycle.
 16. Limit supply water temperature pull down on start up to 1° per minute.
 17. Automatic lead-lag sequence change of compressors.
 18. Unload the compressors if the return water is too high.
 19. Compressor starts with the controlled cylinders unloaded.
 20. Reset of the chilled water temperature.
 21. Indicate status of safeties.
 22. Non-volatile memory (EPROM) with setpoints retained with battery backup.
 23. Automatic high pressure unloader to unload compressor at pressures above 375 psig.
 24. Auto restart after power failure.
 25. BacNET interface
 26. Alarm Relay
 27. Percent of Running Load Amperage
- C. Display the following information with 16 key keypad with two line x 40 character clear English Display for outdoor viewing.
1. Supply and Return water temperature.
 2. Low water temperature cutout setting.
 3. Low ambient temperature cutout setting.
 4. Outdoor air temperature.
 5. English and Metric data.
 6. Suction pressure cutout setting.
 7. Each system suction pressure.
 8. Each system discharge pressure.
 9. Each system oil pressure.
 10. Percent of full load motor current.
 11. Liquid control range. (2.0 - 20°F above setpoint).
 12. Liquid pulldown rate sensitivity adjustment.
 13. Anti-recycle timer status for each compressor.
 12. Compressor starts & operating run hours.
 13. Safety shutdown shall be date and time stamped.
 14. Compressor run status.
 15. History and alarm diagnostic memory display.
- D. All control functions and information shall be available at the unit control panel or via RS 232 cable and phone modem to personal computer.
- E. Chiller shall include a relay board with dry contacts for alarms to notify a Building Automation System of certain events or states of the chiller.
- F. Chiller shall include input for leaving chilled water temperature setpoint based upon a 2-10VDC or 4-20mA signal from a Building Automation System.
- G. Chiller shall include input for chiller current limit setpoint based upon a 2-10VDC or 4-20mA signal from a Building Automation System.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install system in accordance with manufacturer's instructions.
- B. Align chiller package on concrete footings as detailed on the drawings. 12" minimum height.
- C. Locate away from overhead restrictions. Maintain side clearances according to manufacturer's

recommendations and maintain overhead clearance to allow full elimination of hot air discharge.

- D. Install units on vibration isolation pads.
- E. Arrange piping for easy dismantling to permit tube cleaning, removing and or repair.
- F. Level chiller.
- G. Install all electrical and control conduit into the bottom only of electrical cabinet. (No top or side cabinet penetrations)

3.2 CHILLER MANUFACTURER START-UP/ FIELD SERVICES

- A. Provide the services of a factory trained service technician employed full time by the chiller manufacturer to start-up the system. Technicians, as required, shall be factory trained and experienced in the work they perform. (Contractor startup is unacceptable.)
- B. The technicians shall utilize comprehensive report forms to document results. Sample forms shall be submitted for review prior to commencing work.
- C. Upon completion of the work, the report forms shall be signed by the technicians and their supervisor and included in the final report and Owner's manual.
- D. Submit four copies of the final report to the Architect/Engineer for approval within 10 working days of start-up.
- E. Follow the manufacturer's start-up procedures.
 - 1. Verify interlocks.
 - 2. Test and verify operation of safety controls.
 - 3. Calibrate controls.
 - 4. Verify microprocessor based control operation.
 - 5. Test, calibrate, and set the chilled water temperature controls.
 - 6. Verify chilled water temperature reset sequence.
 - 7. Verify operation of the integrated control panel.
- F. Measure and record the following data:
 - 1. Chilled water entering/leaving temperature.
 - 2. Chilled water flow through the chiller.
 - 3. Suction pressure/condensing pressure.
 - 4. Suction pressure/unloading steps.
 - 5. Air entering/leaving condenser; dry bulb temperature.
 - 6. Outdoor ambient; dry bulb.
 - 7. Motor nameplate voltage; phase and full load amperes.
 - 8. Heater coil in starter (as applicable)
 - a. Rating in amperes.
 - b. Manufacturer's recommendation.
 - 9. Power reading (voltage and amperes of legs at motor terminals).
- G. Test and calibrate the operation of the electronic ground current sensing devices.
- H. If the system has been shipped with a holding charge, provide the following:
 - 1. Leak test.
 - 2. Refrigerant pressure test.
 - 3. Evacuate, dehydrate and charge.
- I. Verify that accessories are installed and performing the specified functions. Insert certification in Owner's manual.
- J. Instruct the Owner's operating personnel. Provide Owner with 8 hours of training prior to substantial completion.
- K. Do not operate the equipment for any reason until the factory start-up service has been completed and before all closed loop water treatment system is active.
- L. Provide a print-out from the unit micro-computer control system showing the correct operation

- of all system controls and components.
- M. Provide minimum 24 hour history log displaying accuracy of temperature control system in 15 minute intervals and documented number of compressor cycles during the 24 hour period.
 - N. Remove construction screen from strainer at plate and frame heat exchanger, flush strainer, repair insulation at heat exchanger to like new condition and temporarily attach screen to chiller for inspection by owner and engineer.

END OF SECTION

SECTION 23 73 13
AIR HANDLING UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install air handling units with casing, fans, coils, filters and special items.

1.2 RELATED WORK

- A. Division 23 Mechanical
1. Air Balance
 2. Ductwork
 3. Controls
 4. Electrical Provisions of Mechanical Work
 5. Air Filtration
 6. Heating and Cooling Coils
 7. Other applicable sections

1.3 PERFORMANCE

- A. Unit capacities and characteristics as indicated.
1. Units must be certified in accordance with ARI Standard 430-66.
 2. UL 1995 certification for safety including electric heat.
 3. ARI 430 listed and meet NFPA 90A requirements.

1.4 SHOP DRAWINGS

- A. Indicate assembly, unit dimensions, weight loading required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- B. Submit fan performance curve for each unit:
1. Plot fan volume against static pressure, horsepower and efficiency.
 2. Show point of rating based on static requirements of the system.
 3. Chart of specific sound power level at each octave band center frequency.
 4. For variable volume units, plot fan volume over entire range.
- C. Submit for review a unit internal static pressure loss calculation.
1. Provide an itemized list of static pressure loss at the scheduled CFM for each unit component including and not limited to:
 - a. Coils
 - b. Dirty filters
 - c. Fan and unit system effect
 - d. Cabinet and cabinet inlet and outlet
 - e. Unit mounted dampers
 2. If a unit mounted outside air pretreatment section without supply fan, "piggyback" is specified:
 - a. Provide an itemized static pressure loss as indicated above.
 - b. Determine losses for unit configuration, i.e. parallel or series.
 - c. Include losses in the primary unit internal static pressure required by configuration.
 3. The air handling unit schedule indicates static pressure external to the unit and does not include any losses associated with the air handling equipment.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate units until ductwork is clean, filters are in place, bearings lubricated,

condensate properly tapped, piping connections verified and leak tested, belts aligned and tensioned, all shipping braces have been removed, and fan has been tested under observation.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Inspect for transportation damage and store in a clean, dry location. Protect from weather and construction traffic.
- B. Manufacturer shall provide quick shipment options to minimize product lead times.

1.7 WARRANTY

- A. The Air Handling Unit manufacturer shall provide a full machine parts and labor warranty for a period of one (1) year from substantial completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Carrier
- B. Daikin
- C. JCI
- D. Temtrol
- E. Thermal
- F. Trane

2.2 MISCELLANEOUS REQUIREMENTS

- A. Provide factory assembled units. Large units may be shipped in sections, at contractor's option, to enable entrance to building, or for oversize shipping reasons only.
- B. Furnish units with sealing and fastening hardware supplied by the manufacturer. Include written instructions needed to complete field assembly of the components.
- C. Provide units designed and constructed so that coils, panels, fan housing and fans can be removed without affecting the structural integrity of the unit.
- D. Unit casing panels shall be double wall construction with solid galvanized exterior and solid galvanized interior. Panels shall have a minimum thermal resistance of R-13. The casing shall not exceed 0.0042 inch deflection per inch of panel span at 1.5 times the design static pressure up to a maximum of +8 inches in all positive pressure sections and -8 inches in all negative pressure sections.
- E. Provide full perimeter base rail channel under units constructed of heavy gauge galvanized steel (minimum 10 gauge) and intermediate cross members to assure unit integrity. Provide minimum size base rail to ensure proper trapping and slope of condensate drain (minimum 6 inch from bottom of drain opening).
- F. Fan assembly shall be provided with 1" deflection internally mounted spring vibration isolation under the fan and motor base on units with coils less than 8 sq. ft. and 2" deflection internally mounted spring vibration isolation under the fan and motor base with coils greater than 8 sq. Ft. Units with coils over 35 sq. ft. shall have spring thrust restraints securing the fan housing to the discharge opening panel on units. Fan motor shall be internally mounted. Provide internal flex connection of fan discharge. Maximum acceptable RPM of fan shall not exceed 1000.
- G. Provide factory installed removable hinged access doors in the following locations:
 - 1. Entering and leaving side of all coils to allow for cleaning of coils on both sides of unit.
 - 2. Each side of filter compartment to allow changing of filters from either side.
 - 3. Each side of motor compartment to allow motor and isolation access.
 - 4. Each side of condensate drain pan to allow for cleaning and inspection.

5. Swing the doors against the casing static pressure.
- H. Provide all coil modules, including heating coil modules, with stainless steel drain pans to facilitate cleaning and maintenance of the coils. Drain pan to extend 10" minimum downstream of cooling coil.
- I. Provide coils with stainless steel casings, end plates, tube supports and top & bottom plates.
- J. Units shall meet ASHRAE III Class 6 Low Leakage Standard. Casing shall have less than a 1% leakage rate at plus or minus 8 inches W.G.

2.3 DRAW THROUGH AIR HANDLING UNITS

- A. Provided with:
 1. V-belt drive assembly and motor.
 2. Insulated sheet metal cabinet with removable panels for access to the interior.
 3. Full hinged double wall doors with two-step safety handles.
- B. Drive assembly:
 1. Size for 50% overload.
 2. Matched belts.
 3. Minimum two belt drive Type "B" only (5/8" wide)
 4. Provide adjustable pitch motor pulley for motors.
 5. Provide motor and fan pulley of cast iron keyed to the shaft.
- C. Select the motor so that the brake horsepower required to deliver the design air quantity at the system static pressure will not exceed the motor nameplate rating.
 1. Totally enclosed, fan cooled, Variable Speed.
 2. Minimum 90% nominal efficiency at loads of 70% to 100%.
 3. Premium efficiency
 4. Cast iron frame and end plate
 5. Forged steel lifting eye
 6. Oversized conduit box with ground lug
 7. Provide with factory installed shaft grounding ring by Aegis on units which utilize a variable frequency drive.
 8. Greaseable bearings for motors.
- D. Supply Fans:
 1. Double width, double inlet, forward curved blades.
 2. Statically and dynamically balanced.
 3. Tested after being installed in the fan sections.
 4. Selected for the design air quantities and pressure of the system.
 5. Mounted on a common shaft if multiple wheels.
 6. Minimum of Class II fans.
- E. Select fan to operate at or near its maximum efficiency point when handling the required air quantity and static pressure.
- F. Stainless steel condensate pan with positive slope in all directions to outlet. Line the condensate drain pan with minimum 2" waterproof insulation.
- G. Fan bearings:
 1. Greaseable bearings
 2. Remote grease fittings grouped on the motor access side of the unit.
 3. Self-aligning.
 4. Select for an average life of 200,000 hours.
- H. Insulation, vapor barriers, facings and adhesives shall have:
 1. Flame spread not higher than 25.
 2. Smoke developed rating not higher than 50.

- I. Double wall casing construction. Construct interior casing panels with 3 lb. minimum density insulation for acoustical and condensation control.
 - 1. Condensation on the exterior of the air handling units is not acceptable.
- J. Filter section:
 - 1. Constructed with substantial hinges.
 - 2. Neoprene gasketing.
 - 3. Permanent quick release latching devices.
 - 4. Arranged to accommodate 2" thick filters as specified.
 - 5. Filter rack shall be factory manufactured to accommodate the filter sizes listed below. Filter racks shall not be altered in the field.
 - 6. Low velocity angled filter section unless otherwise specified.
 - 7. 16x20x2, 16x25x2, 20x20x2, 20x25x2 only.
- K. Cooling coils as specified. Extend drain and vent piping through cabinets. Provide grommets at all pipe penetrations through cabinets.
- L. Heating coils as specified. Extend drain and vent piping through cabinets. Provide grommets at all pipe penetrations through cabinets.
 - 1. Location as indicated.
- M. Factory dynamic fan balancing shall be conducted from 16Hz to 60Hz to identify and eliminate critical speeds to ensure stable operation through the entire operating range of the fan and drive assembly. Field fan balancing is not acceptable. Forward factory balancing test report to Engineer upon request.

2.4 BLOW THROUGH VARIABLE AIR VOLUME AIR HANDLING UNIT – DOUBLE DUCT

- A. Provided with:
 - 1. V-belt drive assembly and motor.
 - 2. Insulated sheet metal cabinet with removable panels for access to the interior.
 - 3. Full hinged double wall doors with two-step safety handles.
- B. Drive assembly:
 - 1. Sized for 50% overload.
 - 2. Matched belts.
 - 3. Minimum two belt drive Type "B" only (5/8" wide)
 - 4. Provide adjustable pitch motor pulley for motors.
 - 5. Construct pulley of cast iron; keyed to the shaft.
- C. Motor selected so that the brake horsepower required to deliver the design air quantity at the system static pressure will not exceed the motor nameplate rating.
 - 1. Totally enclosed, fan cooled, Variable Speed.
 - 2. Minimum 90% nominal efficiency at loads of 70% - 100%.
 - 3. Premium efficiency
 - 4. Cast iron frame and end plate
 - 5. Forge steel lifting eye
 - 6. Oversized conduit box with ground lug
 - 7. Provide with factory installed shaft grounding ring by Aegis.
 - 8. Greaseable bearings for motors.
- D. Supply Fans shall be:
 - 1. Double width, double inlet, non-overloading, air-foil blade centrifugal fan, or forward curve fan as required.
 - 2. Statically and dynamically balanced.
 - 3. Tested after being installed in the fan sections.
 - 4. Selected for the design air quantities and pressure of the system.
 - 5. Mounted on a common shaft if multiple wheels.

6. Minimum of Class II fans.
- E. Select fan to operate at or near its maximum efficiency point when handling the required air quantity and static pressure.
- F. Stainless steel condensate pan with positive slope in all directions to outlet. Insulate the condensate drain pan with a minimum of 1-1/2" waterproof insulation.
- G. Fan Bearings:
 1. Greaseable bearings
 2. Remote grease fittings grouped on the motor access side of the unit.
 3. Self-aligning.
 4. Select for an average life of 200,000 hours.
- H. Insulation, vapor barriers, facings and adhesives shall have:
 1. Flame spread not higher than 25.
 2. Smoke developed rating not higher than 50.
 3. 3 lb. density insulation on interior casing panels
- I. Filter section:
 1. Constructed with substantial hinges.
 2. Neoprene gasketing.
 3. Permanent quick release latching devices.
 4. Arranged to accommodate 2" thick filters as specified.
 5. Filter rack shall be factory manufactured to accommodate the filter sizes listed below. Filter racks shall not be altered in the field.
 6. Low velocity angled filter section unless otherwise specified.
 7. 16x20x2, 16x25x2, 20x20x2, 20x25x2 only.
- J. Cooling coils as specified. Extend drain and vent piping through cabinets. Provide grommets at all pipe penetrations through cabinets.
- K. Heating coils as specified. Extend drain and vent piping through cabinets. Provide grommets at all pipe penetrations through cabinets.
- L. Provide a factory installed equalizing grid in the hot deck where heating coils are not installed.
- M. Factory dynamic fan balancing shall be conducted from 16Hz to 60Hz to identify and eliminate critical speeds to ensure stable operation through the entire operating range of the fan and drive assembly. Field fan balancing is not acceptable. Forward factory balancing test report to Engineer upon request.
- N. Design the entrance to the hot and cold decks and baffle to preclude wiping action of the air stream.
- O. Equipment capacities as indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install air handling units according to manufacturer's instructions.
- B. Provide additional drive packages as required by the Testing and Balancing firm.
- C. Air leaks detectable by sound or touch are to be corrected.
- D. Air handling units are to be properly supported to prevent flexing, bending or distorting base rails.
- E. All coils and drain pans are to be cleaned prior to substantial completion if units are used during construction.

- F. Clean all air handling units and return to original manufacturer's condition prior to substantial completion. Vacuum clean all debris from inside air handling equipment.
- G. Install piping to unit with full size 6 inch long dirt leg with 1/2" valve at bottom for cleaning.
- H. Provide for positive gravity drainage of coil condensate. Pipe full size of unit connection.
- I. Adjust fan drives as required to obtain scheduled capacities as directed by the Test and Balance Firm to include sheave and belt replacement.
- J. Align belts to eliminate wear and vibration of belts.
- K. Verify correct drainage of condensate from condensate pan.
- L. Verify correct rotation of fan and wiring of motor.
- M. Lubricate all greaseable ball bearings with manufacturer's suggested lubricant.
- N. Replace filters as required if units are used during construction.
- O. Provide piping installation so that after piping is completed and insulated there is full access to service unit and remove fan housing. Piping to coils shall not block fan section access or cause damage to piping insulation during access.
- P. AHU motors must be wired with Kernay connections inside motor terminal boxes. No wire nuts. Kernay connections must be wrapped with rubber and electrical tape for insulation.

3.2 IDENTIFICATION

- A. Furnish each unit with a durable, deep etched, .025" thick, factory installed aluminum identification plate, permanently mounted with the following information:
 - 1. Unit identification as indicated on Contract Drawings.
 - 2. Serial Number.
 - 3. Model Number.
 - 4. Capacity (CFM) and static pressure.
 - 5. Motor HP.
 - 6. Unit power supply: Volts / PH / Amps.
 - 7. Supply Fan Type.
 - 8. Coil GPM and pressure drop.
 - 9. Sales Order #.
 - 10. Date unit manufactured.

END OF SECTION

SECTION 23 82 16
HEATING AND COOLING COILS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install heating and cooling coils.

1.2 SUBMITTALS

- A. Submit manufacturer's product data sheets and unit capacity information as specified.
- B. Submit manufacturer's Installation, Start-Up and Service Instructions.
- C. Submit internal wiring diagram.
 - 1. Electrical interlocks. *

1.3 RELATED WORK

- A. Division 23 Mechanical.
 - 1. Air Handling Units.
 - 2. Fan Coil Units.
 - 3. Weatherproof Roof Mounted Air Handling Units.
 - 4. Ductwork.
 - 5. Terminal Boxes.

PART 2 - PRODUCTS

2.1 HOT WATER COILS

- A. Hot water coils:
 - 1. Constructed of copper tubes and aluminum fins.
 - 2. Designed and circuited for hot water.
 - a. Maximum temperature 200°F.
- B. Where coils are installed in fan powered VAV boxes, unit heaters and other locations the maximum approved fin spacing is 8 fins per inch.
- C. Non-trapping circuit design:
 - 1. Working pressure 200 psi
 - 2. Tappings for drain and air vent
- D. Provide a Peterson Pete's Plug with retainer strap on the inlet and outlet of each coil.
 - 1. Positioned to permit accurate pressure readings.
- E. Coils shall be constructed in casings as required for installation.
- F. Heating coils installed within ductwork or on the leaving side of a terminal unit shall be installed with a transition ductwork section to match the full face area of the heating coil. Provide an access door on both the entering and leaving sides of the duct mounted coil.

2.2 CHILLED WATER COILS

- A. Chilled water coils:
 - 1. Constructed of copper tubes and aluminum fins
 - 2. Designed and circuited for chilled water
 - 3. Minimum of six rows
- B. Non-trapping circuit design:
 - 1. Working pressure 200 psi.
 - 2. Tappings for drain and air vent.
- C. Provide a Peterson Pete's Plug with retainer strap on the inlet and outlet of each coil. Position to permit accurate pressure readings.
- D. Coils shall be constructed in casings as required for installation.
- E. Where coils are stacked, provide intermediate drain pans with drop tubes to drain

condensate to the main drain pan without flooding the lower coil.

2.3 DIRECT EXPANSION COOLING COILS

- A. DX cooling coils:
 - 1. Constructed of copper tubes and aluminum fins.
 - 2. Designed and circuited for use with direct expansion refrigeration.
- B. Cooling coil face velocity:
 - 1. Not of magnitude to cause moisture to be carried off the coil.
 - 2. Maximum velocity as scheduled.
- C. Circuit cooling coil with interlaced tubes so the entire face is active under all modes of unloading. Refer to the schedule on the drawings.
- D. Coils shall be constructed in casings as required for installation.
- E. Where coils are stacked, provide intermediate drain pans with drop tubes to drain condensate to the main drain pan without flooding the lower coil.

2.4 ELECTRIC HEATERS

- A. Capacity shall be as scheduled on the drawings. Heater shall have 80% nickel, 20% chromium, open resistance coils insulated by floating ceramic bushings, and be supported in an aluminum steel frame.
- B. Ceramic bushings shall be recessed into embossed openings and staked into supporting brackets spaced 3-1/2" maximum center to center.
- C. Coil shall be machine-crimped into threaded terminals and insulated with phenolic bushings. All terminal hardware shall be stainless steel.
- D. Heater shall be listed by the Underwriters Laboratories for zero clearance to combustible surfaces and for use with central air conditioners.
- E. For primary protection, furnish a disk-type automatic reset thermal cutout for pilot duty only.
- F. For secondary protection, load-carrying manual reset thermal cutouts shall be wired in series with each heater circuit. Cutouts shall be rated at 480 volts minimum.
- G. Voltage, phase and number of heating stages shall be furnished in accordance with duct heater schedule. Three-phase heaters shall have single-phase circuits for operation from a 3-phase, 4-wire power source. Circuits shall be rated at 48 amperes maximum. Furnish one set of line terminals to feed all circuits. Heater shall be tested dielectrically at 2000 volts before shipment. Field-installed conductors feeding the heater shall be sized for 125% of the connected load.
- H. Built-in components shall be factory wired to terminal blocks for field connection. All internal wiring shall be insulated for 105°C. Built-in magnetic contactors shall disconnect all ungrounded conductors to each circuit. Furnish heaters with an air flow switch that will not allow heaters to energize without proof of air flow. Built-in transformer shall be dry industrial type, sized to carry full contactor holding coil load. Primary windings shall be fused at the factory. Built-in fuses shall be factory wired to each circuit to protect all underground conductors. Type NON or NOS fuses to be factory installed in phenolic fuse blocks. Built-in disconnect switch to be snap action, industrial type. Provide a door interlock mechanism to prevent hinged terminal box cover from being opened when the switch is on. Switch shall be unfused.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install the duct heaters in accordance with the manufacturer's Installation, Start-Up and Service Instructions.

END OF SECTION

SECTION 23 82 18
DUCTLESS MINI SPLIT DX UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install mini split system. Complete with a slim silhouette, compact, high wall fan coil section with a wired wall mounted thermostat and a slim silhouette horizontal discharge outdoor condensing unit. Unit shall be provided with inverter driven compressor, pre-charged with R410A or R32 refrigerant. air-cooled condensing units complete with casing, compressor, condenser coil, condenser fan and controls required for a split air conditioning system.

1.2 RELATED WORK

- A. Refrigerant Piping.
- B. Electrical Provisions of Mechanical Work.

1.3 PERFORMANCE

- A. Provide performance as scheduled on drawings, and head pressure control to enable unit to operate in temperatures as low as 20 degrees F. ambient.

1.4 QUALITY ASSURANCE

- A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and bear the ETL label.
- B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
- C. The units shall be rated in accordance with Air-conditioning, Heating, and Refrigeration Institute's (AHRI) Standard 210 and bear the AHRI Certification label.
- D. The units shall be manufactured in a facility registered to ISO 9001 Quality assurance Standards and ISO 14001 which are set of standards applying to sustainability and environmental protection set by the International Standard Organization (ISO).
- E. A pressure charge of R410A or R32 refrigerant sufficient for up to twenty-five (25) feet of refrigerant tubing shall be provided in the outdoor condensing unit.
- F. A dry air holding charge shall be provided in the indoor section.

1.5 WARRANTY

- A. Unit shall have a manufacturer's parts and defects warranty for a period five (5) years from the date of the original installation. The compressor shall have a warranty of seven (7) years from date of installation. Warranties shall start at the date of substantial completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Daikin
- B. Trane - Mitsubishi
- C. LG

2.2 INDOOR UNIT GENERAL

- A. The indoor shall be factory assembled, wired and run tested. Contained within the unit cabinet shall be all factory wiring, internal piping, electronic control circuit board and fan with fan motor.
- B. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and auto restart after power interruption function, an emergency operation function and a test run

switch.

- C. Indoor unit and refrigerant pipes shall be charged with dry air before shipment from the factory. All refrigerant piping must be insulated.

2.3 CABINET

- A. The casing shall have a smooth front, top return, in a white finish.
- B. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining shall be standard.
- C. There shall be a separate installation plate which secures the unit firmly to the wall. Secure mounting of plate and all mounting hardware shall be furnished by and be the responsibility of the installer.

2.4 FAN

- A. The indoor unit fan shall be an assembly with a line-flow fan direct driven by a single motor mounted in rubber motor mount.
- B. The fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings.
- C. Manual adjustable vertical guide vanes shall be provided with the ability to change the airflow from side to side (left to right).
- D. An integral, motorized, horizontal air sweep flow louver shall provide an automatic change in airflow by directing the air up and down to provide for uniform air distribution.
- E. The indoor unit fan motor shall operate in four (4) selectable speeds, Powerful, High, Medium, and Low.

2.5 FILTER

- A. Return air shall be filtered by means of easily removed, washable, Catechin air filter and an anti-allergy enzyme filter – blue bellows type.

2.6 COIL

- A. The indoor unit (evaporator) coil shall be of nonferrous construction with smooth, pre-coated aluminum fins on copper tubing.
- B. Tubing shall have inner grooves for high efficiency heat exchange.
- C. All tube joints shall be brazed with PhosCopper or silver alloy.
- D. The coil shall be pressure tested at the factory.
- E. A sloped condensate pan and drain shall be provided under the coil. Drain connections shall be provided at each end of the drain pan.

2.7 ELECTRICAL

- A. Power for the indoor unit shall be supplied from the outdoor unit.
- B. Power supply shall be as indicated on the drawings.
- C. The unit shall be equipped with a micro-processor control system directing indoor and outdoor unit coordinated operation.
- D. The indoor unit shall not have any supplemental electrical heat elements.

2.8 CONTROL

- A. This system shall have a wired wall mounted thermostat/controller to perform input functions necessary to operate the system. The controller shall consist of a Power On / Off switch, Mode Selector, Temperature Setting, Timer Control, Fan Speed Select and Auto Vane Selector.
- B. Temperature changes shall be by 1°F increments with a range of 65°F to 87°F.
- C. There shall be a 24 hour On / Off timer.

- D. The microprocessor located in the indoor unit shall have the capability of sensing return air temperature and indoor coil temperature, receiving and processing commands from the space controller, providing emergency operation and controlling the outdoor unit.
- E. The control voltage between the indoor unit and the outdoor unit shall be 115 volts, AC.
- F. The system shall be capable of automatic restart when power is restored after power interruption.
- G. The control system shall control the operation of the air sweep louvers, as well as provide on / off and system / mode function switching.

2.9 OUTDOOR UNIT GENERAL

- A. The outdoor unit is designed specifically for use with the indoor units. The outdoor unit shall be completely factory assembled, internally piped and wired. Each unit shall be run tested at the factory.
- B. When refrigerant lines are exposed on exterior of building provide "LINE-HIDE" line set cover system.
 - 1. Material, Weather resistant, UV stabilized, ASA/PVC/ABS/Poly/PE
 - 2. Assembly Screws, stainless steel.

2.10 UNIT CABINET

- A. The casing shall be fabricated from zinc coated steel, bonderized with an electrostatically applied, thermally bonded, acrylic or polyester powder coating for corrosion protection.
- B. Case and mounting feet shall be as follows:
 - 1. The base shall be of Aluminum-Zinc-Magnesium alloy coated steel, with welded mounting feet.
- C. Cabinet mounting and construction shall be sufficient to withstand 155 MPH wind speed conditions for use in Hurricane condition areas. Mounting, base support, and other installation to meet Hurricane Code Conditions shall be by others.

2.11 FAN

- A. The unit shall be furnished with a directive drive propeller type fan, statically and dynamically balanced for smooth and quiet operation.
- B. The fan motor shall have inherent protection, be equipped with permanently lubricated bearings. The fan motor shall be mounted and isolated for quiet operation.
- C. The fan shall be provided with a raised guard to prevent contact with moving parts.
- D. The outdoor unit shall have horizontal discharge airflow.

2.12 COMPRESSOR

- A. The compressor shall be a high performance, inverter driven rotary type.
- B. Compressor shall be mounted using rubber isolating bushings to avoid the transmission of vibration.
- C. Compressor shall be protected by an automatic over current relay and a thermal overload switch.

2.13 OPERATION

- A. The outdoor unit shall have an accumulator.
- B. The outdoor unit must have the ability to operate with a maximum height difference of 35 feet between indoor and outdoor units.
- C. The unit shall have a maximum refrigerant tubing length of 65 feet between indoor and outdoor units without the need for line size changes, traps or additional oil. All refrigerant lines must be insulated.
- D. The unit shall be pre-charged for a maximum of 25 feet of refrigerant tubing.

2.14 ELECTRICAL

- A. Power supply shall be as indicated on the drawings.
- B. The outdoor unit shall be controlled by the microprocessor located in the indoor unit. The control voltage between the indoor unit and the outdoor unit shall be 115 volts, AC.

2.15 WALL AND ROOF BRACKET

- A. As indicated on the drawings, provide each unit 3 tons and below with a stainless steel mini-split condenser bracket.
- B. Unit shall be constructed for a maximum weight of 300 lbs.
- C. Unit shall be manufactured by Rectorseal model #WBB-300SS or Diveritech model #QSWB4000SS or approved equal.

2.16 CONDENSATE PUMPS

- A. A condensate pump shall only be provided as a means of condensate disposal when a gravity drain is not available.
- B. Provide a Little Giant Model #554642 VCMA-20ULS-C-PRO-20.
- C. Unit shall be provided with anti-sweat sleeve, tank bracket and overflow detection switch.
- D. Condensate pump shall be wall mounted. Mount pump under wall cassette.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mount condensing units on 4" foundation pads and pipe as shown on Drawings or as recommended by the equipment manufacturer. Install refrigerant filter dryer and sight indicating glass.
- B. Install units on vibration isolation pads.
- C. Ensure unit provided will meet the refrigerant and line lengths required by the installation as indicated on the drawings.
- D. Provide convenience water and electrical within 50 feet of new condensing unit.

3.2 CONTROL WIRING

- A. Furnish and install control wiring as required. Install control wiring in conduit.

3.3 DELIVERY, STORAGE AND HANDLING

- A. Unit shall be stored and handled according to the manufacturer's recommendations.
- B. The wired controller shall be shipped inside the carton with the indoor unit and able to withstand 105°F storage temperatures and 95% relative humidity without adverse effect.

3.4 START-UP

- A. Follow the manufacturer's start-up procedures.
- B. Provide flexible elastomeric rubber closed cell insulation to prevent condensation from occurring on suction piping. After completion of successful start-up, installing contractor shall seal all openings in insulation and apply a protective aluminum sheetmetal jacket over insulation exposed on exterior of building.

END OF SECTION

SECTION 26 01 05
ELECTRICAL OPERATING AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Compile electrical product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare electrical operating and maintenance data as specified in this Section and as referenced in other sections of specifications.
- B. Instruct Owner's personnel in operation and maintenance of equipment and systems.
- C. Submit 3 copies of complete manual in final form.

1.2 ELECTRICAL OPERATING AND MAINTENANCE MANUAL SUBMITTAL SCHEDULE

- A. Thirty (30) days after receipt of reviewed submittals bearing the Architect / Engineer's stamp of acceptance (including re-submittals), submit for review 1 copy of the first draft of the Electrical Operating and Maintenance Manual. This copy shall contain as a minimum:
 - 1. Table of Contents for each element
 - 2. Contractor information
 - 3. All shop drawings, coordination drawings and product data, bearing the Architect / Engineer's stamp of acceptance.
 - 4. All parts and maintenance manuals for items of equipment
 - 5. Warranties (without starting dates)
 - 6. Certifications that have been completed; submit forms and outlines of certifications that have not been completed
 - 7. Operating and maintenance procedures.
 - 8. Form of Owner's Training Program Syllabus (including times and dates)
 - 9. Control operations / equipment wiring diagrams
 - 10. Coordination Drawings
 - 11. Schedule of Lamps, Light Engines
 - 12. Schedule of Ballasts and Drivers
 - 13. Schedule of Fuses
 - 14. Other required operating and maintenance information that are complete.
- B. Copy will be returned to the Contractor within 15 days with comments for corrections.
- C. Submit the completed manuals in final electronic form to the Architect / Engineer.
 - 1. Prior to substantial completion for Owner's use after the Owner accepts facility maintenance.
 - 2. Include all specified data, test reports, drawings, dated warranties, certificates, along with other materials and information.
- D. The Architect / Engineer shall review the manuals for completeness within 15 days.
- E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Architect / Engineer. The manuals will not be retransmitted.
- F. Complete electronic manuals shall be delivered to the Owner prior to substantial completion.

PART 2 - PRODUCTS

2.1 BINDERS

- A. Commercial quality black, 3-ring binders with clear, durable, cleanable plastic covers.
- B. Minimum ring size: 1"; Maximum ring size: 3".

- C. When multiple binders are used, correlate the data into related groupings.
- D. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 - EXECUTION

3.1 ELECTRICAL OPERATION AND MAINTENANCE MANUAL

- A. Form for 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 flyleaf 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.
 - 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 / 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
 - 1) List of lubricants required
 - e. Manufacturer's printed operating and maintenance instructions.
 - f. Copies of typed circuit directories of panel board to reflect actual room graphics numbers and room names (not architectural room numbers from the drawings).
 - 1) Electrical
 - 2) Controls
 - 3) Communications
 - 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. Schedule of fuses
 - i. Complete equipment field accessible internal wiring diagrams
 - j. Schedule of lamps
 - k. Schedule of ballasts
 - l. Each Contractor's coordination drawings
 - 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 26.

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.

END OF SECTION

SECTION 26 05 00
ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions, and Supplementary Conditions, applicable provisions of Division 1 General Requirements, and other provisions and requirements of the Contract Documents apply to work of Division 26 Electrical.
- B. Applicable provisions of this section apply to all sections of Division 26, Electrical.

1.2 CODE REQUIREMENTS AND FEES

- A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.
- B. Electrical work shall comply with applicable inspection services:
 - 1. Underwriters Laboratories
 - 2. National Fire Protection Association
 - 3. State Health Department
 - 4. Local Municipal Building Inspection Department adopted codes with amendments
 - 5. National Electrical Code with local amendments
 - 6. State Regulatory Agencies
 - 7. Where the project is located outside a municipal jurisdiction, and has no municipal inspection services, the National Electrical Code with amendments of the municipality with extraterritorial jurisdiction shall govern.
 - 8. Where the project is located outside any municipal jurisdiction, including extraterritorial jurisdictions, the National Electrical Code with local adopted amendments of the largest municipality located in the same county or parish shall govern.
 - 9. International Energy Conservation Code
 - 10. National Electrical Safety Code
- C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.
- D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.
- E. Obtain all permits required.

1.3 CONTRACTOR'S QUALIFICATIONS

- A. An approved contractor for the work under this division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, and skill, and the 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 has served their Owners satisfactorily for not less than 3 years.

1.4 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, APWA, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date proposals are received. Referenced specifications and standards are minimum requirements for all equipment, material and work. In instances where

- specified capacities, size or other features of equipment, devices or materials exceed these minimums, meet specified capacities.
- B. Use electrical materials and equipment that is constructed and tested in accordance with the standards of NEMA, ANSI, ASTM, or other recognized commercial standard. If materials and equipment is labeled, listed, or recognized by any Nationally-Recognized Testing Laboratory (NRTL) acceptable to the Occupational Safety and Health Administration (OSHA), then provide NRTL-labeled, listed, or recognized material and equipment. Acceptable NRTLs include but are not limited to:
1. Underwriters Laboratories, Inc. (UL)
 2. Factory Mutual Research Corp. (FMRC) (also referred to as "Factory Mutual Global," or "FM Global")
 3. Intertek Testing Services NA, Inc. (ITSNA, formerly ETL)
 4. Canadian Standards Association (CSA)
 5. A complete listing of acceptable NRTLs is published on the OSHA website at <http://www.osha.gov/dts/otpca/nrtl/>.
- C. Where material and equipment is not labeled, listed, or recognized by any NRTL, provide a manufacturer's Certificate of Compliance indicating complete compliance of each item with applicable standards of NEMA, ANSI, ASTM, or other recognized commercial standard.
- D. Do not install or use electrical material or equipment for any use other than that for which it was designed, labeled, listed, or identified unless formally approved for such use by the Owner's AHJ. This *National Electrical Code*® requirement is re-stated for emphasis.
- E. Codes and Standards applicable to this Division:
1. ANSI – American National Standards Institute
 - a. ANSI Z535.1, Safety Colors
 - b. ANSI Z535.2, Environmental and Facility Safety Signs
 - c. ANSI Z535.3, Criteria for Safety Symbols
 - d. ANSI Z535.4, Product Safety Signs and Labels
 2. ASHRAE – American Society of Heating, Refrigeration, and Air Conditioning Engineers:
 - a. ASHRAE Standard 90.1, *Energy Standards for Buildings Except for Low Rise Residential Buildings [ANSI, IESNA]*
 3. ASTM – American Society for Testing and Materials
 4. CBM – Certified Ballast Manufacturers
 5. ICC – International Code Council
 - a. International Building Code® (IBC)
 - b. International Existing Building Code® (IEBC)
 6. ICEA – Insulated Cable Engineers Association
 - a. ICEA S-93-639, *Shielded Power Cables 5-46kV* (NEMA WC-74)
 7. IEEE® - Institute of Electronics and Electrical Engineers
 - a. IEEE C2™, *National Electrical Safety Code* (NESC) [ANSI]
 - b. IEEE Std 141™, *Recommended Practice for Electric Power Distribution for Industrial Plants* ("Red Book")
 - c. IEEE Std 143™, *Recommended Practice for Grounding of Industrial and Commercial Power Systems* ("Green Book")
 - d. IEEE Std 241™, *Recommended Practice for Electric Power Systems in Commercial Buildings* ("Gray Book")
 - e. IEEE Std 242™, *Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems* ("Buff Book")
 - f. IEEE Std 315™, *Graphic Symbols for Electrical and Electronics*

Diagrams

- g. IEEE Std 399™, *Recommended Practice for Power Systems Analysis (“Brown Book”)*
- h. IEEE Std 446™, *Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications (“Orange Book”)*
- i. IEEE Std 493™, *Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems (“Gold Book”)*
- j. IEEE Std 519™, *Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems*
- k. IEEE Std 739™, *Recommended Practice for Energy Management in Industrial and Commercial Facilities (“Bronze Book”)*
- l. IEEE Std 902™, *Guide for Maintenance, Operation, and Safety of Industrial and Commercial Power Systems (“Yellow Book”)*
- m. IEEE Std 1015™, *Recommended Practice Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems (“Blue Book”)*
- n. IEEE Std 1100™, *Recommended Practice for Powering and Grounding Electronic Equipment (“Emerald Book”)*
- o. IEEE Std 1584™, *Guide for Performing Arc-Flash Hazard Calculations*
- 8. IESNA – Illuminating Engineering Society of North America
 - a. IESNA *Lighting Handbook*, Ninth Edition
 - b. IESNA RP-1, *American National Standard Practice for Office Lighting*
 - c. IESNA RP-7, *American National Standard Practice for Lighting Industrial Facilities*
- 9. NECA – National Electrical Contractors Association:
 - a. NECA 1, *Good Workmanship in Electrical Construction* [ANSI]
 - b. NECA 90, *Recommended Practice for Commissioning Building Electrical Systems* [ANSI]
 - c. NECA 100, *Symbols for Electrical Construction Drawings* [ANSI]
 - d. NECA 101, *Standard for Installing Steel Conduits (Rigid, IMC, EMT)* [ANSI]
 - e. NECA 104, *Recommended Practice for Installing Aluminum Building Wire and Cable* [ANSI]
 - f. NECA / NEMA 105, *Recommended Practice for Installing Metal Cable Tray Systems* [ANSI]
 - g. NECA 111, *Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC)* [ANSI]
 - h. NECA / NACNA 120, *Standard for Installing Armored Cable (Type AC) and Metal-Clad Cable (Type MC)*[ANSI]
 - i. NECA 202, *Recommended Practice for Installing and Maintaining Industrial Heat Tracing Systems* [ANSI]
 - j. NECA 230, *Standard for Selecting, Installing and Maintaining Electric Motors and Motor Controllers* [ANSI]
 - k. NECA 331, *Standard for Building and Service Entrance Grounding and Bonding*
 - l. NECA 400, *Standard for Installing and Maintaining Switchboards* [ANSI]
 - m. NECA 402, *Standard for Installing and Maintaining Motor Control Centers* [ANSI]
 - n. NECA / EGSA 404, *Standard for Installing Generator Sets* [ANSI]

- o. NECA 407, *Recommended Practice for Installing and Maintaining Panelboards* [ANSI]
- p. NECA 408, *Recommended Practice for Installing and Maintaining Busways* [ANSI]
- q. NECA 409, *Recommended Practice for Installing and Maintaining Dry-Type Transformers* [ANSI]
- r. NECA 410, *Recommended Practice for Installing and Maintaining Liquid-Filled Transformers* [ANSI]
- s. NECA 411, *Recommended Practice for Installing and Maintaining Uninterruptible Power Supplied (UPS)* (ANSI)
- t. NECA 420, *Standard for Fuse Applications* [ANSI]
- u. NECA 430, *Standard for Installing Medium-Voltage Metal-Clad Switchgear* [ANSI]
- v. NECA / IESNA 500, *Recommended Practice for Installing Indoor Lighting Systems* [ANSI]
- w. NECA / IESNA 501, *Recommended Practice for Installing Exterior Lighting Systems* [ANSI]
- x. NECA / IESNA 502, *Recommended Practice for Installing Industrial Lighting Systems* [ANSI]
- y. NECA / MACSCB 600, *Recommended Practice for Installing and Maintaining Medium-Voltage Cable* [ANSI]
- z. NECA / NEMA 605, *Installing Underground Nonmetallic Utility Duct* [ANSI]
- 10. NEMA – National Electrical Manufacturers Association
- 11. NETA – International Electrical Testing Association, Inc.:
 - a. NETA ATS, *Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems*
 - b. NETA MTS, *Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems*
 - c. NETA ETT, *Standard for Certification of Electrical Testing Technicians* [ANSI]
- 12. NFPA – National Fire Protection Association:
 - a. NFPA 20®, *Standard for the Installation of Stationary Pumps for Fire Protection*®
 - b. NFPA 70™, *National Electrical Code*® (NEC®)
 - c. NFPA 70E, *Standard for Electrical Safety in the Workplace*.
 - d. NFPA 101®, *Life Safety Code*®
 - e. NFPA 110, *Standard for Emergency and Standby Power Systems*
 - f. NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*
 - g. NFPA 780, *Standard for the Installation of Lightning Protection Systems*
 - h. All other NFPA codes and standards except NFPA 5000
- 13. OSHA – Occupational Safety and Health Administration
- 14. IECC – International Energy Conservation Code
- 15. ISO – International Organization for Standardization
- 16. State and Local Energy Conservation Code
- 17. Applicable County and Municipal Codes

1.5 CONTRACT DRAWINGS

- A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.

- B. Every effort has been made by the Engineer to indicate wiring of all receptacles, light fixtures, switches, telephone outlets, HVAC equipment, other equipment, elevator equipment, and all other devices / appliances requiring electrical power. It is the intent of the Engineer that all light fixtures be powered and controlled unless specifically noted on the plans; that all wiring devices (receptacles and direct connected equipment) be circuited to a power source of the correct voltage and that all HVAC, elevator equipment and other equipment be properly wired to the correct voltage power source; that all communications and security systems devices and equipment and all fire alarm system devices and equipment are installed, wired and systems are fully operational.
- C. It is the responsibility of the Contractor to review the construction drawings (reflected ceiling plans) for light fixtures, casework elevation details for electrical devices which are not indicated on the electrical drawings; to review the mechanical and plumbing documents and all other drawings to determine the electrical rough-ins for all equipment requiring power connections, and to include in their proposals the correct and complete electrical rough-ins for all of these items which were inadvertently not indicated on the electrical drawings, OR the Contractor shall specifically enumerate each item requiring electrical rough-in which is not specifically shown on the electrical drawings, and indicate the electrical provisions of these items as specifically excluded from his proposal.
- D. It is the responsibility of the Contractor to compare the scale of all electrical drawings with the scale of the architectural drawings and make adjustments to all electrical drawings which have the incorrect drawing scale so that his material takeoffs are not in error due to an incorrectly labeled drawing scale and his proposal is complete.
- E. No proposal shall be accepted which specifically excludes any of the provisions of paragraphs B, C, or D above.

1.6 PROJECT RECORD DOCUMENTS

- A. Maintain at the job site a separate set of white prints (black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is significantly at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various major and minor feeders, equipment, and other pertinent items, as installed. Record underground and under slab service and feeders installed, dimensioning exact location and elevation of such installations.
- B. At conclusion of project, obtain without cost to the Owner, electronic PDF and AutoCAD 2014 and / or Revit CAD files of the original drawings and transfer as-built changes to these. Provide the following as-built documents including all contract drawings regardless of whether corrections were necessary and include in the transmittal: "2 sets of CDs and prints for Owner's use, one set of CDs, prints, and mylars for Architect / Engineers Records". Delivery of these as-built electronic, reproducibles and prints is a condition of final acceptance.
 - 1. 3 sets of electronic AutoCAD (2014 dwg) and / or Revit CAD drawing files, on CD-ROM media, of each contract as-built drawing.
 - 2. One reproducible Dayrex Mylar film positive of each contract as-built drawing.
 - 3. Three sets of blue-line prints of each contract as-built drawing.
 - 4. Three sets of pdf prints of each contract as-built drawing on CD.
- C. 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 RECORD DRAWINGS.

4. Clearly indicate: DOCUMENT PRODUCED BY:
5. Indicate all changes to construction during construction. Indicate actual routing of all conduits, etc. that was deviated from construction drawings.
6. Indicate exact location of all underground electrical raceways, and elevations.
7. Correct schedules to reflect (actual) equipment furnished and manufacturer.
8. During the execution of work, maintain a complete set of Drawings and specifications upon which all locations of equipment, devices, and all deviations and changes from the construction documents in the work shall be recorded.
9. Exact location of all electrical equipment in building. Label panel schedules to indicate actual location.
10. Exact location of all electrical equipment in and outside of the building.
11. Exact location of all outdoor lighting poles and equipment.
12. Location, size and routing of all feeder conduits, equipment, etc. shall be accurately and neatly shown to dimension.
13. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
14. Cloud all changes.
15. Update all panel schedules with all additional circuits added or deleted through construction. Identify each circuit to include all information specified for directory cards for circuit identification in panelboards.

1.7 SPACE REQUIREMENTS

- A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.8 RELATION WITH OTHER TRADES

- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements. Extend electrical services and final connections to all items requiring same.
- B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.
- C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.
- D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.
- E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under other Division. Determine from the General Contractor / Construction Manager for the various trades, the Owner, and by direction from the Architect / Engineer, the exact location of all items. The construction trades involved shall furnish all roughing-in drawings and wiring diagrams required for proper installation of the electrical work.
 1. Make final electrical connections to all electrically operated equipment indicated on the drawings, except as noted.
 2. The responsibility for alignment of motor and driven equipment is specified in the related division.
- F. Request all Shop Drawings required in ample time to permit proper installation of all electrical provisions.
- G. Extend services as indicated to the various items of equipment furnished by others.

Rough-in for the various items and make final connections ready for operation upon placing of the equipment.

1.9 CONCEALED AND EXPOSED WORK

- A. When the word "concealed" is defined as hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is defined as open to view, in plain sight.

1.10 GUARANTEE

- A. Guarantee work for 1 year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. Replacement of failed parts or equipment shall be provided.

1.11 MATERIAL AND EQUIPMENT

- A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 NOISE AND VIBRATION

- A. Select equipment to operate with minimum noise and vibration. If noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, and judged objectionable by the Owner, Architect, or Engineer, rectify such conditions at no additional cost to the Owner. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.13 ACCEPTABLE MANUFACTURERS

- A. Manufacturers names and catalog number specified under sections of Division 26 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, materials, energy efficiency characteristics (where applicable) and lighting performance characteristics (where applicable) equal to that specified, manufactured by a named manufacturer shall be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before proposal due date. Submit a marked-up set of the relevant specification section indicating all variances, a comparison to the specified product, and of construction and performance criteria, complete design and performance data for the specified product and the proposed substitution for comparison to the Engineer. The Architect issues approvals of acceptable manufacturers as addenda to the Construction Proposal Documents.

1.14 UTILITIES, LOCATIONS AND ELEVATIONS

- A. Locations and elevations of the various utilities included within the scope of this work:
1. Obtained from utility maps and other substantially reliable sources.
 2. Are offered separate from the Contract Documents as a general guide only without guarantees to accuracy.
- B. Examine the site and verify the location and elevation of all utilities and of their relation to the work. Existing utilities indicated on the site plans are for reference only and shall be field verified by the Contractor with the respective public or private utility.

1.15 OPERATING TESTS

- A. After all electrical 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 and Owner. Provide minimum 24-hour advance notice of scheduling of all tests. 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.

1.16 WARRANTIES

- A. All normal and extended warranties shall include parts, labor, miscellaneous materials, travel time, incidental expenses, normal freight / shipping, refrigerant, oils, lubricants, belts, filters and any expenses related to service calls required to diagnose and correct warranty problems.
- B. Manufacturer's warranty shall be from one year from date of substantial completion. Contractor shall be responsible for extending the warranties regardless of date of installation or commissioning.
- C. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.17 BUILDING CONSTRUCTION

- A. It shall be the responsibility of the sub-contractor to consult the Contract Drawings, details and specifications and thoroughly familiarize himself as to the construction and all job related requirements. All construction trades shall cooperate with the General Contractor / Construction Manager Job site superintendent and lay out work so that all raceways and other items are placed in the walls, furred spaces, chases, etc., so that there shall be no delay in the job.

1.18 TEMPORARY FACILITIES

- A. General: Refer to Division 1 for general requirements on temporary facilities.
- B. Temporary Wiring: Temporary power and lighting for construction purposes shall be provided under this Division. Installation of temporary power shall be in accordance with NEC Article 527.
- C. Temporary facilities, wire, lights and devices are the property of this Contractor and shall be removed by this Contractor at the completion of the Contract.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 IDENTIFICATION OF EQUIPMENT

- A. Identification of Equipment:
 - 1. All major equipment shall have a manufacturer's label identifying the manufacturer's address, equipment model and serial numbers, equipment size, and other pertinent data. Take care not to obliterate this nameplate. The legend on all nameplates or tags shall correspond to the identification shown on the Operating Instructions. All panels, cabinets, or equipment requiring 120 volt or higher power shall be labeled as required which includes circuit designation and circuit panelboard location, regardless of which discipline installs the equipment.
 - 2. Three layer laminated plastic engraved identifying nameplate shall be permanently secured to each switchboard, distribution panel, motor control center, transformer, panelboard, safety disconnect switch, enclosed circuit

breaker, transfer switches, remote generator transfer deices not installed inside light fixtures, wireway, busduct plug, terminal cabinet, surge protective device, capacitor, individual motor controller, contactor, fire alarm panels (main and remote booster), and communications (voice, data, video) cabinet or rack, security panels, time clocks, BMCS cabinets, sound reinforcement cabinets and racks, miscellaneous control cabinets, equipment integral disconnect switches, toggle or motor switches, disconnects for equipment, exterior junction boxes, exterior pull boxes, exterior wireways and gutters, and rooftop equipment (i.e.: supply and exhaust fans, rooftop HVAC equipment) with stainless steel screws.

- a. Utility Power: White letters on black background
 Generator Power (White letters on red background)
 UPS Power: White letters on blue background
 Load Bank Circuits: White letters on green background
 Solar or Wind Power Generation: White on orange background
- b. Identifying nameplates shall have 1/2-inch high, engraved letters for equipment designation and 1/4-inch letters indicating source circuit designation, (i.e.: “PANEL HA –fed from MDP-6 located in Mech. Rm. 100”). The words “fed from” and “located” shall be included in the labeling.
 Example: Panel HA
 Fed From MSB
 Located Main Elec. RM 100
 Example: Disconnect for Panel LK
 Location: Kitchen
 Fed From Transformer TLK
 Located Main Elec. RM 100
- c. Each switchboard, distribution panel, transfer switch, generator transfer device (GTD) for emergency lighting, and motor control center feeder or branch circuit device shall have a nameplate showing the load and location of load served in 1/4-inch high, engraved letters. Circuit breaker name and kirk key designation if applicable
- d. Each section of multiple section panelboards shall also indicate panelboard section number (i.e.: Panel “HA-Section 2 – fed from MDP-6 located in Mech. Rm. 100”)
- e. Motor Controllers, starters, and contactors: Provide neatly typed label inside each motor controller and contactor enclosure door identifying motor or load served, nameplate horsepower, full load amperes, code letter, service factor, and voltage / phase rating.
- f. Individual motor controller and contactor nameplates shall include load served, location of load served, panel and circuit numbers serving load, location of panel serving load, panel and circuit number serving control circuit, location of panel serving control circuit (if different from panel serving load), description and location (if applicable) of control controlling contactor (i.e. Controlled: Switch in RM 100, and Controlled: BMCS). Contactor nameplate is to include whether it is a lighting or receptacle contactor and name of contactor. i.e. C-1.

Lighting Contactor Example	Receptacle Contactor Example
Lighting Contactor C1	Receptacle Contactor C2
West Parking Lot Pole Lights	Table Recpts Lab Rm 100
Fed From Panel HA-2,4,6	Fed From Panel LA-2,4,6,8
Located Main Elec. Rm. 100	Located Mech. Rm. 110

Control Circuit-Panel LA 42 Located Main Elec. Rm. 100 Controlled-BMCS	Control Circuit-Panel LA-42 Controlled-Emer Shut Off Mushroom Switch Rm 101
GTD Example	
Exterior lighting wall packs / north soffit / west metal canopy Fed from Panels EHA-2 located in Elec. RM 105 and HA-1 via Lighting Contactor controlled by BMCS located in Elec. RM 200.	

- g. Exterior J-boxes, pull boxes, and gutters shall have panel identification, circuit numbers, and location of panel listed on name plate. Low voltage shall be identified per contents, examples: DATA, BMCS, F/A
- h. Name plates on equipment served from switchboards, distribution panels, I-Line panels, and motor control centers are not to include circuit numbers shown on drawings as the circuit numbers are for construction drawing purposes only.
- i. Panel names for 277/480v shall start with the letter "H" and 120/208v, 120/240v shall start with the letter "L". No panel shall be named to include a number other than multi sectional panels, example HA-section 2. New panels installed in renovation or site additions shall have names approved or designated by Owner's electrical representative. Panel names shall not include the letter "I". Transformer names shall start with the letter "T" followed by the panel name it serves, i.e. TLA.
- j. Main service ATS label shall include equipment name, emergency source and location, normal power source and location, panel served and location. Wall mounted ATS serving lighting loads shall include type of lighting and location, emergency panel and circuit ID and location of panel, normal panel and circuit ID and location of panel.

Main Service ATS Example ATS-1 Emer Power-Emer Generator Located Chiller Yard Normal Power-MSB Located-Mech Rm 100 Serves Panel EHA Located-Mech Rm 100	Wall Mounted Lighting ATS Example ATS Exterior Wall Packs/Soffit Lights North/West Metal Canopy Lights Fed from EHA-2 Located Mech Rm 200 Fed From HB-4 Located Mech Rm 150
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- k. Name plates shall include rated bus amperage, voltage, number of phases, number of wires and type of essential electrical system as applicable.
- l. Switchgear, switchboards, panelboards, motor control centers, or service equipment available fault current labeling: Provide a 2x3 inch permanently affixed (notice) label with white lettering on contrasting blue background permanently affixed to the equipment prior to energizing the equipment. The label shall include the date of installation and the date of calculation and comply with ANSI Z535.4 current standards design and durability. The date of calculation shall be the date indicated by the Engineer of Record's seal on the Construction Documents. Example:

AVAILABLE FAULT CURRENT: ##, ### AMPS
DATE OF INSTALLATION: MM/DD/YY
DATE OF CALCULATION: MM/DD/YY

3. Cardholders and directory cards shall be furnished for circuit identification in panelboards. Cardholder shall be located on inside of panel door and shall be in a metal frame with clear plastic front. Circuit lists shall be typewritten. Circuit descriptions shall include explicit description and identification of items controlled by each individual breaker, including final graphics room number or name designation and name of each item served. If no building appointed room number or name is given, list locations per the following examples – A. Storage in Rm 100 – B. Office in Rm 100 – C. Storage west of Rm. 100. List corridors as “corridors”. Identify circuits controlled by contactors using a separate notation for each contactor used. List notation at bottom of schedule stating the circuits are controlled by a contactor, list exact location of contactor, and how switched. Do not use architectural room number designation shown on plans. Obtain final graphics room number identification from Architect’s final room number graphics plan. All locations served by breakers shall be listed on schedule. Panel schedule shall be large enough to contain all information required. Also refer to Section 26 24 16.
 4. Permanent, waterproof, black markers shall be used to identify each lighting and power grid junction box, gutter and wireway. Clearly indicate the panel and branch circuit numbers available at that junction box, gutter or wireway. Where low voltage relay panels are used for lighting control, identify the low voltage relay panel and number in addition to the branch circuit panel and number.
 5. Pull Boxes, Transformers, Disconnect Switches, etc.: Field work each with a name plate showing identity, voltage and phase and identifying equipment connected to it. The transformer rating shall be shown on the panels or enclosures. For an enclosure containing a motor starter, the nameplate shall include the Owner’s motor number, motor voltage, number of motor phases, motor load being serviced, motor horsepower, and motor full load current. Nameplates shall also indicate where panel is fed from.
- B. Prohibited Markings: Markings intended to identify the manufacturer, vendor, or other source from whom the material has been obtained are prohibited for installation in public, tenant, or common areas within the project. Also prohibited are materials or devices that bear evidence that markings or insignias have been removed. Certification, testing (example, Underwriters Laboratories), and approval labels are exceptions to this requirement.
- C. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of electrical facilities. Provide text of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with industry standards for color and design.
- D. Wire and Cable Markers: Provide vinyl cloth markers with split sleeve or tubing type, except in manholes provide stainless steel with plastic ties.
- E. Wire and Cable Labeling: Provide wire markers on each conductor in all boxes, pull boxes, gutters, wireways, contactors, and motor controllers and load connection. Identify with panelboard / switchboard branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on equipment manufacturer’s shop drawings for control wiring.
- F. Underground Warning Tape: Thomas and Betts or approved equal. Six-inch wide plastic

tape, colored red for 50 volts or above electrical, or orange for communications and control with suitable warning legend describing buried electrical lines; telephone lines and data lines per APWA recommendations. All underground electrical conduits shall be so identified. Tape shall be buried at a depth of 6-inches below grade and directly above conduits or ductbanks. Provide magnetic marking tape below all underground electrical conduits.

- G. Lighting Controls and Equipment: Provide self-adhesive machine typed tape labels with ¼" high white letters on ½" tall black background for digital lighting modules as "DLM". Modules or relays located above ceiling: adhere label to bottom of ceiling T-grid below relay location. Modules or relays located in mechanical or electrical rooms or other areas other than above ceiling: Adhere label to the cover of the module or relay and identify the area they control as "MAIN GYM", "BAND HALL", or "CORRIDOR 100", etc. Remote lighting control switches or push button stations located remotely from the area they control: Adhere label to device face plate, not obstructing screw fasteners, and intuitively identify function such as "GYM LTG LOW-HIGH" or "CAFE LTG DIM", etc.

3.2 CUTTING AND PATCHING

- A. General: Comply with the requirements of Division 1 for the cutting and patching of other work to accommodate the installation of electrical work. Except as authorized by the Architect / Engineer, cutting and patching of electrical work to accommodate the installation of other work is not permitted.

3.3 INSTRUCTION OF OWNER'S PERSONNEL

- A. Prior to substantial completion, conduct an on-site training program to instruct Owner's operating personnel in the operation and maintenance of the electrical systems.
1. Provide the training during regular working day.
 2. The Instructors shall be experienced in their phase of operation and maintenance of the electrical systems and with the project.
 3. Refer to other specification sections for additional training and commissioning requirements.
- B. Time to be allocated for instructions.
1. Minimum of 20 hours dedicated instructor time
 2. 4 hours on each of 5 days
 3. Additional instruction time for specific systems as specified in other Sections.
- C. Before on-site training, submit the program syllabus; proposed time and dates; for review and approval, minimum 48 hours prior to proposed training time and date.
1. One copy to the Owner
 2. One copy to the Architect / Engineer
- D. The Owner shall provide a list of personnel to receive instructions, and shall coordinate their attendance at the agreed upon times.
- E. Use operation and maintenance manuals as the basis of instruction. Review manual with personnel in detail. 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 training. List time and date of each demonstration, hours devoted to the demonstration, and a list of people present, with their respective signatures.

- 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 Operating and Maintenance Manual.

3.4 OPENINGS

- A. Framed, cast or masonry openings for boxes, equipment or conduits are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.5 HOUSEKEEPING PADS

- A. Provide concrete equipment housekeeping pads under all floor and outdoor mounted electrical equipment.
- B. Concrete and reinforcing steel shall be as specified in Division 3, or as indicated or noted.
- C. Concrete pads:
 - 1. 6-inches thick minimum indoors; 8-inches thick minimum outdoors, or match existing if indicated on the drawings to extend existing pads, or in other sections of the specifications.
 - 2. Chamfer strips at edges and corner of forms.
 - 3. Smooth steel trowel finish.
 - 4. Extend 3-inches minimum indoors beyond perimeter of equipment unless otherwise shown.
 - 5. 6-inch x 6-inch #8 wire reinforcement mesh.

3.6 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions, which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
 - 1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
 - 2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
- B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.7 VANDAL RESISTANT DEVICES

- A. Where vandal resistant screws or bolts are employed on the project, deliver to the Owner 2 suitable tools for use with each type of fastener used, and 25 percent spare fasteners.
- B. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.8 PROTECTION

- A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.
- B. Do not deliver equipment to this 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 shall be rejected, and the contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.

3.9 COORDINATION OF BRANCH CIRCUIT OVERCURRENT AND PROTECTION DEVICES

- A. Review with equipment specified which requires electrical connections. Review equipment shop drawings and manufacturer's nameplate data and coordinate exact branch circuit overcurrent protective device and conductors with equipment provided.
1. Provide equipment manufacturer's recommended overcurrent protective device indicated on nameplate at no additional cost to the Owner.
 2. If branch circuit conductors and / or conduit sizing is less than the minimum required by equipment manufacturer, notify the Architect / Engineer immediately, prior to rough-in.
 3. If equipment manufacturer is a substitution to the specified equipment manufacturer, provide the greater of the conductors specified or those required for the installed equipment manufacturer's minimum circuit conductors, at no additional cost to the Owner.
 4. If conductors indicated on plans are in excess of that permitted by equipment manufacturer, notify Architect / Engineer immediately, prior to rough-in.
 5. If conductors indicated on plans are in excess of that permitted by the equipment manufacturer, provide the maximum conductors permitted by the equipment manufacturer based on NEC ampacity tables, either in a single set, or as a set of parallel conductors as permitted by the NEC. Conductor size and quantity entering the equipment enclosures shall not exceed the equipment manufacturer's maximum recommendations.

3.10 FAULT CURRENT AND ARC FLASH STUDY FOR OVERCURRENT DEVICE COORDINATION

- A. Contractor shall provide a coordination study, fault current analysis, and Arc-Flash study report for new electrical distribution equipment downstream to the last new overcurrent device in each feeder or branch circuit, conducted and prepared by the switchgear manufacturer. The coordination study and fault current analysis shall include the manufacturer's recommendations for all adjustable overcurrent devices specified or provided. Study does not require inclusion of existing switchgear, except it shall include existing or new overcurrent devices in existing switchgear serving new switchgear. Contractor shall submit the report results prior to submitting switchgear submittals to allow changes or modifications to equipment selection.
- B. Contractor shall adjust all overcurrent device settings based on manufacturer's recommendations, or as directed by Owner / Architect at no additional cost to Owner. Settings for GFI shall be set at maximum as permitted by the NEC.
- C. Arc-Flash & Shock-Hazard Warning Labels: Provide arc-flash and shock hazard-warning labels that comply with ANSI Z535.4 on switchgear, switchboards, transformers, motor control centers, panelboards, motor controllers, safety switches, industrial control panels and other equipment that is likely to require examination, adjustment, servicing, or maintenance while energized. Locate the marking to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment. On renovation projects, install arc-flash warning labels on existing equipment where lock-out / tag-out will be required for the renovation work. Provide the information listed below on each label. Specify that arc-flash warning label information be produced by the

electrical equipment manufacturer or supplier as a part of the final power system studies to be submitted by the Contractor in accordance with the electrical acceptance testing.

1. Note: In addition to the final arc-flash analysis, the final power system studies include load flow and fault-current calculations, and an overcurrent protective device (OCPD) coordination study based on the actual equipment to be installed for the project.
- D. Information to be determined and applied to electrical equipment:
1. Arc-Flash Protection Boundary
 2. Arc-Flash incident energy calculated in accordance with IEEE Std 15841™
 3. Working distance calculated in accordance with IEEE Std 1584a™
 4. NFPA 70E Hazard / Risk Category Number or the appropriate personal protective equipment (PPE) for operations with doors closed and covers on.
 - a. Typical operations include operating circuit breakers, fused switches, and meter selector switches.
 5. System phase-to-phase voltage
 6. Condition(s) when a shock hazard exists (e.g. "With cover off")
 7. Limited Approach Boundary as determined from NFPA 70E, Table 130.2(C)
 8. Restricted Approach Boundary as determined from NFPA 70E, Table 130.2(C)
 9. Prohibited Approach Boundary as determined from NFPA 70E, Table 130.2(C)
 10. Unique equipment designation or code (described under "Component Identification")
 11. Class for insulating gloves based on system voltage (e.g., Class 00 up to 500V)
 12. Voltage rating for insulated or insulating tools based on system voltage (e.g., 1000V)
 13. Date that the hazard analysis was performed.
 14. "Served from" circuit directory information including the serving equipment designation, location (e.g., room number), circuit number, and circuit voltage / number of phases / number of wires.
 15. If applicable, the "serves" circuit directory information including the served equipment designation, location (e.g., room number), circuit number, and circuit voltage / number of phases / number of wires.
 16. An abbreviated warning label may be used where it has been determined that no dangerous arc-flash hazard exists in accordance with IEEE 1584a™, paragraph 9.2.3.
 17. Use a "DANGER" label where the calculated arc-flash incident energy exceeds 40 cal/cm.
- E. Submittals: Submit four copies of coordination study and certified fault current study results to the Architect for review.

3.11 EQUIPMENT BACKBOARDS

- A. Backboards: ¾ inch, fire retardant, exterior grade plywood, painted gray, both sides.
1. Provide minimum of two 4-ft. by 8-ft. sheets of plywood for each new telephone equipment terminal location.
 2. Provide minimum of two 4-ft. by 4-ft. sheets of plywood for each new data / voice / video / communications equipment location / cable TV head end equipment, or security equipment location.

3.12 TESTING

- A. The contractors for the various sub-systems shall submit proposed testing procedures for their systems, subject to review and approval and Owner acceptance. The contract will not be declared to be substantially complete until the functional operation of the

subsystems have been demonstrated and verified and reports have been provided, reviewed and accepted.

- B. The project will not be declared substantially complete until the following has taken place.
1. The “As-Built” drawings have been submitted, reviewed and accepted by the Architect / Owner / Owner’s Construction Representative.
 2. The building emergency lighting system and other systems including but not limited to those listed below have been tested, completed factory start-up and programming and adjusting as required for a complete and fully operational system acceptable to the Architect and Owner.
 - a. Occupancy Sensor and Lighting Controls
 - b. Surge protective device equipment
 - c. Overcurrent devices
 - d. Motor Controllers
 - e. Emergency Lighting
 - f. Building Fire Alarm System

3.13 LOAD BALANCING

- A. Balance the loads on each low-voltage feeder so that the voltage on each phase is within +/- 1.0% of the average voltage of the three phases. Refer to the DOE Office of Industrial Technologies, “Motor Tip Sheet #7” dated September 2005 available for download to PDF format at no charge at:
http://www1.eere.energy.gov/industry/bestpractices/pdfs/eliminate_voltage_un_balanced_motor-systems7.pdf

END OF SECTION

**SECTION 26 05 05
ELECTRICAL ALTERATIONS PROJECT PROCEDURES**

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Inspection and service of existing equipment and materials to remain or be reused.
- B. Handling of equipment and materials to be abandoned.
- C. Handling of equipment and materials to be removed.

1.2 QUALITY ASSURANCE

- A. Coordination with the Contractor prior to the disconnection or shutdown of existing equipment, or to the modification of existing operational systems.

1.3 CONTRACT DRAWINGS

- A. There is the possibility that there exist conditions and devices that are affected by the work indicated on the drawings and called for in the specifications (project manual) that do not appear on the drawings. It is the Contractors responsibility to visit the site and determine all of the existing conditions and to consider these existing conditions when making and presenting a proposal, to have a complete proposal.

PART 2 – PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Material used to upgrade and repair existing equipment shall conform to that specified.
- B. Material used to upgrade and repair existing equipment shall not void existing warranties or listings of the equipment to be upgraded or repaired.
- C. Material used to upgrade and repair existing equipment shall be new and shall be of the same manufacturer of the existing equipment, shall be acquired through the existing original equipment manufacturer's approved distribution channels, shall have manufacturer's warranties for the new material being used, and shall be listed for the use intended.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Existing materials and equipment indicated on the drawings or in the specifications to be reused shall be inspected for damaged or missing parts. Notify the Architect / Engineer, in writing, accordingly.
- B. If using materials specified or shown on the drawing voids or diminishes the warranty or operation of remaining equipment or systems, the Contractor shall notify the Architect / Engineer, in writing.
- C. Verify field measurements and circuiting arrangements.
- D. Verify that abandoned wiring, panelboards, and switchboards, disconnect switches, and equipment serve only abandoned facilities. Where abandoned wiring, panelboards, switchboards, and equipment which serve existing facilities are to remain, Contractor shall provide means and methods to ensure existing facilities remain energized with the correct voltage, overcurrent protection, conductors, and circuit ampacity required by the existing facilities to remain.
- E. Demolition Drawings are based on casual field observation, and when available, existing record documents. Report discrepancies to Architect before disturbing existing installation, and immediately after such discrepancies are discovered.

3.2 APPLICATION

- A. Existing materials and equipment indicated on the drawings or in the specification to be reused shall be cleaned and reconditioned, including tightening of feeder and bus bar lugs prior to installation and reuse in the modified system.
- B. Remove existing luminaries for alterations/renovations. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. For each luminaire that is taken down for alteration and then reinstalled, replace damaged parts, provide new lamps and, with matching paint, touch-up scratched or abraded areas, and replace cracked, broken or missing lenses or diffusers. Replace unrepairable fixtures with new fixtures.
- C. Material and equipment removed that is not to be salvaged for Owner's use or for reuse on the project shall become the property of the Contractor and shall be removed from the site.
- D. Prior to start of construction, Contractor shall walk areas to be renovated with Owner to identify and document items to be salvaged for Owner's use.
- E. Material or equipment salvaged for Owner's use shall be carefully handled and stored where directed by the Owner.
- F. Materials and equipment not indicated to be removed or abandoned shall be reconnected to the new system.
- G. Clean and repair existing materials and equipment that remain or are to be reused.
- H. Panelboards Reused and Modified for Renovation: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

3.3 SEQUENCING AND SCHEDULING

- A. Coordinate utility service outages with Utility Company, Architect and Owner.
- B. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits use personnel experienced in such operations.
- C. Existing Electrical Service: Refer to drawings for work in remodeled areas. Where facilities in these areas are to remain in service, any related work to keep the facilities in operation is specified in this Division. Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain written permission from Owner at least 10 business days before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area. Disclose the extent, exact time and expected duration of the outage in a written request to the Owner.
- D. Remove and replace existing conduit, wiring, outlets, devices, lighting fixtures, panels and appurtenances as occasioned by new or remodeled construction. Re-establish service to lights, switches and devices that may be interrupted by remodeled construction.
- E. Disconnect electrical systems in walls, floors and ceilings scheduled for removal. When outlets are removed, wire shall be pulled out of the conduit back to the nearest remaining box or cabinet.
 - 1. Remove exposed conduit that has been abandoned.
 - 2. Cap conduit beyond the finish line.
 - 3. Provide unswitched circuit leg for emergency battery powered equipment; circuit from same branch circuit breaker as switched normal lighting circuit.
- F. Where new/existing luminaries or devices are shown being connected to existing circuits:
 - 1. Field verify existing system voltage
 - 2. Provide ballast / device to match system voltage

- G. Verify the loading of each circuit affected by remodeling work. The maximum load of any branch circuit shall not exceed 80% of its rating.
- H. Remove equipment, systems, conductors, wiring, raceways, etc. abandoned or not required for existing or new systems. Coordinate with Architect / Owner for salvage by Owner. Remove abandoned / not required raceways and wiring back to nearest box serving load to remain, or back to panel if not serving remaining load.
- I. Existing Power, and Lighting and Appliance Branch Circuit Distribution System: Maintain existing system in service unless as noted or specified otherwise. Disable system only to make switchovers and connections. Notify Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.
- J. Existing Lighting System: Maintain existing system in service unless as noted or specified otherwise. Disable system only to make switchovers and connections. Notify Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.
- K. Existing Fire Alarm System: Maintain existing system in service. Disable system only to make switchovers and connections. Notify Owner and local fire service at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.
- L. Existing Telephone System: Maintain existing system in service. Disable system only to make switchovers and connections. Notify Owner and Telephone Company at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.
- M. Existing Paging and Sound Reinforcement Systems: Maintain existing system in service. Disable system only to make switchovers and connections. Notify the Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.
- N. Existing Data Network: Maintain existing system in service. Disable system only to make switchovers and connections. Notify the Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.
- O. Existing Video Distribution System: Maintain existing system in service. Disable system only to make switchovers and connections. Notify the Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.
- P. Existing Security System: Maintain existing system in service. Disable system only to make switchovers and connections. Notify the Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.
- Q. Existing Video Surveillance System: Maintain existing system in service. Disable system only to make switchovers and connections. Notify the Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.

3.4 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- 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 materials shall remain the property of the Owner, and shall be delivered to such destination as directed by the Owner's representative unless they are not wanted, then it will be the responsibility of this Contractor to remove such items and properly dispose of

them. 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 approval of the Owner's representative substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.

1. Remove abandoned electrical distribution equipment, utilization equipment, outlets and accessible portions of wiring, raceway systems, and cables back to the source panelboard, switchboard, switchgear, communications closet, or cabinet. Abandoned wiring and raceways can result from actions that include the following:
 - a. Equipment is removed or relocated
 - b. Fixtures are removed or relocated
 - c. System is no longer used
 - d. There is no demonstrable near term future use for the existing circuit or raceway system.
 2. Leave abandoned electrical equipment, conductors, and material in place only if one or more of the following conditions exist:
 - a. The removal requires the demolition of other structures, finishes, or equipment that is still in use. An example is abandoned conduit above an existing plaster ceiling.
 - b. Removal is not feasible due to hazards, construction methods, or restricted access.
 - c. Removal of abandoned conductors may damage conductors that must remain operational.
 3. Remove conduits, including those above accessible ceilings, to the point that building construction, earth, or paving covers them. Cut conduit beneath or flush with building construction or paving. Plug, cap, or seal the remaining unused conduits. Install blank covers for abandoned boxes and enclosures not removed.
 4. Extend existing equipment connections using material and methods compatible with the existing electrical installation and this division.
 5. Restore the original fire rating of floors, walls, and ceilings after electrical demolition.
 6. Use approved lock-out / tag-out procedures to control hazardous energy sources. Assure that an electrically safe work condition exists in the demolition area before beginning demolition. Where possible, disconnect the building from all sources of electrical power before beginning demolition.
- B. All items 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 relocations and to restore them 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.
- C. When items scheduled for relocation and/or reuse are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner's representative 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's representative, at no additional cost to the Owner.
- D. Conduit 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's representative. Conduit 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 Construction Inspector. 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 that must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner's representative hereinbefore specified.

- E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed. Replace existing wiring devices and cover plates with new wiring devices and new cover plates in renovated areas. Any corridor, room, or area indicated to have any new wiring devices installed shall have all of the existing wiring devices and cover plates replaced with new wiring devices and new cover plates.
- F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- G. Disconnect and remove abandoned luminaries. Remove brackets, stems, hangers, and other accessories.
- H. Repair adjacent construction and finishes damaged during demolition and extension work.
- I. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
- J. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.
- K. Existing conduit raceway found to need additional hangers installed and/or junction box covers shall be added at no additional cost to the Owner.
- L. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

3.5 PROTECTION OF THE WORK

- A. Provide adequate temporary support and auxiliary structure as necessary to ensure structural value or integrity of affected portion of work.
- B. Provide devices and methods to protect other portions of work from damage.
- C. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.

3.6 IDENTIFICATION OF EQUIPMENT IN RENOVATED AREAS

- A. Identification of Equipment: Provide new, typed panel directory cards (and card holders if needed) for existing panelboards located within the renovated areas. Ring out all new and existing circuits within these panelboards as specified in Section 26 05 00 Electrical General Provisions. Do not include the description "existing". Provide new nameplates for all existing electrical equipment in renovated areas as specified in Section 26 05 00 Electrical General Provisions.

3.7 CORRECTIVE MEASURES FOR DAMAGE DURING CONSTRUCTION IN EXISTING LOW VOLTAGE SYSTEMS

- A. Repairs, equipment replacements, and corrections to low voltage systems due to damage caused by contractor:
 - 1. Notify the Owner immediately of any disruption or damage to any low voltage system.
 - 2. Any disruption or damage to the existing access control system or fire alarm system shall be corrected the same day as the disruption or damage occurred. The

- access control system and fire alarm system shall be tested daily in the presence of the owner prior to the Contractor leaving the job site each day.
3. For each low voltage system a manufacturer certified contractor and certified technicians shall perform corrective measures to each system component that was functional prior to demolition and renovation and found defective or non-functional within 14-days prior to estimated date of substantial completion.
 4. Corrective measures to all low voltage systems to correct components of the low voltage systems found damaged by the contractor shall be completed to the satisfaction of the Owner and Architect / Engineer prior to acceptance of substantial completion at no additional cost to the Owner.

END OF SECTION

SECTION 26 05 10
CONTRACT QUALITY CONTROL

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Contract quality control including workmanship, manufacturer's instructions, mock-ups and demonstrations.

1.2 QUALITY CONTROL PROGRAM

- A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work in accordance with contract documents. Submit a narrative outline of the Quality Control Program or Plan.

1.3 WORKMANSHIP

- A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform work by persons qualified to produce workmanship of specified quality. Persons performing electrical work shall be required to be licensed. There shall be on-site supervision at all times, including punch list work, with that person having a minimum of journeyman license. Helpers, apprentices shall have a minimum of apprentice license.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.
- D. Provide finishes matching approved samples; all exposed finishes shall be approved by the Architect / Engineer. Submit color samples as required.

1.4 MANUFACTURER'S INSTRUCTIONS

- A. Comply with instructions in full detail, including each step in sequence.
- B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.5 MANUFACTURER'S CERTIFICATES

- A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.6 MANUFACTURER'S FIELD SERVICES

- A. When required in individual Specification Sections, manufacturer shall provide manufacturer's qualified personnel to observe:
 - 1. Field conditions
 - 2. Condition of installation
 - 3. Quality of workmanship
 - 4. Start-up of equipment
 - 5. Testing, adjusting, and balancing of equipment
- B. Manufacturer's qualified personnel shall make written report of observations and recommendations to Architect / Engineer.

1.7 MOCKUPS

- 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 where possible.
- D. Perform tests and submit results as specified.

1.8 SCHEDULING OF 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. Demonstrations
- B. Refer to other specification sections for pre-functional checklist for requirements to aid in preparing mock-ups.

PART 2 – PRODUCTS

2.1 EQUIPMENT AND MATERIAL

- A. Comply with recognized National rating and approval agencies as well as all codes and ordinances at the federal, state and city levels.

PART 3 – EXECUTION

3.1 ADJUSTMENTS AND MODIFICATIONS

- A. Contractor shall provide all adjustments and modifications as requested by the manufacturer's qualified personnel at no additional cost to Owner.
- B. Coordination Drawings:
 - 1. Electrical room size and location required and to scale
 - 2. Equipment and accessories, switchgear and piping
 - 3. Indicate clearances and service access.

3.2 ELECTRICAL ACCEPTANCE TESTING

- A. Perform electrical acceptance testing and inspections in accordance with the current edition of the International Electrical Testing Association (NETA), *Acceptance Testing Specification* (ATS).
- B. Perform acceptance testing, inspection, function tests, and calibration to assure that installed electrical systems and components, both Contractor and user-supplied are:
 - 1. Installed in accordance with design documents and manufacturer's instructions.
 - 2. Tested and inspected in accordance with applicable codes and standards (e.g. NFPA 110 and NFPA 111).
 - 3. Ready to be energized.
 - 4. Operational within industry and manufacturer's tolerances.

3.3 INSPECTIONS BY LOCAL AUTHORITY HAVING JURISDICTION (AHJ)

- A. Contractor shall notify design prime consultant and associated Architect / Owner's Construction Manager when he requests an inspection by the AHJ.

3.4 MOCK-UPS

- A. Mock up the light fixture fireproofing for each type of light fixture to be located in fire rated ceilings. Demonstrate that the fire proofing material does not interfere with the mechanical operation of light fixture doors, hinges, or latches.
- B. Mock up a typical classroom, science lab of each type, and computer lab with all wiring devices, all lighting controls, covers plates, rough-in boxes, conduits, MC cables, etc.

Provide all conductors from all wiring devices to above ceiling space to demonstrate conduit or MC Cable routing and conductor fill.

- C. Mock up a typical panelboard backbox with Surge Protective Device (SPD) panelboard extension backbox or SPD device.
- D. Mock up ten feet of cable tray including all supports, hardware and bonding.

END OF SECTION

SECTION 26 05 12
ELECTRICAL SHOP DRAWINGS, COORDINATION DRAWINGS & PRODUCT DATA

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Prepare submittals as required by Division 01 and as outlined below.
- B. Provide individual submittals based on the project specification section number and description and only items specified or required in that specific project specification section.
- C. Submit product data shop drawings only for the following items indicated below when included as part of the project specifications, and for items specifically requested elsewhere in the Contract Drawings and Specifications. Architect / Engineer reserves the right to refuse shop drawings not requested for review, typically for basic materials and commodity off-the-shelf materials, and/or to imply that materials shall be provided as specified without exception.
- D. The term submittal, as used herein, refers to all:
 - 1. Shop Drawings
 - 2. Coordination Drawings
 - 3. Product data
- E. Submittals shall be prepared and produced for:
 - 1. Distribution as specified
 - 2. Inclusion in the Operating and Maintenance Manual, in the related O&M manual section.

1.2 ARCHITECT / ENGINEER REVIEW OF SUBMITTALS

- A. The Architect / Engineer will:
 - 1. Review requested submittals with reasonable promptness. Specific equipment submittal within a materials specification section that may be required to be expedited shall be submitted separately without other submittal items not requiring the same prompt attention.
 - 2. Affix stamp and initials or signature and indicate requirements for resubmittal or exceptions to submittal as submitted.
 - 3. Return submittals to Contractor for distribution or for resubmission.
- B. Review of submittals will not extend to design data reflected in submittals that is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.
- C. Architect / Engineer's review is only for conformance with the design concept of the project and for compliance with the information given in the contract.
 - 1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
 - 2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes, or coordination with the work of other trades.
- D. The review of a separate item as such will not indicate approval of the assembly in which the item functions.

1.3 SUBSTITUTIONS

- A. Do not make requests for product or material substitution employing the procedures of this Section. The procedure for making a formal request for substitution is specified in Division 01.

PART 2 – PRODUCTS

- A. Each individual submittal shall be an individual specific electronic data file with the file name resembling the product specification section number and title. Refer to Division 01 for additional data file format and media requirements.

PART 3 – EXECUTION

3.1 SPECIFICATION COMPLIANCE REVIEW

- A. Do not submit an outline form of compliance, submit a complete copy with the product data.
- B. Mark up a complete copy of the complete specification section for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect / Engineer / Owner (Does Not Comply, Explanation:).
- C. Variances for product or materials typically include updated model numbers or updated versions of the specified product from the same manufacture or an equal or better product from the approved manufactures list. Substitutions from manufacture's not on the approved manufacture's will not be reviewed unless prior approval using one of the procedures for substitutions or changes in the contract documents are followed as required in Division 01.

3.2 COMPOSITE COORDINATION DRAWINGS

- A. Produce a set of composite coordination drawings for above ceiling, below ceiling, and below floor of electrical, mechanical, and technology equipment rooms and equipment yards for review and comment within four (4) weeks of receipt of Owner's official Notice to Proceed. Show coordination of items including but not limited to structural and architectural elements, all mechanical and plumbing piping, ductwork, equipment, electrical conduit, low voltage communications and safety/security systems cabling, cable trays, lighting, electrical switchgear, generators and UPSs, and any public or private building utility services.
 - 1. Prepare the composite plans at one-quarter inch (1/4") equals one-foot scale. Include larger scale sections with vertical elevations of elements as required to confirm coordinate of all elements.
 - 2. For each room containing major electrical switchgear and each outside equipment area with major electrical switchgear and other equipment also include NEC working space, NEC equipment space, and NEC access to NEC working space, and housekeeping pad location and dimensions.
 - 3. Prepare coordination drawings to coordinate installations for efficient use of available space allowing for future additional equipment wherever possible, for proper sequence of installation, and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.
 - 4. Identify field dimensions. Show relation to adjacent or critical features of work or products.
- B. Submit composite coordination shop drawings in plan, elevation and sections, showing receptacles, outlets, electrical and telecommunication devices in casework, cabinetwork and built-in furniture.
 - 1. Verify location of wiring devices and outlets, communication devices and outlets, safety and security devices, and other work specified in this Division.
 - 2. Coordinate with drawing details, site conditions, composite coordination drawings, and millwork other equipment shop drawings prior to installation.
 - 3. Submit coordination and shop drawings prior to rough-in and fabrication.

3.3 EQUIPMENT SHOP DRAWINGS AND PRODUCT DATA

- A. Submittals shall not be combined or bound together with any other material submittal. Do not submit entire product catalogs, submit only specific data sheets indicating required product information and available product options or accessories.
- B. Submittal Specification Information:
 - 1. Every submittal document shall bear the following information as used in the project manual:
 - a. The related specification section number
 - b. The exact specification section title
 - c. Additional identifiers as required in Division 01.
 - 2. Submittals delivered to the Architect / Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been submitted or delivered.
- C. All product options specified shall be clearly indicated on the product data submittal. All options listed on the standard product printed data not clearly identified as either part of or not part of the product data submitted shall become part of the Contract and shall be assumed to be provided with the product submitted.
- D. Mark each copy of standard manufacture's printed data to identify pertinent products, referenced to specification section and article number.
- E. Show reference standards, performance characteristics and capacities; wiring diagrams and controls; component parts; finishes; dimensions and required clearances.
- F. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete or strike through information not applicable.
- G. Submit drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.
- H. Show all dimensions of each item of equipment in its to be installed assembled condition with all components assembled. Include a series of drawings of individual components as necessary for reference.
- I. Identify field dimensions; show relation to adjacent or critical features or work or products.
- J. Submit individually bound shop drawings and product data for the following when specified or provided.
- K. The Fault Current and Overcurrent Device Coordination Analysis shall be submitted prior to other electrical switchgear dependent on the results of the study for specific product selection by the vendor or contractor for compliance with the study.
 - 1. The emergency life safety power system equipment shall be fully coordinated as required by the NEC.
 - 2. The AIC and WCR ratings of all products meet or exceed the available fault current at that equipment's location.
 - 3. Electrical systems other than life safety power systems shall be coordinated as much as practicable while reducing arc flash energy as much as practical.
- L. Required submittals when products are indicated or specified:
 - 1. Fault Current and Overcurrent Device Coordination Analysis. Submit this analysis three (3) weeks prior to any overcurrent device submittal to allow modifications to overcurrent device product selection submittal based on the manufacture's analysis and recommendations at no additional cost to the Owner.
 - 2. Enclosed Switches and Circuit Breakers
 - 3. Enclosed Motor Controllers

4. Panelboards, load centers, and enclosures
5. Wiring devices
6. Lighting fixtures
7. Lighting Controls and Occupancy Sensors
8. Surge Protection Devices
9. Site Lighting Poles, Fixtures, Drivers, and Lamps
10. Electrical controls and time switches
11. Electrical Contactors
12. Motor control centers
13. Transformers
14. Switchboards
15. Metering equipment for energy monitoring and usage
16. Emergency/Standby generator sets and transfer switches
17. Surface Raceways
18. Architectural Dimming Systems
19. Theatrical Lighting Systems
20. Sports Lighting Equipment, Fixtures, Poles

3.4 MANUFACTURERS INSTRUCTIONS

- A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, calibrating, balancing and finishing.

3.5 CONTRACTOR RESPONSIBILITIES

- A. Review, make corrections or annotations for clarification of manufacturer supplied data, stamp and sign submittals prior to transmittal.
- B. Determine and verify:
 1. Field measurements
 2. Field construction criteria
 3. Manufacturer's catalog numbers
 4. Conformance with the Contract Documents
- C. Coordinate submittals with requirements of the work and of the Contract Documents.
- D. Notify the Architect / Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.
- E. Do not fabricate products, or begin work for which submittals are required, until such submittals have been produced and bear contractor's stamp of acceptance or approval. Do not fabricate products or begin work until return of reviewed submittals with Architect / Engineer's acceptance.
- F. Contractor's responsibility for errors, omissions, or un-approved substitutions in submittals is not relieved whether Architect / Engineer reviews submittals or not.
- G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect / Engineer reviews submittals or not, unless Architect / Engineer gives written acceptance of the specific deviations identified by the Contractor on reviewed documents.
- H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
 1. Proper sizes and capacities
 2. That the item will fit in the available space in a manner that will allow proper service; manufacture's and code required clearances.
 3. Construction methods, materials and finishes
- I. Schedule submissions at least 15 days before date reviewed submittals will be needed by the Contractor for processing or for making corrections for re-submittal.

- J. General and Electrical Contractor's Stamp of Approval
1. The general contractor and the electrical contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
 2. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect / Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.
 3. Do not deliver any submittals to the Architect / Engineer that do not bear the Contractor's stamp of approval and signature.
 4. Submittals delivered to the Architect / Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

3.6 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor. Product and equipment related to site work or other trades which require extensive rough-in, foundations, or structural support shall be submitted as soon as possible after given notice to proceed with construction.
- B. Number of submittals required:
1. Coordination Drawings: Submit one electronic data file (pdf) and three opaque reproductions or coordination drawings.
 2. Product Data: Submit electronic data PDF files. Refer to Division 01 for specific requirements. PDF files that are 20MB or larger may indicate that a submittal includes information not specifically relevant to the specific product being provided, information not required for the review of the specific product such as a complete product catalog or catalog section. Contractor shall include only the product data required to review the specific products characteristics for compliance with the contract documents.
- C. Accompany submittals with transmittal letter containing:
1. Date
 2. Project title and number
 3. Contractor's name, address and contact information.
 4. The number of each Shop Drawing, Project Datum and Sample submitted
 5. Other pertinent data as required in Division 01.
- D. Submittals shall include:
1. The date of submission
 2. The project title and number
 3. Contract Identification
 4. The names of:
 - a. Contractor
 - b. Subcontractor
 - c. Supplier
 - d. Manufacturer
 5. Identification of the product
 6. Field dimensions, clearly identified as such
 7. Relation to adjacent or critical features of the work or materials

8. Applicable standards
 9. Identification of deviations from contract documents
 10. Suitable blank space for General Contractor and Architect / Engineer stamps
 11. Contractor's signed and dated Stamp of Approval.
- E. Coordinate submittals into logical groupings to facilitate interrelation of the several items.
1. Finishes which involve Architect / Engineer selection of colors, textures or patterns
 2. Associated items requiring correlation for efficient function or for installation

3.7 RESUBMISSION REQUIREMENTS

- A. Make resubmittals under procedures specified for initial submittals. Re-submittals shall be a complete submittal as if it were the initial submittal unless otherwise instructed in the review comments on the original submittal.
1. Indicate that the document or sample is a resubmittal
 2. Identify changes made since previous submittals
- B. Indicate any additional changes which have been made by the contractor other than those requested by the Architect / Engineer.

END OF SECTION

SECTION 26 05 19
CONDUCTORS AND CONNECTORS – 600 VOLT

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Provide electrical conductors, wire and connector work as shown and specified manufactured in the USA.
- B. Types: The types of conductors and connectors required for the project include the following:
 - 1. 600V building conductors
 - 2. 600V building conductor connectors
 - 3. 600V 2-hour fire rated power cable
- C. Application: The applications for conductors and connectors required on the project are as follows:
 - 1. Power distribution circuitry
 - 2. Lighting branch circuitry
 - 3. Appliance, receptacle, and equipment branch circuitry
 - 4. Motor branch circuitry
 - 5. Control wiring
 - 6. Line voltage
- D. Refer to other specific specification sections for voice, video, data, alarm and instrumentation cables.

1.2 QUALITY ASSURANCE

- A. UL Label: Conductors and connectors shall be UL labeled.

1.3 REFERENCES

- A. Refer to other specific specification sections regarding specialized wiring and connections.

PART 2 – PRODUCTS – Provide products manufactured in the USA

2.1 CONDUCTORS AND CONNECTORS

- A. General: Except as indicated, provide conductors and connectors of manufacturer's standard materials, as indicated by published product information, designed and constructed as instructed by the manufacturer, and as required for the installation.
- B. Conductors: Provide factory-fabricated conductors of the size, rating, material, and type as indicated for each use. Conductors shall be soft or annealed copper wires meeting, before stranding, the requirements of ASTM B 3, Standard Specification for Soft or Annealed Copper Wire for Electrical Purposes, latest edition.
 - 1. Conductors for control wiring sized #14 AWG through #10 AWG shall be stranded.
 - 2. Conductors for power and lighting shall be stranded. Stranding shall be Class B meeting the requirements of ASTM B 8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, or Soft.
- C. Insulation for standard building conductors: Insulation shall meet or exceed the requirements of UL 83, Standard for Thermoplastic Insulated Wires.
 - 1. All wiring inside lighting fixtures shall be temperature rated per NEC.
 - 2. Insulation for copper conductors shall be UL Type THHN/THWN, 90 degrees C.
- D. Insulation for 2-hour fire rated power cables: Insulation shall meet or exceed the requirements of UL 2196 Fire Test for Electrical Circuit Protection Systems, and UL 44, Standards for Fire Resistive Cable. Conductor ampacity shall be based on 75C.

Combination UL Type insulation types are permissible where the required UL Type is part of the combination UL listing.

1. Conductors installed underground: Insulation for underground fire rated conductors shall be wet location, UL Type RHW 75 degrees C, or UL RHW-2 90 degrees C.
 2. Conductors installed above ground: Insulation for above ground fire rated conductors shall be UL Type RHH 90C or RHW 75C or UL RHW-2 90C.
 3. Electrical Circuit Protective Systems (FHIT) – System 27 of the UL Fire Resistance Directory
- E. Cable Lubricant: Fire resistant, nonflammable, water-based type for standard building conductors. Provide cable lubricants for fire rated cables as recommended by the cable manufacturer.

2.2 COLOR CODES FOR CONDUCTORS FOR BRANCH CIRCUITS AND FEEDERS

- A. Color coding for conductors as required by NEC 210.5. Color coding for phase and voltage shall be as required by local codes and local standards. Where such standards do not exist, color coding shall be as follows:

Color Code Table	USE CONTINUOUS COLOR-CODED INSULATION THROUGHOUT					
System/ Phase	A	B	C	N	G	IG
120/208 3 Ph	Black	Red	Blue	White	Green	Green/Yellow Stripe
120/240 3 Ph	Black	Orange	Blue	White	Green	Green/Yellow Stripe
120/240 1 Ph	Black	N/A	Blue			
277/480	Brown	Purple	Yellow	Gray	Green	Green/Yellow Stripe

Notes to Color Code Table:

1. 120/208, 120/240, and 277/480 Volt Systems shall be routed in separate raceways.
2. Switched legs of phase conductors for lighting and appliance branch circuits shall be of the same color as described above throughout the entire circuit.
3. Conductors shall be the same color from breaker to device or outlet.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General: Install electrical conductors and connectors as shown, in accordance with the manufacturer's written instructions, the requirements of NEC, the NECA Standard of Installation, and industry practices.
- B. Coordination: Coordinate conductor installation work with electrical raceway and equipment installation work, as necessary for interface.
- C. Conductors:
1. Provide a grounded (neutral) conductor for each branch circuit. Do not share grounded (neutral) conductors.
 2. No more than six phase conductors shall be installed in a single raceway. Any combination of phase conductors and grounded (neutral) conductors in any raceway shall not exceed nine.

3. When any combination of four or more phase and grounded (neutral) conductors are installed in a raceway, the minimum size for all conductors including equipment ground conductor shall be #10 AWG, and they shall be de-rated accordingly.
4. When more than four (4) conductors are size #10 AWG, they shall be installed in a one-inch conduit.
5. Pull conductors together when more than one is being installed in a raceway. Whenever possible, pull conductors into their respective conduits by hand. Use pulling lubricant when necessary.
6. Before any conductor is pulled into any conduit, thoroughly swab the conduit to remove foreign material and to permit the wire to be pulled into a clean, dry conduit.
7. Run feeders their entire length in continuous section without joints or splices.
8. No wire smaller than #12 AWG shall be permitted for any lighting or power circuit. No wire smaller than #14 AWG shall be used for any control circuit, unless shown otherwise.
9. Provide the same size wire from the panelboard to last outlet on circuit. For 20 amp branch circuits operating at 150V or less, provide #10 AWG wire when the first outlet is over 75-feet from the panelboard. For branch circuits operating at 150 to 600 volts, provide #10 AWG wire when the first outlet is over 150-feet from the panelboard.
10. Branch circuit voltage drop shall not exceed 3% of rated voltage.
 - a. Total voltage drop from the point of service to the last outlet or utilization equipment of the same voltage shall not exceed five-percent of rated voltage.
 - b. Total voltage drop from the point of service to transformers with adjustable taps, buck-boost transformers, uninterruptable power supplies (UPS), or voltage regulators shall not exceed five-percent of rated voltage.
 - c. Total voltage drop from a separately derived system, transformer with adjustable taps, buck-boost transformer, uninterruptable power supply (UPS), or voltage regulator to the last outlet or utilization equipment of the same voltage shall not exceed five-percent of rated voltage.
 - d. Total voltage drop from the point of service to distribution equipment of the same voltage shall not exceed two-percent of rated voltage.
 - e. Branch circuit voltage drop from distribution equipment to the last outlet or utilization equipment shall not exceed three-percent of rated voltage.
 - f. Provide the same size branch circuit conductors to last outlet on circuit unless specifically noted or indicated otherwise on the drawings. For 20 amp branch circuits operating at 150-Volts or less, provide #10 AWG wire when the first outlet is over 75-feet from the panelboard. For branch circuits operating above 150-Volts to 600-Volts, provide #10 AWG wire when the first outlet is over 150-feet from the panelboard.
11. No tap or splice shall be made in any conductor except in outlet boxes, pull boxes, junction boxes, splice boxes, or other accessible locations. Make taps and splices using an approved compression connector. Insulate taps and splices equal to the adjoining conductor. Make splices or taps only on conductors that are a component part of a single circuit, protected by approved methods. Taps or splices in feed through branch circuits for connection to light switches or receptacles shall be made by pigtail connection to the device.
12. Support conductors in vertical raceways, as required by the NEC.

13. Do not permit conductors entering or leaving a junction or pull box to deflect to create pressure on the conductor insulation.
 14. Make joints in branch circuits only where circuits divide. These shall consist of one through circuit to which the branch from the circuit shall be spliced.
 15. Make connections in conductors up to a maximum of one #6 AWG wire with two #8 AWG wires using twist-on pressure connectors of required size.
 16. Make connections in conductors or combinations of conductors larger than specified using cable fittings of type and size required for specific duty.
 17. After a splice is made, insulate entire assembly with UL-approved insulating tape to a value equivalent to the adjacent insulation.
 18. Make splices and connections in control circuit conductors using UL-approved solderless crimp connectors.
 19. All conduits shall be installed with an insulated grounding conductor per NEC 250.122. Where green conductor insulation is not available, the ground conductor shall be identified with green phasing tape at all accessible locations.
 20. Neatly train and lace wiring inside boxes, equipment and panelboards. Provide tie-straps around conductors with their shared neutral conductor where there are more than two neutral conductors in a conduit.
 21. Clean conductor surfaces before installing lugs and connectors.
 22. Make splices, taps and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 23. Provide stranded conductors connected with pressure type connectors / compression fittings and terminal lugs UL listed for the type of conductor used (AL-CU) and correctly sized to the diameter of the bare conductors.
 24. Run mains and feeders their entire length in continuous pieces without splices or joints.
 25. Color code conductors.
 26. Do not install a pull string in conduits containing conductors.
 27. Conductors shall be the same color from load side of overcurrent protection device to outlet or utilization equipment.
 28. Spare conductors shall not be installed in any conduit, gutter, raceway, panel or enclosure unless noted otherwise.
- D. Two-hour fire rated cable:
1. Two-hour fire rated power cable shall be installed per manufacturer's installation instructions in compliance with UL Fire Resistance Directory, Electrical Circuit Protective Systems (FHIT), and System 27.
 2. Two-hour fire rated power cable shall be installed in rigid steel EMT or rigid steel galvanized conduit (RGC) with steel fittings. Provide fire rated sealant to the end of the raceway to prevent gases from migrating from the fire rated cable into the equipment.
 3. Provide two-hour rated cable where conduit or cables enters or passes through the building envelope at areas or rooms that are not two-hour rated equipment rooms for the following:
 - a. Fire Pump feeders.
 - b. Emergency Feeders (Life Safety) as defined by NFPA Article 700.
 - c. Legally required level one standby systems as defined by NFPA 110 and NFPA Article 701. These systems include but are not limited to those used to aid firefighting and rescue operations, smoke removal systems, and elevators designated for ADA and/or fire rescue operations.
 4. Alternate two hour rated feeder conductor sizes may be substituted for the

required conductor ampacity, voltage drop, or equipment lug terminations based on two-hour fire rated conductor standard size availability or provided equipment manufacturer's cable terminations. The substituted conductor ampacity shall meet or exceed the specified cable ampacity and exceed the required equipment minimum circuit ampacity. Provide substitutions and the required conduit sets and sizes as required for the substitutions at no additional cost to the Owner.

- E. Identification: Label each phase conductor in each junction box with corresponding circuit number, using self-adhesive wire markers.
- F. Splices and Joints:
 - 1. In accordance with UL 486A, C, D, E, and NEC.
 - 2. Aboveground Circuits (No. 10 AWG and smaller):
 - a. Connectors: Solderless, screw-on, reusable pressure cable type, rated 600 V, 220° F, with integral insulation, approved for copper and aluminum conductors. Push-in type connectors are prohibited.
 - b. The integral insulator shall have a skirt to completely cover the stripped wires.
 - c. The number, size, and combination of conductors, as listed on the manufacturers' packaging, shall be strictly followed.
 - 3. Motor connections:
 - a. All AHU motors connections shall be split bolt connectors.
 - b. All non-AHU motors 10 HP and larger shall be split bolt connectors.
 - c. All non-AHU motors less than 10 HP shall be split bolt connectors or as recommended by the manufacturer.
- G. Aboveground Circuits (No. 8 AWG and larger):
 - 1. Connectors shall be indent, hex screw, or bolt clamp type of high conductivity and corrosion resistant material, listed for use with copper and aluminum conductors.
 - 2. Provide field-installed compression connectors for cable sizes 250 kcmil and larger with not less than two clamping elements or compression indents per wire.
 - 3. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Splice and joint insulation level shall be not less than the insulation level of the conductors being joined.
 - 4. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.
- H. Underground Branch Circuits and Feeders:
 - 1. Submersible connectors in accordance with UL 486D, rated 600 V, 190°F, with integral insulation.

3.2 TESTING

- A. Pre-Energization Check: Before energizing, check cable and conductors for circuit continuity and short circuits. Correct malfunctions.
- B. Service Entrance and Feeder Insulation Resistance Test: Each main service entrance conductor and each feeder conductor shall have its insulation resistance tested after the installation is complete except for connection at its source and point of termination. Testing shall be performed by qualified technicians who have been trained in testing procedures and in the use of all test equipment.
 - 1. Make tests using a Biddle Megger or equivalent test instrument at a voltage of not less than 1000 VDC; measure resistance from conductor to conductor, conductor to neutral (if present) and from conductor to ground. Insulation resistance shall not be less than the following:

Wire Size (AWG)	Insulation Resistance (Ohms)
#8	250 K
#6 through #2	100 K
#1 through #4/0	50 K
Larger than #4/0	25 K

2. Conductors that do not meet or exceed the insulation resistance values listed above shall be removed, replaced, and retested.
- C. Submittals: Contractor shall furnish instruments and personnel required for tests. Submit 4 copies of certified test results to Architect for review. Test reports shall include conductor tested, date and time of test, relative humidity, temperature, and weather conditions.
 - D. Voltage and Current Values: The voltage and current in each conductor shall be measured and recorded after connections have been made and the conductor is under load.

SAMPLE DC HIGH VOLTAGE CABLE TEST REPORT
(Specification Paragraph 3.2, C)

Date _____

Contract and Work Location: ____
Contract (Project) No.: _
Circuit Identification: __
(Dwg., Title, Number and Ckt. Number)

Test Equipment: _____
(Make, Model, Serial No., Etc.)
Applied Test Voltage _____
Normal Oper. Voltage _____
Cable Installation: New _____ Used _____
(Date) (No. Years)
Cable Size _____ AWG
Cable Length _____ Ft.
Cable Material _____ Cu _____ AI
Temperature _____ Humidity _____

TEST DATA - RESISTANCE IN KILO OHMS

CONDUCTOR PER PHASE	A-N	B-N	C-N	A-G	B-G	C-G	A-B	B-C	A-C

END OF SECTION

SECTION 26 05 26
ELECTRICAL GROUNDING

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Grounding shall conform to the requirements of:
 - 1. National Electrical Code.
 - 2. Governing local codes.
 - 3. All Local Utility Companies
- B. Ground effectively and permanently.
 - 1. Neutral conductor at the main service disconnect and other separately derived systems.
 - 2. All conduit systems.
 - 3. All electrical equipment and related current carrying supports or structures.
 - 4. All metal piping systems.
 - 5. All building structural metal frames.
 - 6. All telephone/voice/video/CATV/data utilities

1.2 REFERENCE STANDARDS

- A. ANSI/IEEE Standard 142 - "Recommended Practice for Grounding of Industrial and Commercial Power Systems."
- B. ANSI/UL 467 - "Safety Standard for Grounding and Bonding Equipment."
- C. Article 250 of the NEC (NFPA 70) for grounding.
- D. NECA – Standard of Installation
- E. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems
- F. EIA / TIA 607

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Copperweld
- B. nVent ERICO
- C. Burndy
- D. O. Z Gedney
- E. Eaton

2.2 GROUNDING ELECTRODES

- A. Driven Rod Electrode
 - 1. 3/4" x 10'-0" copper clad grounding electrode.
 - 2. UL listed.
 - 3. Approved thermal fusion connector methods (exothermic).
- B. Metal frame of building or enclosure.
- C. Foundation concrete encased rebar.

2.3 DATA / VOICE COMMUNICATIONS CLOSET GROUND BAR

- A. MDF closets/head end rooms: Erico Cadweld #B544A028 ground bar with 7/16-inch holes.
- B. IDF closets, Erico Cadweld #B542A004 ground bar with 7/16-inch holes.
- C. Heavy-duty, two bolt type, copper alloy or bronze for grounding and bonding applications, in configurations required for particular installation.

2.4 EXOTHERMIC CONNECTIONS

- A. Exothermic type for underground and structural steel; Cadweld
- B. Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

2.5 WIRE

- A. Stranded, copper cable
- B. Foundation Electrodes: 4/0 AWG
- C. Grounding Electrode Conductor: Size to meet NFPA 70 requirements

PART 3 – EXECUTION

3.1 GROUNDING AND BONDING

- A. In the service equipment, provide a separate (dedicated) ground bus.
 - 1. Bond the ground bus with copper bus bar or cable, of equal or greater current carrying capacity of the service grounding conductor, to the neutral bar.
 - 2. Resistance of neutral to ground shall not exceed 10 Ohms.
 - 3. Connect the electric service grounding electrode conductors to the incoming metal water pipe system (when available, using a suitable ground clamp) and to a supplemental electrode such as a ground rod or ground ring.
 - 4. Provide grounding and bonding at the power company's metering equipment.
 - 5. Provide access and cover for access to the ground grid and removable connections for testing the system.
- B. Connect the grounding electrode conductor between the ground bus and the grounding electrode system.
 - 1. In rigid PVC conduit.
 - 2. Provide thermo fusion connection for each rod ground electrode.
 - a. All rod electrodes shall be located outside the building in non-paved areas where available. Access cover top shall be flush with finish grade or floor.
 - b. Install rod electrodes as required. Install additional rod electrodes as required to achieve specified resistance to ground.
 - c. The minimum distance between driven ground rod electrodes shall be 10'.
 - 3. The total ground resistance shall not exceed 10 Ohms for service entrance grounds and 25 Ohms for equipment grounds.
 - a. Where this condition cannot be obtained with one electrode, install a longer electrode, deep-driven sectional electrodes, or additional grounding electrodes until the required ground resistance is obtained.
- C. Provide an insulated equipment grounding conductor inside all conduits, raceways, surface raceways, gutters and wireways. The ground wire shall be bonded to each box to suitable lug, bus, or bushing. All bonding jumpers shall be routed inside conduit or raceway.
- D. Provide an insulated isolated equipment grounding conductor in addition to the insulated equipment grounding conductor for all isolated grounding feeders, branch circuits, outlets and isolated grounding receptacles.
- E. Provide all conduit terminating in switchgear, transformers, switchboards, panelboards and voice/data outlets with grounding bushings, where required, and ground wire extended to ground bus in equipment. Install grounding bushings where reducing washers are used and concentric and eccentric knock-outs are used.
- F. Main bus and building grounding electrode conductor installation shall be witnessed by the Architect / Engineer.

- G. Provide bonding to meet Regulatory Requirements.
- H. Interface with lightning protection system when lightning protection system is specified.
- I. Locate and install anchors, fasteners, and supports in accordance with NECA "Standard of Installation".
- J. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- K. Do not use spring steel clips and clamps.
- L. Do not use powder-actuated anchors.
- M. Do not drill or cut structural members.
- N. Do not use compression or mechanical connectors underground.
- O. Do not use sheetmetal or self-drilling screws for bonding connections. Provide listed or approved connectors.
- P. Provide grounding access well for each driven ground electrode, not located in manholes or pull boxes.
 - 1. Access well top shall be flush with finish paved surfaces.
 - 2. Ground access wells located in non-paved areas shall be set two-inches above surrounding finished grade. Provide 12-inch wide by 8-inch deep reinforced concrete crown around neck or opening and sloped down away from pull box opening.
 - 3. Provide thermal fusion (exothermic) connectors approved for direct burial.

3.2 METAL FRAME OF BUILDING OR STRUCTURE

- A. Effectively ground the building steel or structure per NEC 250-52 (2).

3.3 UFER GROUND

- A. Provide a UFER ground at bottom of building slab per NEC 250.52 (3), bond to building steel.

3.4 MISCELLANEOUS REQUIREMENTS

- A. Continuity of the equipment grounding system shall be maintained throughout the project. Equipment grounding jumpers shall be installed across conduit expansion fittings, liquid-tight flexible metal and flexible metal conduit, and other non-electrically continuous raceway fittings.
- B. Equipment grounding conductors and grounding electrode conductor shall be stranded copper conductors and run in a suitable raceway. Grounding conductors and grounding electrode conductor shall be continuous, without joints or splices over their entire length, except as allowed by NFPA 70/NEC.
- C. For separately derived alternating current system grounds, bond the case and neutral of each transformer secondary winding directly to the nearest available effectively grounded structural metal member as required in NEC 250.
- D. Exterior Electrical Equipment Racks:
 - 1. Provide driven ground electrode.
- E. Technology/Data/Voice Communications, CATV, CCTV, and MATV Equipment Grounding: Provide grounding electrode conductor from the communications service equipment to the building grounding system as required. Grounding shall conform to ANSI/TIA/EIA 607(A) – Commercial Building Grounding and Bonding Requirements for Telecommunications, National Electrical Code®, ANSI/NECA/BICSI-568 and manufacturer's grounding requirements as minimum. Bonding shall be of low impedance to assure electrical continuity between bonded elements.
 - 1. MDF Closets Telecommunications Main Ground Bar (TMGB): Provide Erico #EGBA14424MM ground bar, wall mounted to the telecommunications plywood backboard. Provide one #3 AWG insulated ground conductor from ground bar to

- building steel. Provide #2/0 AWG insulated ground conductor to the building electrical service ground at the nearest electrical switchboard or panelboard.
2. IDF Closets Telecommunications Ground Bar (TGB): Provide Erico #EGBA14410FF ground bar mounted to the telecommunications plywood backboard. Provide one #6 AWG insulated ground conductor from ground bar to building steel and to ground bus of nearest electrical panelboard or switchboard.
 3. Provide #2/0 AWG insulated ground conductor between each TMGB and all TGBs.
 4. Provide #2/0 AWG insulated ground conductor from TMGB to electrical service ground bus at main electrical service switch.
 5. Bond each equipment rack, cabinets, frames, together and with #6 AWG insulated ground conductor to the local TMGB / TGB. Bond and ground equipment racks, housings, messenger cables, raceways, and rack-mounted conduit.
 6. Route TMGB – TGB ground conductor using the shortest, straightest, route practical with long radius curves.
 7. All conduits terminating to cable trays, wireways, and racks shall be mechanically fastened. When connected to a cable tray or rack, it must be connected with ground bushings, wire bonded to the tray or rack, and grounded to the main building grounding system or IDF room grounding bar using #6 AWG copper.
- F. Ground lighting fixture bodies to the conduit grounding system.
- G. Bond receptacle ground to the box and conduit ground system, except where and insulated/isolated grounding receptacle or outlet is specified.
- H. Ground connections to building steel, grounding electrodes and all underground connections shall be by thermal fusion (exothermic).
- I. Provide OZ Type “BJ” bonding jumper at all expansion joints, points of electrical discontinuity or connections in conduit where firm mechanical bond is not possible, such as flexible connections, insulating couplings, etc.
- J. Ground each lighting and power panelboard by connecting the grounding conductors to the grounding stud.
- K. Ground each secondary dry-type transformer to the ground bus of the primary side panelboard. Provide a bonding jumper between the ground stud and the neutral. Ground transformer ground stud to ground ring if a ground ring is installed or the nearest structural steel member.
- L. Bond every item of equipment served by the electrical system to the building equipment ground system. This includes, but is not limited to, switchboards, panelboards, disconnect switches, receptacles, cable trays, controls, fans, air handling units, pumps and flexible duct connections.
- M. Ground each light pole, power distribution poles, and metal conduit stub-ups at each light pole base.
- N. Ground all metal conduit including metal conduit used for bends and penetrations through concrete.
- O. Bond hot water and cold water piping together at each domestic water heater.

3.5 MANHOLE AND/OR PULL BOX GROUNDING

- A. Provide a driven ground rod and ground bond ring in each power and telephone manhole or pull box. Bond cable racks and medium voltage cable shields at splices and terminations, ductbank conduit ground bushings and all other metal components in manholes or pull box to the ground ring.

3.6 COORDINATION

- A. General: Coordinate installation of grounding connections for equipment with equipment installation work.

3.7 TESTING

- A. Ground Resistance Test: Perform a ground resistance test for comparison to future inspection and testing data by the Owner. Test shall be performed using a Biddle Megger Earth Tester or equivalent test instrument. The test shall not be performed within 48 hours after the last rainfall.
 - 1. Inspect and test in accordance with NETA ATS except Section 4
 - 2. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13
- B. True Root Mean Square (RMS) AC measurements: The True RMS AC Measure test should be performed for all bonding conductors. The recommended maximum AC current value on any bonding conductor should be less than 1 ampere (A). The recommended maximum DC current value should be less than 500 milliamperes (mA). If abnormally high AC current levels are present on any bonding conductor, a dangerous faulty wiring condition likely exists within the room.
- C. Two-Point Bonding Measurements: The Two-point Bonding test should be performed for all bonding conductors. This test should be performed using an earth grounding resistance tester configured for a continuity test. The test is performed by connecting the meter leads between the nearest available grounding electrode (e.g., structural steel) and the TMGB or TGB. The recommended maximum value for the bonding resistance between these two points is 0.1 Ohms (100 milliohms).
- D. Submittals: Furnish instruments and personnel required for tests. Personnel shall be trained in all aspects of testing grounding systems and shall be formally trained on using all test equipment required. Submit 2 copies of certified test results for Owner's record and submit 4 copies of certified test results to Architect / Engineer for review. Test reports shall include date and time of tests, relative humidity, temperature, and weather conditions.

END OF SECTION

SECTION 26 05 27
EXPANSION OF EXISTING ELECTRICAL GROUNDING SYSTEM

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Grounding shall conform to the requirements of:
 - 1. National Electrical Code
 - 2. Governing local codes
 - 3. Local Utility Company
- B. Ground effectively and permanently.
 - 1. Verify existing neutral conductor bonding at the main service disconnect and at other new/relocated or reused separately derived systems.
 - 2. All new/relocated conduit or cable tray systems and busway
 - 3. All new/relocated electrical equipment and related current carrying supports or structures
 - 4. All new / relocated metal piping systems
 - 5. All new building structural metal frames

1.2 REFERENCE STANDARDS

- A. ANSI/IEEE Standard 142 - "Recommended Practice for Grounding of Industrial and Commercial Power Systems."
- B. ANSI/UL 467 - "Safety Standard for Grounding and Bonding Equipment."
- C. Article 250 of the NEC (NFPA 70) for grounding.
- D. NECA – Standard of Installation
- E. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems
- F. EIA / TIA 607

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Copperweld
- B. nVent ERICO
- C. Burndy
- D. O.Z. Gedney
- E. Eaton

2.2 GROUNDING ELECTRODES

- A. Driven Rod Electrode
 - 1. 3/4" x 10'-0" copper clad grounding electrode, UL listed
 - 2. UL listed grounding electrode connector
 - 3. Approved thermal fusion methods (exothermic)
- B. Metal Frame of Building
- C. Existing grounding electrode system

2.3 DRIVEN ELECTRODE ACCESS BOX AND COVER

- A. Hubbell Tier 22 FRP 20-inch round bolt down cover with "GROUND" embossed on top.

2.4 MATERIALS AND COMPONENTS

- A. Reference other sections of this specifications for materials specified there.
- B. Heavy-duty, copper, two bolt type, copper alloy or bronze compression lugs for grounding and bonding applications, in configurations required for particular installation.

PART 3 – EXECUTION

3.1 SYSTEMS 600 VOLTS OR LESS

- A. In the existing service equipment, field verify existing condition of ground bus.
 - 1. Field verify existing bond of the ground bus to the existing service grounding conductor, to the neutral bar.
 - 2. Tighten existing ground lugs and connections.
- B. Connect the grounding electrode conductor between the ground bus and the grounding electrode system.
 - 1. In rigid PVC conduit.
 - 2. Provide thermo fusion connection for each rod ground electrode.
 - a. All rod electrodes shall be located outside the building in non-paved areas where available. Access cover top shall be flush with finish grade or floor.
 - b. Install rod electrodes as indicated. Install additional rod electrodes as required to achieve specified resistance to ground.
 - c. The minimum distance between driven ground rod electrodes shall be 10'.
 - 3. The total ground resistance shall not exceed 10 Ohms for service entrance grounds and for equipment grounds.
 - a. Where this condition cannot be obtained with one electrode, install a longer electrode, deep-driven sectional electrodes, or additional grounding electrodes until the required ground resistance is obtained.
 - b. Refer to drawings for project specific ground resistance requirements.
- C. Field verify the grounding electrode conductor between the ground bus and the grounding electrode systems are in compliance with the NEC.
- D. Provide an insulated grounding conductor inside all new conduits, raceways, surface raceways and cables used for power distribution. The ground wire shall be bonded to each box. All bonding jumpers shall be routed inside conduit or raceway.
- E. Provide an insulated, isolated equipment grounding conductor in addition to the insulated equipment grounding conductor for all isolated grounding feeders, branch circuits, outlets and receptacles.
- F. Provide all new/relocated conduits terminating in switchgear, transformers, switchboards, and panelboards with grounding bushings, where required and ground wire extended to ground bus in equipment.
- G. Where modifications to the main service disconnect are required, main bus and building grounding electrode conductor installation shall be witnessed by the Architect / Engineer.
- H. Interface with lightning protection system when lightning protection system is specified.
- I. Locate and install anchors, fasteners, and supports in accordance with NECA “Standard of Installation”.
- J. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- K. Do not use spring steel clips and clamps.
- L. Do not use powder-actuated anchors.
- M. Do not drill or cut structural members.
- N. Do not use compression or mechanical connectors underground.

3.2 SYSTEMS OVER 600 VOLTS

- A. Provide insulated grounding bushings at each new/relocated conduit termination. The grounding system shall be made continuous with bare copper jumpers.
 - 1. Connect the copper grounding jumpers to the ground bus in the equipment.
- B. Install a grounding conductor in each conduit.

1. 600 V code gauge Type XHHW.
 2. Green insulation.
- C. Connect the grounding conductor to:
1. Each new/relocated/reused splice or pull box enclosure.
 2. Each new/relocated/reused transformer enclosure.
 3. All new/relocated/reused primary switchgear enclosures.

3.3 MISCELLANEOUS REQUIREMENTS

- A. Continuity of the building equipment grounding system shall be maintained throughout the project. Grounding jumpers shall be inside conduit, fittings and boxes and shall be installed across conduit expansion fittings, liquid-tight flexible metal and flexible metal conduit, light fixture pigtails in excess of 6', and other non-electrically continuous raceway fittings.
- B. Grounding conductors and grounding electrode conductor shall be stranded copper conductors and run in a suitable PVC raceway. Grounding conductors and grounding electrode conductor shall be continuous, without joints or splices over their entire length, except as allowed by NFPA 70/NEC.
- C. For separately derived alternating current system grounds, bond the case and neutral of each transformer secondary winding directly to the nearest available effectively grounded structural metal member as required in NEC 250.
- D. Technology/Data/Voice Communications, CATV, CCTV, and MATV Equipment Grounding: Provide grounding electrode conductor from the communications service equipment to the building grounding system as required. Provide #6 ground conductor from telephone/voice/CATV/data company demarcation point to building electrical service entrance ground electrode connection and as required by all local utility companies.
1. New MDF Closets Telecommunications Main Ground Bar (TMGB): Provide Erico Cadweld #B544A028 ground bar with 7/16-inch holes, wall mounted to the telecommunications plywood backboard. Provide one #3 AWG insulated ground conductor from ground bar to building steel. Provide #2/0 AWG insulated ground conductor to the building electrical service ground at the main electrical service disconnect.
 2. New IDF Closets Telecommunications Ground Bar (TGB): Provide Erico Cadweld #B542A004 ground bar with 7/16-inch holes, mounted to the telecommunications plywood backboard. Provide one #6 AWG insulated ground conductor from ground bar to building steel.
 3. Provide #2/0 AWG insulated ground conductor between each TMGB and all TGBs.
 4. Provide #2/0 AWG insulated ground conductor from TMGB to electrical service ground bus at main electrical service switch.
 5. Bond each equipment rack with #6 AWG insulated ground conductor to the TMGB / TGB.
 6. Route TMGB – TGB ground conductor using the shortest route practical with long radius curves.
- E. Ground new and removed/replaced lighting fixture bodies to the conduit grounding system.
- F. Receptacles: Provide a ground wire bonded to the conduit ground system, except where and insulated isolated grounding receptacle is specified.
- G. Motor Frames: Ground the frame of each motor with a properly sized separate ground wire around flexible conduit.
- H. Provide grounding access well for each driven ground electrode, not located in manholes

or pull boxes.

1. Access well top shall be flush with finish paved surfaces.
 2. Ground access wells located in non-paved areas shall be set two-inches above surrounding finished grade. Provide 12-inch wide by 8-inch deep reinforced concrete crown around neck or opening and sloped down away from pull box opening.
 3. Provide thermal fusion (exothermic) connectors approved for direct burial.
- I. Ground all light poles and all exterior metal structures supporting conduit, switchgear, or light fixtures.
- J. Exterior Electrical Equipment Racks:
1. Provide driven ground electrode for racks mounted remote from building structure.
 2. Where mounted on roof, ground to be building structural steel.
- K. Ground connections to building steel, grounding electrodes and all underground connections shall be by thermal fusion (exothermic).
- L. Transformers: Provide driven ground electrode and building steel electrode at each transformer.
- M. Bond hot water and cold water piping together at each domestic water heater.

3.4 COORDINATION

- A. General: Coordinate installation of grounding connections for equipment with equipment installation work.

3.5 TESTING

- A. Ground Resistance Test: Perform a ground resistance test for comparison to future inspection and testing data by the Owner. Test shall be performed using a Biddle Megger Earth Tester or equivalent test instrument. The test shall not be performed within 48 hours after the last rainfall.
1. Inspect and test in accordance with NETA ATS except Section 4
 2. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13
- B. The Root Mean Square (RMS) AC measurements: The True RMS AC Measure test should be performed for all bonding conductors. The recommended maximum AC current value on any bonding conductor should be less than 1 ampere (A). The recommended maximum DC current value should be less than 500 milliamperes (mA). If abnormally high AC current levels are present on any bonding conductor, a dangerous faulty wiring condition likely exists within the room.
- C. Two-Point Bonding Measurements: The two-Point Bonding test shall be performed for all bonding conductors. This test should be performed using an earth grounding resistance tester configured for a continuity test. The test is performed by connecting the meter leads between the nearest available grounding electrode (e.g., structural steel) and the TMGB or TGB. The recommended maximum value for the bonding resistance between these two points is 0.1 ohms (100 milliohms).
- D. Submittals: Furnish instruments and personnel required for tests. Personnel shall be trained in all aspects of testing grounding systems and shall be formally trained on using all test equipment required. Submit 2 copies of certified test results for Owner's record and submit 4 copies of certified test results to Architect / Engineer for review. Test reports shall include date and time of tests, relative humidity, temperature, and weather conditions.

END OF SECTION

SECTION 26 05 33 CONDUIT SYSTEMS

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Furnish and install a complete system of electrical conduits and fittings.

1.2 REFERENCE STANDARDS

- A. National Electrical Code
- B. Local codes and ordinances
- C. UL
- D. ETL

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS – Provide products manufactured in the USA

- A. Raceways:
 - 1. Allied, International Metal Hose, Ipex, Heritage Plastics, Wheatland, Can-Tex, Carlon, Certain-Teed, Anamet, Inc., Electri-Flex Co., Western Tube and Conduit.
 - 2. PVC Coated RGC: Robroy Perma Cote, Robroy Plasti-Bond, or Calbond – no exceptions
 - 3. Stainless Steel: Robroy, Calbrite, Gibson
 - 4. Aluminum: Penn Aluminum, American Conduit, Wheatland, Eaton B-Line, Patriot Aluminum Products
- B. Fittings:
 - 1. Appleton, Crouse Hinds, Topaz, Steel City, O.Z. Gedney, Carlon, Heritage Plastics, Raco, Ipex, International Metal Hose, Lew Electric Fittings Co.
 - 2. PVC Coated ferrous fittings: Robroy Perma Cote, Robroy Plasti-Bond, or Calbond – no exceptions
 - 3. Stainless Steel: Robroy, Calbrite, Gibson, Crouse Hinds
 - 4. Aluminum: Penn Aluminum, American Conduit, Wheatland, Eaton B-Line, Patriot Aluminum Products
- C. Condulets and Conduit Bodies:
 - 1. Appleton, Form 85
 - 2. PVC Coated: Robroy Perma-cote or Plasti-Bond, – no exceptions
 - 3. Stainless Steel: Robroy, Calbrite, Gibson, Crouse Hinds
- D. Steel MC Cable for light fixture whips:
 - 1. AFC
 - 2. Southwire
 - 3. General Cable
 - 4. Kaf-Tech

2.2 GENERAL

- A. The minimum conduit size shall be ¾-inch unless indicated otherwise in Divisions 26, 27 or 28.
 - 1. Branch Circuits: Minimum conduit size shall be ¾-inch.
 - 2. Feeder Circuits: Minimum conduit size shall be ¾-inches.
 - 3. Technology, telecommunications, and low voltage systems: The minimum conduit size shall be ¾-inches unless noted or indicated otherwise.
 - 4. The minimum conduit size between buildings for technology, voice, data, fire alarm, video, security, surveillance, BMCS, and other telecommunications shall

- be 2-inch unless indicated otherwise.
- B. The minimum conduit size for flexible metallic conduit for tap connections to individual light fixtures shall be ½ inch, or steel metal clad (MC) cable with insulated ground conductor maximum 6 feet.
 - C. Electrical nonmetallic tubing, flexible polyethylene or PVC tubing shall not be used on this project.
 - D. BX and AC cable shall not be used on this project.
 - E. PVC elbows shall not be used on this project.
 - F. Intermediate metal conduit (IMC) shall not be used on this project.

2.3 RIGID METAL CONDUIT

- A. UL labeled, Schedule 40:
 - 1. Mild steel pipe, zinc coated inside and out
 - 2. Aluminum Alloy 6063, T-1 temper
 - 3. Threaded ends
 - 4. Insulated bushings
- B. Fittings shall meet the same requirements as rigid metal conduits.
 - 1. UL labeled
 - 2. Threaded fittings

2.4 ELECTRICAL METALLIC TUBING (EMT)

- A. UL labeled, standard weight:
 - 1. Cold rolled steel tubing, zinc coated inside and out
 - 2. Aluminum Alloy 6005, 6063. Temper T-1
- B. Fittings shall meet the same requirements as EMT conduits.
 - 1. UL labeled
 - 2. Insulated throat connectors
 - 3. Steel fittings with setscrews with lock nuts on threaded ends, no snap locks
 - 4. Cast metal fittings are not approved
 - 5. Uni-couple type connectors are not approved
 - 6. Split ring, anti-short bushings are not approved

2.5 PVC COATED RIGID STEEL WITH URETHANE INTERIOR COATING

- A. The PVC coated galvanized rigid conduit and fittings must be ETL Listed and Verified. The PVC coating must have been investigated and verified by ETL as providing the primary corrosion protection for the rigid metal conduit. Ferrous fittings for general service locations must be ETL Listed with PVC as the primary corrosion protection. Hazardous location fittings, prior to plastic coating must be UL listed for the hazard conditions to which they are to be used. All conduit and fittings must be new, unused material. Applicable UL standards may include UL 6 Standard for Safety, Rigid Metal Conduit, and UL514B Standard for Safety, Fittings for Conduit and Outlet Boxes.
- B. The PVC coated galvanized rigid conduit and fittings must be ETL Verified to the Intertek ETL SEMKO High Temperature H₂O PVC Coating Adhesion Test Procedure for 200 hours. The PVC coated galvanized rigid conduit must bear the ETL Verified PVC-001 label to signify compliance to the adhesion performance standard.
- C. The conduit shall be hot dip galvanized inside and out with hot galvanized threads.
- D. A PVC sleeve extending one pipe diameter or two inches, whichever is less, shall be formed at every female fitting opening except unions. The inside sleeve diameter shall be matched to the outside diameter of the conduit.
- E. The PVC coating on the outside of conduit couplings shall have a series of longitudinal ribs 40 mils in thickness to protect the coating from tool damage during installation.

- F. Form 8 Condulets, ½-inch through 2-inch diameters, shall have a tongue-in-groove gasket to effectively seal against the elements. The design shall be equipped with a positive placement feature to ease and assure proper installation. Certified results confirming seal performance at 15 psig (positive) and 25 inches of mercury (vacuum) for 72 hours shall be available.
- G. Form 8 Condulets shall be supplied with plastic encapsulated stainless-steel cover screws.
- H. A urethane coating shall be uniformly and consistently applied to the interior of all conduit and fittings. This internal coating shall be a nominal 2 mil thickness. Conduit or fittings having areas with thin or no coating shall be unacceptable.
- I. The PVC exterior and urethane interior coatings applied to the conduit shall afford sufficient flexibility to permit field bending without cracking or flaking at temperatures above 30°F (-1°C).
- J. All male threads on conduit, elbows and nipples shall be protected by application of a urethane coating.
- K. All female threads on fittings or conduit couplings shall be protected by application of a urethane coating.
- L. Independent certified test results shall be available to confirm coating adhesion under the following conditions
 1. Conduit and conduit exposure to 150°F (65°C) and 95% relative humidity with a minimum mean time to failure of 30 days. (ASTM D1151)
 2. The interior coating bond shall be confirmed using the Standard Method of Adhesion by Tape Test (ASTM D3359).
 3. No trace of the internal coating shall be visible on a white cloth following six wipes over the coating which has been wetted with acetone (ASTM D1308).
 4. The exterior coating bond shall be confirmed using the methods described in Section 3.8, NEMA RN1. After these tests the physical properties of the exterior coating shall exceed the minimum requirements specified in Table 3.1, NEMA RN1.
- M. Right angle beam clamps and U bolts shall be specially formed and sized to snugly fit the outside diameter of the coated conduit. All U bolts shall be provided with plastic encapsulated nuts that cover the exposed portions of the threads.
- N. All fittings, clamps, straps, struts, and hardware used with PVC coated conduit shall be PVC coated or 316 stainless steel

2.6 STEEL FLEXIBLE CONDUIT

- A. Steel flexible metallic conduit:
 1. Zinc coated inside and out
 2. 18-inches minimum length, 24-inches maximum length
- B. Steel flexible metallic conduit for tap connections to light fixtures where steel MC Cable fixture whips are not used:
 1. 18 inches minimum length; 6 feet maximum length
- C. Liquid tight flexible steel conduit
 1. Type L.A. - Grounded - UL Approved
 2. 18-inches minimum length, 24-inches maximum length

2.7 PVC CONDUIT

- A. UL labeled Schedule 40 and Schedule 80
- B. PVC fittings and solvent welded joints
- C. Acceptable PVC conduit manufacturer: Ipex, Cantex

2.8 CONDULETS AND CONDUIT BODIES

- A. UL Labeled
- B. Form 85
- C. PVC Coated: Form 8
- D. LBC Condulets shall be used for size 2 inch and above.
- E. LL and LR Condulets shall not be used for 2 inch and above

2.9 ROOF MOUNTED CONDUIT AND BOX SUPPORTS

- A. Conduit supports and pads suitable for direct sunlight, conduit size, weight, quantity and roof system with unistrut supports and accessories. Conduit supports shall allow for conduit expansion and contraction.
- B. Refer to roofing specifications for additional information. The limitations and restrictions contained in any roofing specification shall prevail and supercede these specifications for roof mounted supports for conduits and boxes.
- C. Approved Manufacturer:
 - 1. Portable Pipe Hangers
 - 2. Eaton B-Line
 - 3. Miro Industries, Inc.

2.10 ALUMINUM CONDUIT

- A. UL Labeled
- B. Aluminum fittings shall meet the same requirements of aluminum conduits, compatible steel fittings.
 - 1. UL Labeled for use with aluminum conduit.

2.11 STAINLESS STEEL CONDUIT

- A. UL Labeled
- B. Rigid Stainless Steel:
 - 1. Type 304 Stainless Steel
 - 2. Threaded ends
 - 3. Insulated Bushings
- C. EMT:
 - 1. Type 304 Stainless Steel
 - 2. Compression Fittings
 - 3. Insulated Bushings
- D. Fittings, elbows, nipples, strut, device box, clamps straps, etc.
 - 1. Type 304 Stainless Steel

2.12 EXTERIOR IN-GRADE PULL BOXES

- A. Enclosures, boxes and covers are required to conform to all test provisions of the most current American Association of State Highway and Transportation Officials (AASHTO) standards for H-20 loading applications.
 - 1. AASHTO H-20 certified precast concrete, cast iron or other AASHTO recognized materials, rated for deliberate traffic.
 - 2. Conduit entry knock-outs as required
 - 3. Bolt down galvanized steel/cast iron covers
 - 4. Thin wall knocks outs as required
 - 4. Integral bottom
 - 5. Box height as required for specified conduit depth and required top elevation.
 - 6. Concrete design strength of minimum 5,500 PSI at 28-days
 - 7. Place enclosures on a minimum of 6 inches of coarse gravel with a border of 6-inches beyond the enclosures exterior dimension.

8. Size and volume as required for application.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install electrical conduits and fittings for all wiring of any type unless specifically specified or instructed to do otherwise. Install conduits and fittings in accordance with local codes and applicable sections of the NECA “Standard of Installation”, concealed where possible.
 1. Fasten conduit supports to building structure and surfaces; do not support to roof deck.
 2. Arrange supports to prevent misalignment during wiring installation.
 3. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
 4. Do not attach conduit to ceiling support wires.
 5. Arrange conduit to maintain head room and present neat appearance.
 6. Maintain 4-inch clearance between conduit and rooftop surfaces.
 7. Cut conduit square using saw or pipe cutter; de-burr cut ends.
 8. Bring conduit to shoulder of fittings; fasten securely.
 9. Conduit penetrations to all individual motor controllers, VFDs, and motor control cabinets shall only be made at the bottom of the enclosure. For other equipment, provide listed water sealing conduit hubs to fasten conduit to sides or tops of electrical equipment enclosures, device box, gutter, wireway, disconnect, etc.
 10. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
 11. Ground and bond conduit as required.
 12. Identify conduit as required.
 13. Route all conduits above building slab perpendicular or parallel to building lines.
 14. Do not use no-thread couplings and connectors for galvanized steel, PVC coated galvanized steel, or aluminum rigid conduit.
- B. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.
- C. In areas where raceway systems are exposed and acoustical or thermal insulating material is to be installed on walls, partitions, and ceilings, raceways shall be blocked out proper distance to allow insulating material to pass without cutting or fitting. Also provide Kindorf galvanized steel channels to serve as standoffs for panels, cabinets and gutters.
- D. Securely fasten conduits, supports and boxes, to ceiling (not roof deck), walls, with Rawl Plugs or approved equal anchors. Use lead cinch anchors or pressed anchors. Use only cadmium plated or galvanized bolts, screws. Plastic anchors and lead anchors shall not be used for overhead applications.
- E. Provide separate raceway systems for each of the following when specified, indicated or required:
 1. 120/208 volt circuits
 2. 277/480 volt circuits
 3. Emergency
 - a. Life safety branch
 - b. Critical branch
 - c. Equipment branch
 4. Voice/Data
 5. Sound reinforcement
 6. Theatrical and Architectural Dimming Controls
 7. MATV/CATV

8. Security CCTV
 9. Security System
 10. Communications / PA Systems / Sound System Line Input and Speakers
 11. Fire Alarm
 12. Lighting and Building Management Control Systems
- F. Unless shown otherwise, do not install conduit in or below concrete building slabs.
- G. Unless shown otherwise, do not install conduit horizontally in concrete slabs.
- H. Roof penetrations shall be made in adequate time to allow the roofing installer to make proper flashing. Conduit for equipment mounted on roof curbs shall be routed through the roof curb. Conduit, gutters, pull boxes, junction boxes, etc. shall not be routed on roof unless specified otherwise. Where specifically indicated to be routed or mounted on the roof, supports shall be as specified, as recommended by roofing manufacturer and roof support manufacturer and as required by NEC. Place supports every five feet along conduit run and within 3 feet of all bends, condulets, and junction boxes. Provide roofing pad under stands as directed by Architect and as recommended by roofing manufacturer and roof support manufacturer. Provide additional unistrut supports and accessories as required.
- I. PVC coated conduit shall have all nicks and cuts to the protective coating repaired using manufacturer's approved touch-up material as recommended by manufacturer. Provide a minimum of two-wraps of 3M-50 type tape over touch-up.
- J. Installation of the PVC Coated Conduit System shall be performed in accordance with the Manufacturer's Installation Manual. To assure correct installation, the installer shall be certified by Manufacturer to install coated conduit. Submit copies of training certification with submittal. Contractor shall coordinate installation with manufacturer's representative for field training and observation of installed PVC coated rigid galvanized conduit and fittings. Manufacturer's representative shall certify the installation is in accordance with manufacturer's installation instructions. Submit copies of installation certification prior to cover-up of underground installation.
- K. All conduit terminations at locations including but not limited to, switchgear, pull boxes, outlet boxes, stub-up, and stub-outs:
1. Provide insulated throat connectors for EMT conduits.
 2. Provide insulated bushing on all rigid conduit terminations.
 3. Provide locknuts inside and outside of all boxes and enclosures.
 4. Provide threaded type plastic bushing at all boxes and enclosures
- L. In suspended ceilings, support conduit runs from the structure, not the ceiling system construction.
1. Do not support from structural bridging.
 2. Do not support from metal roof deck.
- M. Completely install each conduit run and all bushings prior to pulling conductors. All boxes are to be accessible after completion of construction.
- N. All conduits must be kept dry and free of water or debris with approved pipe plugs or caps. Cap or plug conduit ends prior to concrete pouring.
- O. Ream ends of conduits after cutting and application of cutting die to remove rough edges.
- P. Install all above concrete slab conduits perpendicular or parallel to building lines in the most direct, neat and workmanlike manner.
1. Cable Tension:
 - a. 0.008 lb./cmil for up to 3 conductors, not to exceed 10,000 pounds.
 - b. 0.0064 lb./cmil for more than 3 conductors, not to exceed 10,000 pounds
 - c. 1000 lbs. per basket grip.
 2. Sidewall pressure: 500 lbs./ft.
 3. Conduit runs within the following limits of bends and conduit length between

- pull points shall not exceed the above installation pulling tension and sidewall pressure limits.
- a. Three (3) equivalent 90-degree bends: not more than fifty feet (50') between pull points.
 - b. Two (2) equivalent 90-degree bends: not more than one hundred feet (100') between pull points.
 - c. One (1) equivalent 90-degree bend: not more than one hundred fifty feet (150') between pull points.
 - d. Straight pull: not more than two hundred feet (200') between pull points.
4. Indicate sizes of conduits, wireway sections, and cable tray sections on the as-built drawings.
 5. Hold horizontal and vertical conduits as close as possible to walls, ceilings and other elements of the building construction. Conduits shall be kept a minimum of 6 inches clear of roof deck / insulation, and 2 inches clear of above floor deck / insulation.
 6. Install conduits to conserve building space and not obstruct equipment service space or interfere with use of space. Conduit shall not be routed on floors, paved areas or grade.
 7. Where a piece of equipment is wired from a switch or box on adjacent wall, the wiring shall go up the wall from the box, across at or near the ceiling, and back down to the equipment. Wiring shall not block the walkway between wall and equipment.
 8. Horizontal runs of conduit on exposed walls shall be kept to a minimum.
 9. Conduit for mechanical / plumbing equipment installed outdoors shall be routed with the associated mechanical / plumbing pipe support rack system where practical, coordinate with Divisions 22 and 23.
 10. Conduits installed in public areas, not concealed by architectural ceilings, shall be supported by galvanized steel channel racks to bottom of roof deck or floor deck. Conduits shall be grouped for neat workman-like appearance.
- Q. Install expansion and deflection fittings and bonding jumpers on straight runs which exceed 200-feet, on center, and at 200-foot maximum, on center, on straight runs which exceed 400-feet, and where conduits cross building expansion joints.
- R. Provide grounding bushings at concentric/eccentric knockouts or where reducing washers are used.
- S. Run conduit to avoid proximity to heat producing equipment, piping surfaces with temperatures exceeding 104 degrees F., and flues, keeping a minimum of 13-inches clear.
- T. Install conduit as a complete system, without conductors, continuous from outlet to outlet and from fitting to fitting. Make up threaded joints of conduit carefully in a manner to ensure a tight joint. Fasten the entire conduit system into position. A run of conduit between outlet and outlet, between fitting and fitting, or between outlet and fitting shall not contain more than the equivalent of four quarter bends, including those bends located immediately at the outlet or fitting.
- U. Conceal conduit systems in finished areas. Conduit may be exposed in mechanical and electrical rooms, and where otherwise shown or indicated only. Run the conduit parallel and perpendicular to the structural features of the building and support with malleable iron conduit clamps at intervals as required by NEC or on conduit racks, neatly racked and bent in a smooth radius at corners.
- V. Conduit bends shall be factory elbows or shall be bent using equipment specifically designed to bend conduit of the type used to maintain the conduit's UL listing. Conduit hanger spacing shall be 10 feet or less and as required by the NEC for all conduit. Beam

clamp attachments to steel joist chords is prohibited. Beam clamps may only be used at beams, no exceptions. Connections to joists shall be made with galvanized channel extended between joist chords or with galvanized channel bearing on the vertical legs of joist chord angles.

- W. Support conduit on galvanized channel, using compatible galvanized fittings (bolts, beam clamps, and similar items), and galvanized threaded rod pendants at each end of channel and secure raceway to channel and channel to structure. Where rod pendants are not used, channel supports are to be secured to structure at each end. Conduit supports are to be secured to structure using washers, lock washers, nuts and bolts or rod pendants; use of toggle bolt “wings” are not acceptable. Support single conduit runs using a properly sized galvanized conduit hanger with galvanized closure bolt and nut and threaded rod. Raceway support system materials shall be galvanized and manufactured by Kindorf, Unistrut, Superstrut, Caddy, or Spring Steel Fasteners, Inc. Provide chrome or nickel-plated escutcheon plates on conduit passing through walls and ceilings in finished areas. Do not support conduit from other conduit, structural bridging or fire rated ceiling system. Do not support more than one conduit from a single all-thread rod support. Provide electrical insulating sleeve or wrapping for aluminum conduit supported by zinc coated supports or fasteners. Channel supports shall have cut ends filed smooth. When installed outside of the building, or in areas subject to moisture, the cut ends shall be painted with ZRC galvanized paint or equivalent.
- X. Terminate all motor connection conduits in mechanical room spaces with a floor pedestal and with “Tee” conduit at motor outlet height for flexible conduit.
- Y. Where conduit is not embedded in concrete or masonry, conduit shall be firmly secured by approved clamps, half-straps or hangers. Tie wire and short pieces of conduit used as supports and or hangers are not approved.
- Z. Where “LB” condulets are used, 2-inches and larger shall be type “LBD”.
- AA. No more than 12 conduits containing branch circuits may be installed in junction boxes, pull boxes or gutters.
- BB. Flexible metal conduit and liquid tight flexible metal conduit shall only be used for final connections from junction box to the following: motorized equipment, transformers, interior light fixtures above ceilings, and power poles. They shall not be used in lieu of rigid conduit runs. They shall not be used for wall or roof penetrations except for exterior building mounted light fixtures and installed in a PVC coated RGC conduit sleeve at least one size larger than the OD of the flexible conduit.
- CC. Where 3-1/2-inch conduit is specified and the required or specified material is Schedule 80 PVC, provide 4-inch conduit.
- DD. “Daisy Chaining” light fixtures installed for lay-in ceiling areas is not allowed. Each light fixture shall have its own fixture whip from junction box. The only exception being light fixtures installed end to end using chase nipples between them, or light fixtures recessed in non-accessible ceilings.
- EE. In above ceiling applications, do not install raceways, junction boxes, gutters, disconnects, etc. within 36 inches directly in front of HVAC control boxes or other equipment requiring access from a point starting from the top of control box / equipment down to ceiling.
- FF. Do not install conduit, junction boxes, etc. within 18 inches of outside edges of roof access openings.
- GG. Install minimum size 2-inch nipple, at least one, between multi-sectional panels for branch circuit independent of feeder conductors.

3.2 CONDUITS

- A. Conduit above grade indoors:
 - 1. Concealed Conduits: EMT with steel set screw fittings
 - 2. Exposed conduits:
 - a. Below nine feet AFF where not directly attached and against building walls, ceiling, or structure: Rigid metal conduit.
 - b. Where subject to physical damage: Rigid metal conduit.
 - c. Wet locations: PVC coated galvanized rigid steel or aluminum conduit
 - d. Damp Locations: Aluminum rigid conduit.
 - e. Exposed conduits in mechanical rooms or electrical rooms shall be rigid galvanized steel when installed below 18-inches above finished floor.
- B. Conduit installed above grade outdoors:
 - 1. Galvanized rigid steel for conduits up utility poles and where subject to physical damage or where located less than four feet above finished floor.
 - 2. Aluminum where not subject to physical damage and where located four feet above finished floor.
- C. Conduit where indicated underground:
 - 1. PVC Coated Galvanized rigid steel conduit elbows and Schedule 80 PVC, or PVC coated galvanized steel straight run conduits. PVC conduits for underground branch circuits shall be Schedule 80 or Schedule 40 PVC.
 - a. PVC conduit and fittings shall be used only for straight horizontal runs and for vertical risers at site lighting pole bases. Bending straight sections of PVC conduit to less than 25-foot radius or the use of PVC factory bends is not allowed.
 - b. Change in direction of conduit runs, either vertical or horizontal, shall be with PVC coated galvanized steel elbows or long sweep bends of straight PVC conduit sections. Long sweep bends of straight PVC 20-foot sections shall have a minimum radius of curvature of 25 feet and a maximum arc of 22.5degrees. Multiple long sweep bends of straight PVC sections shall be separated by a minimum of 20-feet of straight, linear, PVC sections.
 - c. Provide PVC coated rigid galvanized steel conduit elbows and fittings with urethane interior coating at all changes in direction with radius of less than 25-feet and at all vertical runs to 18 inches above finished floor elevation. For interior slab penetrations, provide continuous PVC coated rigid galvanized steel conduit and fittings with urethane interior coating from change in direction to 18 inches above finished floor elevation, except where stubbed-up under and inside equipment or switchgear where conduit shall be terminated at minimum two inches above concrete housekeeping pad.
 - d. Elbows for underground electrical service entrance, feeders, transformer primary / secondary, telecommunication, and low voltage conduits shall be PVC coated rigid galvanized steel with long radius as follows:
 - 1) Up to 1-inch conduit, minimum 12-inch radius.
 - 2) 1.5-inch conduit, minimum 18-inch radius.
 - 3) 2-inch conduit, minimum 24-inch radius.
 - 4) 2.5-inch conduit, minimum 30-inch radius.
 - 5) 3-inch conduit, minimum 36-inch radius.
 - 6) 3.5 to 6-inch conduit, minimum 48-inch radius.
 - e. Conduit for all floor boxes shall be routed below building slab from floor box to nearest column, wall, or as indicated.
 - f. Conduits shall not be routed horizontally in building slab, grade beams or

- pavement.
2. Underground conduits:
 - a. Concrete encasement for utility installed conductors shall be as specified by the utility and comply with their standards and specifications.
 - c. Provide conduit spacers for parallel branch/feeder conduits.
 - d. Conduits either specified or approved in writing to be routed under building slab for electrical branch circuits or voice / data / video / communications horizontal drops or outlets shall be installed 18 inches below finished floor and on select fill. All other conduits, including but not limited to electrical feeders, voice / data / video / communications vertical, riser, tie, trunk, or service cable conduits shall be installed 48-inches below finished floor and on select fill.
 - e. Use suitable manufactured separators and chairs installed 4 feet on centers. Securely anchor conduit at each chair to prevent movement during backfill placement.
 3. Install building voice / data / video / communications main service conduits and electrical service transformer primary and secondary conduits with top of conduit 48-inches below finished grade or pavement. Voice / data / video / communications conduits and electrical service primary conduits for utility owned electrical service transformers shall also comply with the respective utility company requirements and standards. All other underground conduits outside of building other than voice / data / video / communications main service conduits and electrical service transformer primary and secondary conduits shall have top of conduit at 36 inches minimum below finished grade or pavement.
 4. Provide two "caution" plastic tapes at 6-inches and 18-inches below finished slab, grade, or pavement; identify as specified in Section 26 05 00.
 5. Conduits located outside the building, provide magnetic locator tape at top of first compacted layer of backfill.
 6. During construction, partially completed underground conduits shall be protected from the entrance of debris such as mud, sand, and dirt by means of conduit plugs. As each section of the underground conduit is completed, a testing mandrel with diameter ¼-inch smaller than the conduit, shall be drawn through each conduit. A brush with stiff bristles shall be drawn through until conduit is clear of particles of earth, sand, or gravel. Conduit plugs shall then be installed.
 7. Utility underground conduit for Utility Company cable shall be installed per Utility Company standards, and their specifications for this project.
 8. Concrete shall be Portland Cement conforming to ASTM-C-150, Type 1, Type III or Type V if specified. Cement content shall be sufficient to product a minimum strength of 2,500 PSI.
 9. Contractor shall stake out routing and location of underground conduits using actual field measurements. He shall obtain approval of the Owner and Architect before beginning trenching, horizontal drilling, and excavation.
 10. Verify location and routing of all new and existing underground utilities with the Owner and Architect on the job site. Stake out these existing utilities so that they will not be damaged. Stake out new utilities to provide coordination with other trades and with new and existing utilities, easements, property lines, restricted land use areas, and right-of-ways. Verify existing public utilities with Call811.
- D. Conduit shown in concrete walls, floor or roof slab:
 1. PVC Coated Galvanized Rigid steel.
- E. Conduits that penetrate concrete slabs, or within 100 feet of cooling towers, or at designated corrosive locations.

1. PVC coated galvanized rigid steel
- F. Connections to motorized equipment mounted on roof, rotating equipment, transformers, and kitchen or food processing equipment, or where flexible conduit is required outdoors.
 1. Liquid tight flexible metal conduit (1/2 inch may be used for roof top supply / exhaust fans only)
 2. Liquid tight flexible metal conduit length shall be between 18 and 24 inches
 3. Conduit for roof-mounted equipment shall be routed inside the roof curb assembly roof opening. Provide permanent lock-off device at panelboard circuit breakers serving roof equipment and accessories to enable tag-out procedures for all power routed through roof curb and to the roof mounted equipment and accessories.
- G. Light fixture whips:
 1. Accessible ceilings and open structure: 1/2-inch flexible steel conduit or steel MC cable, length not to exceed 6-feet.
 2. Non-accessible ceilings: 1/2-inch flexible steel conduit. Length as required to make a tap at an accessible j-box. Recessed light fixtures in non-accessible ceilings may be daisy chained using the light fixture's integral, UL listed j-box or internal wire way that is accessible through fixture from below the ceiling.
 3. Dedicated insulated ground wire.
 4. Light fixture whips shall not rest on ceiling grid or tile.
 5. Light fixture whips shall not be supported from the ceiling suspension system. Support from the structure with #13 AWG galvanized iron wire pendants and Caddy clips. Do not support conduit from structural bridging. Flexible conduit and steel MC cable shall be kept a minimum of 2 inches clear of roof deck.
- H. Conduits at Natatorium or therapeutic pool areas:
 1. Underground conduit shall be as specified in this section.
 2. Exterior conduits and boxes within 100 feet of exhaust openings shall be PVC coated galvanized rigid steel or stainless steel.
 3. Exposed conduits in chemical storage rooms, pool mechanical equipment (pump rooms, and pool equipment storage rooms shall be Schedule 80 PVC. Boxes shall be PVC, or 304 Stainless Steel.
 4. Exposed conduits and boxes in indoor pool areas and all other indoor public areas shall be Type 304 Stainless Steel.
- I. Conduits located inside greenhouses and natatorium pump and water treatment rooms:
 1. Schedule 80 PVC
 2. PVC coated galvanized rigid steel conduit and fittings.

3.3 CONDUIT PENETRATIONS, SLEEVES AND ESCUTCHEONS

- A. Furnish sleeves for placing in construction for all conduit passing through concrete or masonry walls, partitions, beams, all floors other than grade level, and roofs. A conduit sleeve shall be one size larger than the size of conduit, which it serves except where larger sizes are required for manufactured water, fire, or smoke stop fittings.
 1. Sleeves set in concrete floor construction shall be minimum Schedule 40 galvanized steel.
 2. Sleeves shall extend 3-inches above the finished floor.
- B. Sleeves in concrete or masonry walls shall be Schedule 40 galvanized steel. Sleeves shall be set flush with finished wall.
- C. Install manufactured UL listed water, fire, and smoke stop fittings, or caulk around conduit or cables in sleeves with sufficient UL listed fire safe insulation or foam to maintain wall or floor slab fire or smoke rating. Refer to Architecture drawings for locations of rated walls.

- D. Provide Linkseal Mechanical Seals around conduit penetrations through walls below grade. Provide a pull box to install a water stop inside wall penetration. Internally seal low voltage cabling conduit penetrations with waterproof caulking.
- E. Sleeves penetrating walls below grade shall be Schedule 40 black steel pipe with ¼-inch thick steel plate secured to the pipe with continuous fillet weld. The plate shall be located in the middle of the wall and shall be 2-inches wider all around than the sleeve that it encircles. The sleeve should extend a minimum of 24-inches on either side of the penetration. The entire assembly shall be hot-dipped galvanized after fabrication. Do not sleeve or penetrate grade beams.
- F. Conduit passing through the housing on connected equipment shall pass through a cleanly cut hole protected with a threaded steel bushing. Route conduit through roof openings, for piping and ductwork or through suitable roof jack, with pitch pocket. Coordinate location with roofing installation as required.
- G. Conduit passing through fire rated wall shall be sealed with Fire Stop. Route conduit to preserve fire resistance rating of partitions and other elements, using materials and methods under the provisions of Division 7.

3.4 POWER DISTRIBUTION UNDERGROUND FEEDER CONDUIT AND UNDERGROUND SERVICE ENTRANCE CONDUIT

- A. Power underground feeder and service entrance shall be of individual conduit. Unless shown otherwise, the type of conduit used shall not be mixed in any one underground conduit and shall be the size indicated on the drawings. Conduit for 120V and above shall be separated from control and signal conduits by a minimum of 3-inches.
- B. During construction, partially completed underground conduits shall be protected from the entrance of debris such as mud, sand, and dirt by means of conduit plugs. As each section of the underground conduit is completed, a testing mandrel shall be drawn through until each conduit is clear of particles of earth, sand, or gravel. Conduit plugs shall then be installed.
- D. Conduit for service entrance underground conduits shall be as indicated on the drawings.
- E. Primary power underground conduit shall be installed in accordance with utility company standards and the utility company specifications for this project.

3.5 TELECOMMUNICATIONS, LOW VOLTAGE AND EMPTY CONDUIT SYSTEM RACEWAYS

- A. Conduit shall be installed in accordance with the specified requirements for conduit and with the additional requirements that no length of run shall exceed 100-feet for 1 inch or smaller trade sizes and shall not contain more than two 90-degree bends or the equivalent. Pull or junction boxes shall be installed to comply with these requirements. Provide plastic bushings at all conduit terminations. Provide a grounding bushing on each data and voice conduit.
- B. Completely install all conduit runs and all bushings prior to pulling conductors. All boxes shall be accessible after completion of construction.
- C. Conduits shall be installed from outlet box to above an accessible ceiling. All cables routed through open spaces (no-ceiling below roof deck or above floor deck) shall be routed in conduit. Telecommunications systems, CATV, CCTV, fire alarm and BMCS cables can be installed above accessible ceilings without conduit. Cables installed above accessible ceiling shall be plenum rated. Conduit rough in of these cables shall include a 90-degree turn-out to an accessible location with insulated bushings on the end of the conduit.
 - 1. Provide conduit from each telecommunications outlet box to accessible ceiling plenum.

2. Provide conduit from each security / surveillance device outlet box to accessible ceiling plenum.
 3. Provide two conduits for each multi-media outlet box and each outlet box indicated to contain more than four data, audio, or video drops to accessible ceiling plenum.
 4. Provide the following minimum conduits for telecommunications and multi-media wall, floor, and ceiling mounted outlet boxes. Use the largest diameter conduit indicated below unless instructed otherwise in writing from the Architect:
 - a. Non-masonry outlet box: Two 1-inch conduits.
 - b. Masonry outlet box: Two 1-inch conduits, or three 3/4-inch conduits.
 - c. Where indicated differently on plans or where conflicts arise, notify the Architect / Engineer prior to installation.
- D. All conduit in which cable is to be installed by others shall have pull string installed. The nylon pull string shall have not less than 200 lb. tensile strength. Not less than 12-inches of slack shall be left at each end. Provide blank cover plate before substantial completion if box is for a future installation after substantial completion of the project. Conduit shall extend to a minimum six inches above nearest accessible ceiling and be turned horizontally with plastic bushing at terminations.
- E. Conduits for Building Entrance Facilities:
1. Underground Outside Plant: Install a pull box every 300-feet or after 180 degree turns.
 2. Inside Plant: Install a pull box every 150-feet or after 180 degree turns. All turns shall be large sweeps, not sharp 90s, with the radius of the sweep at least 10X the diameter of the conduit. Hence, a 4-inch conduit requires a 40-inch minimum radial sweep. If field conditions absolutely mandate a sharp 90-degree bend to be installed, then a pull box shall be installed at that location regardless of distance.
 3. Building entrance facilities shall not terminate in an IDF or any other space except the MDF.
 4. Coordinate the termination location of the building entrance facilities in the MDF with the room layout and equipment configuration.
 5. Provide 4-inch conduit unless indicated otherwise. Provide (3) fabric innerducts in each 4-inch conduit.

3.6 EXTERIOR IN-GRADE PULL BOXES

- A. Provide pull boxes where specified and as required.
- B. Pull boxes located in pavement shall be set with proper extensions so that top of cover is flush with pavement.
- C. Pull boxes located in non-paved areas shall be set two-inches above surrounding finished grade. Provide 12-inch wide by 8-inch deep reinforced concrete crown around neck or opening and sloped down away from pull box opening.

3.7 IDENTIFICATION

- A. Conduit Systems: Provide adequate marking of conduit larger than one inch exposed or concealed in interior accessible spaces to distinguish each run as either a power (120/208V or 277/480V) or signal / telecommunication conduit (Fire Alarm, BAS, BMCS, Security, CCTV, Access Control, Intrusion Detection, Telecom, etc.). Except as otherwise indicated, use orange banding with black lettering. Provide self-adhesive or snap-on type plastic markers. Locate markers at ends of conduit runs, near switches and other control devices, near items of equipment served by the conductors, at points where conduit passes through walls or floors or enters non-accessible construction, and at

spacing of not more than 50-feet along each run of exposed conduit. Switch-leg conduit and short branches for power connections need not be marked, except where conduit is larger than 1-inch.

END OF SECTION

**SECTION 26 05 35
ELECTRICAL CONNECTIONS FOR EQUIPMENT**

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Electrical connections as required and scheduled, and as specified.

1.2 RELATED WORK

- A. Refer to other Divisions for specific individual equipment electrical requirements.

1.3 QUALITY ASSURANCE

- A. UL Label: Products shall be UL listed to the extent possible.

PART 2 – PRODUCTS

2.1 MATERIALS AND COMPONENTS

- A. General: For each electrical connection indicated, provide a complete assembly including, but not limited to, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire nuts, and other items and accessories needed to complete splices and terminations.
- B. Raceways: Refer to related sections.
- C. Conductors and Connectors: Refer to related section. Conductors at equipment terminations shall be copper.
- D. Terminals: Provide electrical terminals as indicated by the terminal manufacturer for the application.

PART 3 – EXECUTION

3.1 INSTALLATION OF ELECTRICAL CONNECTIONS

- A. General: Install electrical connections as shown, in accordance with applicable portions of the NECA Standard of Installation, and industry practices.
- B. Conductors: Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Where possible, match conductors of the electrical connection for interface between the electrical supply and the installed equipment.
- C. Splice Insulation: Cover splices with electrical insulation equivalent to, or of a higher rating than, insulation on the conductors being spliced.
- D. Appearance: Prepare conductors by cutting and stripping covering, jacket, and insulation to ensure a uniform and neat appearance where cables and wires are terminated.
- E. Routing: Trim cables and wires to be as short as practical. Arrange routing to facilitate inspection, testing, and maintenance.
- F. Motor Connections: Where possible, terminate conduit in conduit boxes at motors. Where motors are not provided with conduit boxes, terminate the conduit in a suitable conduit, and make motor connections. Conduit passing through the housing on connected equipment shall pass through a cleanly cut hole protected with an approved grommet. For all AHU or fan motors and all other motors 10 HP and larger, at the motor connection do not use wire nuts. Provide copper alloy split bolt connectors or compression lugs and bolts. Insulate connection with Scotch Super 88 vinyl electrical tape over rubber tape, or Tyco Gelcap Motor Connection Kit.
- G. Conduit connections to equipment including, but not limited to, Variable Frequency Drives, Manual and Automatic Transfer Switches, Surge Suppression Devices, motor controllers, electrical disconnects, food service / processing equipment, electronics, control panels and Owner furnished equipment:

1. Make conduit penetrations only at the bottom flat surface of the equipment and only where permitted by the equipment manufacturer to avoid un-intentional water entry. Coordinate installation of electrical connections for equipment with equipment installation work. Where equipment manufacture does not permit a bottom conduit entry, verify with Owner/Engineer and locate the conduit entry at the side surface as close as possible to the bottom of the enclosure.
 2. Where conduit originates from an elevation above the conduit entry, provide a "T" conduit below the enclosure's bottom elevation. Provide conduit from the conduit up to the enclosure bottom horizontal surface for electrical connection.
 - 3.
- H. Identification: Refer to Electrical General Provisions for identification of electrical power supply conductor terminations with markers approved as to type, color, letter and marker size by the Architect. Fasten markers at each termination point, as close as possible to each connecting point.
- I. Equipment and Furnishings: Refer to other Divisions. Coordinate power and control provisions shown for equipment and furnishings with the provisions required for the furnished equipment and furnishings. Where the power and control requirements are less than or equal to those specified, modifications to power and control provisions shall be made at no cost as a part of coordination. Where power and control requirements are in excess of those shown, notify the Architect in writing of the requirements.
- J. Elevators and Escalators, and Wheelchair Lifts: Refer to Other Divisions. Coordinate power and control provisions shown with the provisions required for the furnished equipment. Where the power and control requirements are less than or equal to those specified, modifications to power and control provisions shall be made at no cost as a part of coordination. Where power and control requirements are in excess of those shown, notify the Architect in writing of the requirements. Provide lockable disconnect switches for main power, control power, lighting power, etc. as required by the NEC and all local codes. Provide all necessary means of two-way communication for emergency phones.

END OF SECTION

SECTION 26 05 37
ELECTRICAL BOXES AND FITTINGS

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Provide electrical box and fitting work as required, scheduled, indicated, and specified.

1.2 QUALITY ASSURANCE

- A. UL Label: Electrical boxes and fittings shall be UL listed.

PART 2 - PRODUCTS– Provide products manufactured in the USA

2.1 FABRICATED MATERIALS

- A. Interior Outlet Boxes: Provide galvanized steel interior outlet wiring boxes, of the type, shape, and size, including depth of box, to suit respective locations and installation. Construct with stamped knockouts in back and sides. Provide gang boxes where devices are shown grouped. Single box design; sectional boxes are not acceptable, except for wall mounted electronic displays.
1. Type of Various Locations:
 - a. Wall mounted interactive media boards, video displays, televisions, electronic signage and similar installations; recessed wall mounted box for power and/or multi-media (low voltage) outlets: Arlington Industries #TVBS 613, 4-gang steel box with white trim plate.
 - b. Technology, data, voice, video and multi-media outlet boxes at locations other than wall mounted interactive media boards, video displays, televisions, electronic signage and similar installations: minimum 4-inch square (2-gang), 3-inch deep interior outlet boxes. Raco #260H large capacity box with ½ through 2-inch knockouts.
 - c. Security, access control, and video surveillance outlet boxes: single gang, 3-inch deep outlet boxes mounted long axis vertically.
 - d. All other applications: minimum 4-inch square (2-gang) 2-1/8-inch deep boxes.
 - e. Masonry Walls: Galvanized switch boxes made especially for masonry installations; depths of boxes must be coordinated for each installation.
 - f. Surface: Type FS or FD box with surface cover.
 - g. Corrosive locations or natatorium areas: 316 stainless steel construction suitable for the installation.
 - h. Hazardous (Classified) Locations: Explosion proof boxes, seals and fittings.
 - i. Special: Where above types are not suitable, boxes as required, taking into account space available, appearance, and Code requirements
 2. Interior Outlet Box Accessories: Outlet box accessories required as for installation, including covers or wall device plates, mounting brackets, wallboard hangers, extension rings, plaster rings for boxes in plaster construction, fixture studs, cable clamps and metal straps for supporting outlet boxes. Accessories shall be compatible with outlet boxes used and meet requirements of individual wiring.
- B. Damp Location Outlet and Damp or Wet Location Switch Boxes: Deep type, hot dipped galvanized cast-metal weatherproof outlet wiring boxes, of type, shape, and size required. Include depth of box, threaded conduit ends, and stainless steel cover plate with spring-

- hinged waterproof caps suitable for application. Include faceplate gasket and corrosion-resistant, tamper / vandal proof fasteners.
- C. Wet Location Outlet Boxes: Hot dipped galvanized cast-iron weatherproof outlet wiring boxes, of type, shape, and size required. Include depth of box, threaded conduit ends.
 - D. Junction and Pull Boxes: Galvanized sheet steel junction and pull boxes, with screw-on covers, of type, shape, and size, to suit respective location and installation.
 - 1. Type for Various Locations:
 - a. Minimum Size: 4-inch square, 2-1/8-inches deep.
 - b. 150 Cubic Inches in Volume or Larger: Code gauge steel with sides formed and welded, screw covers unless shown or required to have hinged doors. All boxes mounted above ceiling shall have screw covers. Boxes in all other areas with covers larger than 12-inches shall have hinged with screw covers. Knockouts factory stamped or formed in field with a cutting tool to provide a clean symmetrically cut hole.
 - c. Exterior or Wet Areas: 304 stainless steel NEMA 4X construction with gaskets and corrosion-resistant fasteners
 - E. Conduit Bodies: Provide galvanized cast-metal conduit bodies, of type, shape, and size, to suit location and installation. Construct with threaded conduit ends, removable cover, and corrosion-resistant screws.
 - F. Bushings, Knockout Closures, and Locknuts: Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts, and insulated conduit bushings of type and size to suit use and installation.
 - G. Outlet boxes in fire rated walls: Provide 2-hour rated gasket within box and below cover, equal to Rectorseal Metacaulk box guard and cover guard.

PART 3 - EXECUTION

3.1 INSTALLATION OF BOXES AND FITTINGS

- A. Install electrical boxes and fittings as shown and as required, in compliance with NEC requirements, in accordance with the manufacturer's written instructions, in accordance with industry practices.
- B. Provide recessed device boxes for wall mounted interactive media boards, video displays, televisions, electronic signage and similar installations.
- C. Provide minimum 4-inch square (2-gang), 3-inch deep interior outlet boxes for technology, data, voice, video, and multi-media outlet boxes at locations other than wall mounted interactive boards, video or visual displays. Provide single gang only, 3-inch deep outlet boxes mounted long axis vertically for security, access control, and video surveillance, coordinate with security equipment installation. Provide minimum 4-inch square (2-gang) 2-1/8-inch deep boxes for all other applications. Where indicated differently on plans or where conflicts arise, notify the Architect / Engineer prior to installation. Box extenders or plaster rings shall not be used to increase size. Provide increased box size as required.
- D. Junction and pull boxes, condulets, gutters, located above grid ceilings shall be mounted within 18-inches of ceiling grid. Junction and pull boxes above grid ceilings shall be mounted in the same room served. Junction boxes and pull boxes required for areas with inaccessible ceilings shall be located above the nearest accessible ceiling area. All junction box or pull box openings shall be side or bottom accessible. Removal of light fixtures, mechanical equipment or other devices shall not be required to access boxes. Outlet boxes above ceiling for low voltage terminations shall face towards the floor.
- E. Use outlet and switch boxes for junctions on concealed conduit systems except in utility areas where exposed junction or pull boxes can be used.

- F. Determine from the drawings and by measurement the location of each outlet. Locate electrical boxes to accommodate millwork, fixtures, marker boards, and other room equipment at no additional cost to the Owner. The outlet locations shall be modified from those shown to accommodate changes in door swing or to clear interferences that arise from construction as well as modifying them to center in rooms. The modifications shall be made with no cost as part of coordination. Check the conditions throughout the job and notify the Architect of discrepancies. Verify modifications before proceeding with installation. Set wall boxes in advance of wall construction, blocked in place and secured. Set all wall boxes flush with the finish and install extension rings as required extending boxes to the finished surfaces of special furring or wall finishes. Provide wall box support legs attached to stud to prevent movement of box in wall.
- G. Unless noted or directed otherwise at installation, place outlet boxes as indicated on architectural elevations and as required by local codes.
- H. Outlets above counters, mount long axis horizontally. Refer to architectural elevations and coordinate to clear backsplash and millwork.
- I. Provide pull boxes, junction boxes, wiring troughs, and cabinets where necessary for installation of electrical systems. Surface mounted boxes below 9 feet and accessible to the public shall not have stamped knockouts.
- J. Provide weatherproof boxes for interior and exterior locations exposed to weather or moisture.
- K. Provide knockout closures to cap unused knockout holes in boxes.
- L. Locate boxes and conduit bodies to ensure access to electrical wiring. Provide minimum 12-inch clearance in front of box or conduit body access.
- M. Secure boxes to the substrate where they are mounted, or embed boxes in concrete or masonry.
- N. Boxes for any conduit system shall not be secured to the ceiling system, HVAC ductwork or piping system.
- O. Provide junction and pull boxes for feeders and branch circuits where shown and where required by NEC, regardless of whether or not boxes are shown.
- P. Coordinate locations of boxes in fire rated partitions and slabs to not affect the fire rating of the partition or slab. Notify the Architect in writing where modification or construction is required to maintain the partition or slab fire rating.
- Q. Exterior boxes installed within 50-feet of cooling towers or water treatment areas shall be of 304 stainless steel, weatherproof NEMA 4X construction.
- R. Identification: Paint the exterior and cover plates of building interior junction boxes and pull boxes located above accessible ceilings or non-finished areas to correspond to the following colors:
 - 1. Orange: - 480/277 VAC systems
 - 2. Light Blue: - 240 VAC three phase delta systems.
 - 3. Red – All Emergency circuits, regardless of voltage, and fire alarm system.
 - 4. Light Green - 120/208 VAC 3 phase and 120/240 VAC single-phase systems
 - 5. Yellow – Building Management and Control System - BMCS
 - 6. White - Security and Surveillance equipment circuits
- S. All box covers shall be labeled with Panel ID and circuit numbers of all circuits available in box using permanent black marker. Boxes containing main feeders are to list where fed from and load (example “MSB to Panel HA”). Information listed is to be legible, markovers are not acceptable. Multi-sectional panel numbers are not to be listed on covers (example “LA2” referring to Panel LA sec. 2 is to be listed as “LA”). Label covers for special applications explaining contents (example “Emerg. Gen. Annunciator controls”, “IDF ground”). Do not attach box covers that have both sides painted or

- labeled differently. In public areas where boxes are painted same color as room per architect, label inside covers. Boxes that are not used shall be labeled as not used and include panel ID. Example "Not Used Panel LA". Unused raceways not in sight of panel shall be terminated in a box and labeled not used and include panel identification.
- T. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
 - U. Use flush mounting outlet box in finished areas unless specifically indicated as being used with exposed conduit.
 - V. Locate flush-mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
 - W. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches with stud separation. Provide minimum 24 inches with separation in acoustic rated walls.
 - X. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness. Provide UL listed materials to support boxes in walls to prevent movement. Ensure box cannot be pushed inside wall.
 - Y. Use stamped steel bridges to fasten flush mounting outlet box between studs.
 - Z. Install flush mounting box without damaging vapor barriers, wall insulation or reducing its effectiveness.
 - AA. Use adjustable steel channel fasteners for hung ceiling outlet box.
 - BB. Do not fasten boxes to ceiling support wires.
 - CC. Support systems are to hang vertically straight down. All-thread supports, when used, are not to be installed at an angle or bent.
 - DD. Use gang box where more than one device is mounted together. Do not use sectional box.
 - EE. Use gang box with plaster ring for single device outlets.
 - FF. Support outlets flush with suspended ceilings to the building structure.
 - GG. Mount boxes to the building structure with supporting facilities independent of the conduits or raceways.
 - HH. Where multiple feeders are in one pull box, conductors shall be wrapped with 3M No. 7700 Arc and fireproof tape.
 - II. Provide plaster rings of suitable depth on all outlet boxes. Face of plaster ring shall be within 1/8 inch from finished surface.
 - JJ. Equip boxes supporting fixtures designed to accept fixture studs with 3/8-inch stud (galvanized malleable iron) inserted through back of box and secured by locknut. Boxes not equipped with outlets shall have level metal covers with rust-resisting screws.
 - KK. Do not mount junction boxes above inaccessible ceilings or in inaccessible spaces. Do not mount junction boxes above ceilings accessible only by removing light fixture, mechanical equipment or other devices. At inaccessible spaces use junction box furnished with light fixture or light fixture wiring compartment UL listed for through wiring.
 - LL. No more than 12 conduits containing branch circuits may be installed in any junction or pull box.
 - MM. All junction boxes shall be protected from building finish painters' over spray and from fire proofing overspray. Remove protective coverings when painting and fire proofing are complete.
 - NN. Bond equipment grounding conductor to all junction and pull boxes.
 - OO. Do not mount boxes or conduit bodies on walls directly above electrical panels or switchgear located next to walls.
 - PP. Do not mount boxes or conduit bodies within 18 inches of outside edges of roof access openings.
 - QQ. Box extenders or plaster rings shall not be used to increase the Code mandated cable capacity of a box. Provide proper size box.

3.2 ADJUSTING

- A. Adjust flush-mounting outlets to make front flush with finished wall material.
- B. Install knockout closures in unused box openings.

END OF SECTION

SECTION 26 05 40
ELECTRICAL GUTTERS AND WIREWAYS

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Provide electrical gutter work as shown, as specified and as required.
- B. Application: The types of electrical gutters required for the project include the following:
 - 1. Electrical wiring gutters
 - 2. Voice / Data / Video / Communication and signal distribution wireway

1.2 QUALITY ASSURANCE

- A. UL Label: Gutters and wireways shall be UL labeled.

PART 2 – PRODUCTS

2.1 ELECTRICAL GUTTERS AND WIREWAYS

- A. General: Provide hinged electrical gutters and wireways in the types and sizes indicated or required, minimum 16 gauge thickness, with rounded edges and smooth surfaces; constructed in compliance with applicable standards; with features required.
- B. Size: Provide size indicated. Where size is not indicated, construct in accordance with the NEC and other standards. Gutters shall be of manufacturer's standard lengths, without field cutting or field extensions.
- C. Accessories: Provide gutter and wireway accessories where indicated, constructed of same metal and finish as gutters or wireways.
- D. Supports: Provide gutter and wireway supports indicated, conforming to NEC, and as recommended by the manufacturer, and as specified in Section 26 05 33 Conduit Systems.
- E. Materials and Finishes: NEMA 1 gutters and wireways shall have gray powder coat finish over galvanized steel. Gutters and wireways installed outside shall be NEMA 3RX minimum. Gutters or wireways installed within 100-feet of cooling towers, at kitchen or food preparation areas, and natatorium, spa or therapy pool areas shall be of 304 stainless steel NEMA 4X construction.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Provide gutters and wireways only where specified or required. Use of gutters and wireways shall be kept to a minimum.
- B. Finishing: Remove burrs and sharp edges of gutters and wireways wherever they could be injurious to conductor insulation or jacket.
- C. Installation: Install gutters and wireways where shown or required, in accordance with the manufacturer's written instructions, NEC, NECA "Standard of Installation," and with recognized industry practices to ensure that the gutters and wireways comply with the specified requirements. Comply with requirements of NEMA and the NEC pertaining to installation of electrical gutters.
- D. Grounding: Electrically ground gutters and wireways to ensure continuous electrical conductivity. Provide equipment grounding conductor.
- E. Conductors:
 - 1. Complete gutter and wireway installation before starting the installation of conductors.
 - 2. Provide sufficient space to permit access for installing, splicing, and maintaining the conductors.
- F. A maximum of 12 conduits containing branch circuits shall be allowed to be installed in

any gutter or wireway.

END OF SECTION

**SECTION 26 05 50
FIRESTOPS**

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Provide firestop as required, and as specified. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.
- B. Types: Firestop required for the project includes smokestop.

1.2 QUALITY ASSURANCE

- A. UL Label: Firestops shall be UL labeled.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Nelson
- B. 3M (Minnesota Mining Manufacturing)
- C. Hilti
- D. Specified Technologies, Inc.
- E. Metacaulk

2.2 MATERIAL AND COMPONENTS

- A. General: Except as otherwise indicated, provide firestop manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended by the manufacturer, and as required for installation.

2.3 FIRESTOP

- A. Conduits: Provide a soft, permanently flexible sealant for 1-1/2 to 2 hour rated fireproofing for steel conduits (up to 4" diameter).
- B. Low Voltage Cables, Fiber Optic Cable and Innerduct: Provide Specified Technologies, Inc. EZ-Path single, double, or triple pathways as required.

PART 3 – EXECUTION

3.1 INSTALLATION OF FIRESTOPS

- A. General: Install firestops in accordance with the manufacturer's installation instructions and industry practices to ensure that the firestops comply with requirements. Comply with UL and NFPA standards for the installation of firestops.

END OF SECTION

SECTION 26 08 00
ELECTRICAL AND LIFE SAFETY SYSTEMS TECHNICAL COMMISSIONING
REQUIREMENTS

PART 1 – GENERAL

1.1. RELATED DOCUMENTS

- 1.1.1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.1.2. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.2. SUMMARY

- 1.2.1. The purpose of this Section is to define responsibilities in the Commissioning Process. Other electrical system testing is required under other Division 26 Specification Sections. National Electrical Installation Standards (NEIS) NECA 90-2004, “Recommended Practice for Commissioning Building Electrical Systems”, 27th Volume of the NEIS Series, provides additional guidance for the commissioning of electrical systems.
- 1.2.2. Commissioning requires the participation of the Contractor to ensure that all systems are operating in a manner consistent with the Contract Documents. General Commissioning Requirements are provided separately and coordination is detailed in Division 01. Division 26 and 28 Contractors shall be familiar with all parts of Division 01, the General Commissioning Requirements and the Commissioning Plan issued by the Owner’s CxA, shall execute all Commissioning responsibilities assigned to them in the Contract Documents and include the cost of Commissioning in the Contract price.
- 1.2.3. Electrical Testing Agency (ETA)
 - 1.2.3.1. The Contractor shall retain an independent Electrical Testing Agency (ETA). Their specific testing responsibilities are delineated in individual technical sections within Division 26. This generally requires checking and testing of the electrical power distribution equipment per National Electrical Testing Association (NETA) Acceptance Testing Standards (ATS).
 - 1.2.3.2. Attend, as needed, Pre-Commissioning Meeting(s), Pre-Installation Meeting(s), and other Project meetings scheduled by the Contractor, Owner or CxA to facilitate the Commissioning process.
 - 1.2.3.3. Obtain all required manufacturer’s data to facilitate tests.
 - 1.2.3.4. Provide assistance to the CxA in preparation of the specific System Verification Checklists (SVC) and Functional Performance Test procedures.
 - 1.2.3.5. Generally, the ETA shall provide their standard forms to document the NETA tests to be incorporated into the System Verification Checklists and Functional Performance Test records.
 - 1.2.3.6. The ETA shall assist the Contractor in completing required SVC information such as relay settings, protective overload settings, and equipment ratings utilizing the protocols in the Commissioning Plan.
 - 1.2.3.7. Perform and clearly document all completed Start-up and system operational checkout procedures, providing a copy to the Contractor.
 - 1.2.3.8. Clearly indicate any deficiencies identified during testing and add to an action list for resolution and tracking. The field technicians shall keep a running log of events and issues.
 - 1.2.3.9. Provide skilled technicians to execute testing. Ensure that they are available and present during the agreed-upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem solving.

- 1.2.4. Electrical systems to be commissioned include the following:
 - 1.2.4.1. Unit Substations / Electrical Switchboards
 - 1.2.4.2. Secondary Normal Power Distribution
 - 1.2.4.3. Emergency / Standby Power Distribution
 - 1.2.4.4. Branch Power Distribution and Components
 - 1.2.4.5. Emergency Generators and Paralleling Switchgear
 - 1.2.4.6. Uninterruptible Power Supplies (UPS)
 - 1.2.4.7. Lighting Controls - Occupancy Sensors (25% greater than 25 sensors installed, 100% less than 25 sensors installed)
 - 1.2.4.8. Lighting - Daylight Controls (100%)
 - 1.2.4.9. Lighting - Time Switch Controls (100%)

1.3. DEFINITIONS

- 1.3.1. Refer to Division 01: General Commissioning Requirements for definitions.

1.4. SUBMITTALS

- 1.4.1. Contractor shall provide Owner and / or CxA with documentation required for Commissioning Work. At minimum, documentation shall include: Detailed Start-up procedures, full sequences of operation, Operating and Maintenance data, performance data, control drawings, and details of Owner-contracted tests.
 - 1.4.1.1. Shop drawings and product submittal data related to systems or equipment to be commissioned.
- 1.4.2. Contractor shall submit to Owner and / or CxA installation and checkout materials actually shipped inside equipment and actual field checkout sheet forms used by factory or field technicians.
- 1.4.3. Where installation testing may be performed in a progressive manner (i.e. grounding systems, insulation resistance, etc.), the Contractor shall prepare and submit to the Owner, A/E team and CxA a testing plan that details how the progressive testing will be performed, documented and presented for approval prior to the start of any testing activities.
- 1.4.4. Contractor shall provide Owner with documentation required for Commissioning work. At minimum, documentation shall include: Detailed Start-up procedures, Full sequences of operation, Operating and Maintenance data, Performance data, Functional Performance Test Procedures, Control Drawings, and details of Owner-Contracted tests.
- 1.4.5. Contractor shall provide any additional documentation needed to complete the requirements of the Commissioning Process
 - 1.4.5.1. Factory Performance Test Reports: Review and compile all factory performance data to assure that the data is complete prior to executing the FPTs.
 - 1.4.5.2. Incorporate manufacturer's initial energizing / startup procedures with System Verification Checklists.
 - 1.4.5.3. Final Electrical Testing Agency (ETA) Reports documenting all NETA requirements indicated in the Project Documents
 - 1.4.5.4. Completed equipment Start-up certification forms along with the manufacturer's field or factory performance and Start-up test documentation.
 - 1.4.5.5. Operating and Maintenance (O&M) information per the requirements of the Technical Specifications and Division 01 requirements.

PART 2 - PRODUCTS

2.1. GENERAL

- 2.1.1. All materials and installation shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- 2.1.2. Refer to the General Commissioning Requirements for other work products related to the Commissioning Process
- 2.1.3. Contractor is required to follow all applicable industry and site specific safety practices, lockout / tagout requirements, specialized PPE requirements, and provide qualified, trained personnel to execute Commissioning Process requirements.

2.2. TEST EQUIPMENT

- 2.2.1. The Contractor shall provide all specialized tools, test equipment and instruments required to execute Start-up, checkout, and testing of equipment.
- 2.2.2. All specialized tools, test equipment, and instruments required to execute Start-up, checkout, and testing of equipment shall be of sufficient quality and accuracy to test and/or measure system performance within specified tolerances. A testing laboratory must have calibrated test equipment within the previous twelve (12) months. Calibration shall be NIST traceable. Contractor must calibrate test equipment and instruments according to manufacturer's recommended intervals and whenever the test equipment is dropped or damaged. Calibration tags must be affixed to the test equipment or certificates readily available.

PART 3- EXECUTION

3.1. CONSTRUCTION PHASE

- 3.1.1. In each purchase order or subcontract that is written for changes in scope, include the appropriate requirements for submittal data, Commissioning documentation, testing assistance, Operating and Maintenance (O&M) data, and training, as a minimum.
- 3.1.2. Attend Pre-Commissioning Meeting(s), Pre-Installation Meeting(s), and other Project meetings scheduled by the Owner, CxA or Contractor to facilitate the Commissioning process.
- 3.1.3. Provide manufacturer's data sheets and shop drawing submittals of equipment.
- 3.1.4. Provide additional requested documentation to the Owner and / or CxA, prior to O&M manual submittals, for development of System Verification Checklists and Functional Performance Testing procedures.
 - 3.1.4.1. Typically, this will include detailed manufacturer's installation and Start-up, operating, troubleshooting and maintenance procedures, full details of any Owner-contracted tests, full factory testing reports, if any, and full warranty information.
 - 3.1.4.2. In addition, the installation, Start-up, and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Contractor and / or CxA.

This information and data request may be made prior to normal submittals.
- 3.1.5. With input from the Lighting Controls, PCMS vendors and A/E, clarify the operation and control of commissioned equipment in areas where the Specifications, control drawings, or equipment documentation are not sufficient for writing detailed test procedures.
- 3.1.6. During the installation, Start-up and initial checkout process, execute and document related portions of the System Verification Checklists for all commissioned equipment according to the procedures indicated in the Commissioning Plan.
- 3.1.7. Factory Start-ups: Factory Start-ups are specified for certain equipment. Factory Start-ups generally are Start-up related activities that will be reviewed and checked prior to Functional Performance Tests. All costs associated with factory Start-ups shall be included with the contract price unless otherwise noted. Notify the Commissioning Team

of the factory Start-up schedule and coordinate these factory Start-ups with witnessing parties. The Commissioning Team members may witness these Start-ups at their discretion.

- 3.1.8. Independent Testing Agencies: For systems that specify testing by an independent testing agency, the cost of the test shall be included in the Contract price unless otherwise noted. Testing performed by independent agencies may cover aspects required in the System Verification Checklists, Start-ups, and Functional Performance Tests. Coordinate with the independent testing agency so that CxA, Owner and/or A/E can witness the test to ensure that applicable aspects of the test meet requirements.
- 3.1.9. Provide skilled technicians to execute starting of equipment and to assist in execution of Functional Performance Tests. Ensure that they are available and present during the agreed-upon schedules and for a sufficient duration to complete the necessary tests, adjustments, and problem solving.
- 3.1.10. Correct deficiencies (differences between specified and observed performance) as interpreted by the Owner's Project Manager and A/E and retest the system and equipment.
- 3.1.11. During construction, maintain as-built marked-up Drawings and Specifications of all Contract Documents and Contractor-generated coordination Drawings. Update after completion of Commissioning activities (include deferred tests).
- 3.1.12. Provide training of the Owner's operating personnel as specified.
- 3.1.13. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

3.2. WARRANTY PHASE

- 3.2.1. Execute seasonal or deferred tests, witnessed by the CxA and Owner, according to the Specifications.
 - 3.2.1.1. Complete deferred tests as part of this Contract during the Warranty Period. Schedule this activity with the Owner.
- 3.2.2. Correct deficiencies and make necessary adjustments to O&M manuals, Commissioning documentation, and as-built drawings for applicable issues identified in any deferred or seasonal testing.

3.3. INSTALLATION

- 3.3.1. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- 3.3.2. All installation shall be in accordance with the Project Documents.

3.4. TRAINING

- 3.4.1. Refer to the individual section of this Specification for specific training requirements on each system.
 - 3.4.1.1. Refer to the General Commissioning Requirements and Division 01 of the Project Specifications for overall training requirements related to the Commissioning process and this project.

SECTION 26 09 25
ELECTRICAL CONTACTORS

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Miscellaneous electrical contactors as shown, required, scheduled, and specified.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Provide products produced by one of the following:
Schneider Electric - Square D
ABB-General Electric
Siemens

2.2 CONTACTORS

- A. Provide contactors as shown, required, and specified. The number of poles, ampere-ratings, and pole arrangements shall be as required. Contactors shall conform to the following:
1. Rated for continuous duty at full rated current in an unventilated enclosure. Eight-hour duty ratings are not acceptable.
 2. Contacts shall be readily replaceable, self-aligning, silver alloy.
 3. Load contactors shall be rated for not less than 30A continuous rating. Auxiliary contacts shall be rated for not less than 10 amperes.
 4. Contactors rated for lighting and mixed loads shall have an interrupting capacity of 150% of their continuous duty rating.
 5. Contactors shall be capable of successfully handling inrush currents at 20 times rating.
 6. Provide a minimum of two spare load contacts on each individual contactor rated 60A or less for future use.
- B. Electrically-held Devices shall conform to the following:
1. AC operated units shall have laminated low loss electrical steel core pieces with machine ground pole faces and shading coils.
 2. Units rated at 300A and above shall have DC operating coils and include the necessary rectifier for the AC/DC operation.
 3. Normally open contactors shall be spring-loaded open and magnetically closed.
 4. Contactors for emergency lighting or power shall be normally closed.
- C. Controls: Individual contactors operated by automatic controls shall have 30.5mm HAND-OFF-AUTOMATIC switches, otherwise provide HAND-OFF switches. Contactor controls shall be mounted in the contactor enclosure cover. Contactors serving receptacle loads controlled by local switching shall not have Hand-Off-Auto nor Hand-Off switching.
- D. Control Power. Provide dedicated 120-volt circuit for contactor control power and indicator pilot lights. Do not use same circuit feeding load.
- E. Enclosure:
1. Contactors and control enclosures installed in indoor locations shall be NEMA 1 heavy-duty enclosures unless shown otherwise.
 2. Contactors and control enclosures installed at kitchen and food preparation locations, hose down areas, cooling towers, exterior locations, in greenhouses, and in other corrosive areas shall be NEMA 4X, stainless steel.

- F. Minimum interrupting rating shall be 35KAIC.

PART 3 – EXECUTION

3.1 INSTALLATION OF MISCELLANEOUS ELECTRICAL CONTROLS

- A. Provide electrically held contactors, with line side wiring complete, in accordance with the National Electrical Code and manufacturer's recommendations.
- B. Fuses: Install fuses where coil control power is fed from line side of contactor.
- C. Adjustment: Adjust operating mechanisms for free mechanical movement.
- D. Coordinate contactor control and operation requirements with the Building Management Control System.
- E. Identify each contactor as specified in Section 26 05 00.
- F. Contactors shall not be installed above ceiling and shall be readily accessible. Locate contactors in same room as panelboard serving the load unless otherwise indicated.

3.2 INTERIOR AND EXTERIOR LIGHTING CONTROL

- A. Parking lot lighting, building mounted exterior lighting, and exterior signage shall be controlled by separate lighting contactors by the specified Building Management and Control System. Interior lighting as noted on the plans shall be controlled as noted on the plans and as specified by the Building Management and Control System. Contractor shall circuit all systems to be controlled by the Building Management and Control System through contactors compatible with system controls and shall ensure the control and operation of lighting control system is complete.
- B. Where control is a three-wire momentary control signal, provide control interface to operate electrically held 2-wire control contactors.
- C. Provide normally closed contactors for emergency lighting and power circuits where contactors are indicated or required.
- D. Provide normally closed contactors for circuits controlled by "emergency power off" or teacher control switches in science classrooms, computer labs, and vocational instructional areas.
- E. Exterior lighting shall be controlled by the Building Management Control System, with local BMCS manual override for both "ON" and "HIGH" settings.

END OF SECTION

SECTION 26 09 28
DIGITAL LIGHTING CONTROLS – CY-FAIR ISD

PART 1 - GENERAL

1.1 INTRODUCTION

- A. The work covered in this section is subject to all of the requirements in the General Conditions of the Specifications. Contractor shall coordinate all of the work in this section with all of the trades covered in other sections of the specification to provide a complete and operable system.
- B. Contractor shall provide to the digital lighting control equipment manufacturer all quantities for system including but not limited to room controllers, occupancy sensors, button stations, photocells, emergency lighting controllers, and wire lengths for room controller communications bus.
- C. Contractor shall demonstrate to the Owner, the complete successful operation of system including but not limited emergency lighting operation. Demonstration shall occur a minimum of 30 days prior to the contract schedule completion date. Installing electrical contractor shall replace any failed material during warranty period of one year at no additional cost to the Owner.
- D. Refer to the drawings and other specifications in Division 23 and 26 regarding lighting controls for exterior lighting and other interior areas indicated for control by the Building Management Control System (BMCS) or other means other than the digital lighting controls specified in this section.
- E. Factory startup and commissioning for substantial completion, 90-day verification re-commissioning, and 11-month close-out commissioning shall be provided.

1.2 QUALITY ASSURANCE

- A. Component Pre-testing: All components and assemblies are to be factory pre-tested and burned-in prior to installation.
- B. NEC Compliance: Comply to NEC as applicable to electrical wiring work.
- C. NEMA Compliance: Comply with applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.

1.3 SYSTEM DESCRIPTION & OPERATION

- A. The lighting control system as defined under this section covers the following equipment for local room or local area networks only. Building wide network equipment is not required and shall not be provided unless those capabilities are inherent to the base components required or specified for local room controls only.
 1. Digital Room Controllers – Self-configuring, digitally addressable relay controllers with 0-10-volt dimming control for lighting and single relay application-specific plug load controllers when plug load control is specified or required.
 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 – If Code required, single-zone closed loop and multi-zone open loop daylighting sensors with two-way active infrared (IR) communications that 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.
6. 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.
 7. DLM Lighting control system components shall have the capability to be easily expanded in the future to a building wide network functionally using all of the following topologies: a fully wired network.
- B. Lighting controls and automation for exterior lighting and interior areas not controlled by the system specified in this section shall be as required and as specified by other specification sections in Division 23, and 26.
- C. Power and communications for lighting controls provided shall be wired. Use of batteries or wireless communications is prohibited. Dimming control wiring shall not be installed with any line voltage power wiring conduits.

1.4 SUBMITTALS

- A. Submit the specification line-by-line compliance review, shop drawings, and the product data specified below under one cover as a complete submittal.
1. Specification compliance review: refer to Electrical Shop Drawings specification section for instructions and additional information.
 2. Shop Drawings:
 - a. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed (standard diagrams will not be accepted).
 - b. Scale drawing for each area showing the exact location of each sensor, room controller, and digital switch.
 3. Product Data: Catalog sheets, specifications and installation instructions.
 - a. Include data for each device which:
 - b. Indicates where sensor is proposed to be installed.
 - c. Prove that the sensor is suitable for the proposed application.

1.5 WARRANTY

- A. Wattstopper Digital Lighting Management (DLM) control products: Provide a five-year complete manufacturer's warranty on all products to be free of manufacturers' defects.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. WattStopper (Legrand North America, LLC)
1. System: Digital Lighting Management (DLM). No Substitutions.

2.2 DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR SYSTEM

- A. Ceiling mounted (or where specifically indicated or required to be wall mounted to suit installation); passive infrared (PIR), ultrasonic, or dual technology (passive infrared and ultrasonic) digital occupancy sensor. Furnish the 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.
- 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 shall be required.
- E. WattStopper product numbers: LMPX, LMDX, LMPC, LMUC, LMDC, LMDW

2.3 DIGITAL WALL SWITCHES

- A. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configurations; grey, compatible with building standard stainless-steel 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 dependent; 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.

2.4 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 shall be simple to install and shall not have dip switches, potentiometers or require special configuration. The control units shall 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
 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 configurations
 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 LED drivers.
 6. 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
 7. Discrete model listed for connection to receptacles, for occupancy-based control of plug loads within the space.
 - a. One relay configuration only
 - b. Automatic-ON/OFF configuration
 8. WattStopper product numbers: LMRC-211, LMRC-212, LMRC-213, LMPL-201,

2.5 DIGITAL PHOTOSENSORS

- 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 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.

2.6 ROOM OR AREA NETWORK

- A. The DLM local network shall be a free topology lighting control physical connection and communication protocol. Digital room devices connect to the network using CAT 5e cables with RJ-45 connectors which provide both data and power to room devices. The DLM local network shall 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.

2.7 CONFIGURATIONS TOOLS

- A. A configuration tool facilitates optional customization of DLM local networks and is used to set up open loop daylighting sensors. A wireless configuration tool features infrared communications, while PC software connects to each local network via a USB interface.
- B. Features and functionality of the wireless configuration tool shall include:
1. Two-way infrared (IR) communication with DLM IR-enabled devices within a range of approximately 30-feet.
 2. High visibility organic LED (OLED) display, pushbutton user interface and menu-driven operation.
 3. Read, modify and send parameters for occupancy sensors, daylighting sensors, room controllers and buttons on digital wall switches.
 4. Save up to nine occupancy sensor setting profiles and apply profiles to selected sensors.
 5. Temporarily adjust the light level of any load(s) on the local network and incorporate those levels in scene setting.
 6. Adjust or fine-tune daylighting settings established during auto-commissioning and input light level data to complete commissioning of open loop daylighting controls.
- C. WattStopper Product Numbers: LMCT-100, LMCI-100/LMCS-100

2.8 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/Dimming control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting to be fully bright ON until normal power is restored. Features include:
1. 120/277 volts, 50/60 Hz., 20-amp driver rating
 2. Push to test button
 3. Auxiliary contact for remote test or fire alarm system interface.
- B. WattStopper Product Numbers: ELCU-200.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION:

- A. Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated. Provide a minimum of eight hours of on-site technical support for the coordination between the BMCS and the Wattstopper lighting controls. Ensure that the sequences of operation involving the BMCS are fully operational as specified and as required.
- B. The installing contractor shall, prior to request of WattStopper factory start up and site commissioning, request an on-site meeting by including local factory representative, Owner and the general contractor, to assist in identification of any open-ended issues, thereby eliminating potential for delays and system commission interruptions.
- C. Upon confirmation of progress by local factory authorities, the installation electrical contractor shall complete the start-up request form found in the WattStopper submittals, including any field changes from the contract documents. This is essential to facilitate substantial completion.
- D. Room controllers shall be installed so that they are easily accessible for replacement or maintenance:
 - 1. Mount lighting control equipment to junction boxes as recommended by the manufacturer.
 - 2. Where accessible ceiling heights are 10-feet AFF or less, room controllers shall be mounted on wall above local control switch location between 4 and 18-inches above the accessible ceiling and 2-inches clear of T-grid for above ceiling access.
 - 3. Where ceiling heights are above 10-feet, room controllers shall be mounted in an ancillary area above the ancillary area local control switch location with accessible ceiling of 10-feet or less. The high ceiling room controller shall be mounted adjacent to the lower ceiling room controller serving the ancillary area. The room controller for the high ceiling and ancillary area(s) may utilize the same room controller for each area if practical. If an ancillary area with low accessible ceiling area is not available, the room controller shall be installed in the same mechanical or electrical room as the electrical panel serving the lighting for that area and clearly labeled for its use and specific room that it controls.
 - 4. Smaller ancillary spaces not separated by doors that adjoin the larger space do not require an additional control zone and shall be controlled with the larger adjoining space zone to reduce complexity.
- E. Lighting controls shall meet the minimum requirements of all local codes in effect when the project will be permitted with whatever exceptions deemed appropriate by the Owner. Wherever possible, minimize the complexity of the controls design to reduce the quantity and types of required sensor hardware, low voltage and line voltage wiring:
 - 1. Provide UL 924 emergency load control devices so that designated emergency interior light fixtures will be controlled ON/OFF/dimmed with adjacent area lighting and be brought to full-bright ON during power failure.
 - 2. Provide full floor area occupancy/vacancy sensor coverage wherever sensors are required.
 - 3. Provide 20-minute time out delay where vacancy sensor control is provided or required.
 - 4. Provide 20-minute or IECC maximum time out delay, whichever is shortest, where occupancy sensor control is provided or required.
- F. Where daylighting controls are required or indicated they shall be fully automatic and full range dimming without local user overriding of the daylighting maximum light level set point or trim level. Local user override to dim to OFF shall be provided. A single photo sensor shall be interfaced with the room controller for each daylighting zone in an area

and for each cardinal direction as required by the IECC, and as recommended by the lighting control system vendor.

- G. Low voltage cabling installed above ceiling shall be supported every 5 feet at a minimum height of 3 feet above grid/ceiling but no closer than six inches below deck. Support system shall be ceiling wire attached to structure and clipped to ceiling support grid using Caddy drop wire securing clip #EC311. Cabling shall hang plumb to devices. Low voltage control wiring shall not be installed in the same raceway with line voltage wiring.
- H. Renovation areas: Utilize existing wall box switch locations where line voltage wiring is removed and therefore can be utilized for low voltage control controls and control cabling unless shown or noted otherwise.

3.2 GENERAL SEQUENCES OF OPERATION

- A. Refer to plan and plan details for additional information for specific areas and additional requirements. Where plans or plan details are in conflict with these specifications, provide the more stringent of the two, however verify with the Owner/Architect for clarification for the exact requirements to be provided prior to construction at no additional cost to the Owner.
- B. Areas with lighting that requires dimming: Manual ON shall initially bring the lighting level to lighting control system 80-percent set point but not lower than the minimal CFISD design standard-maintained foot-candela light level for the type of space served. Refer to CFISD's Electrical-Light Fixture standards for required maintained light levels. Contractor/vendor shall verify in the field with CFISD during the commissioning process typical acceptable light levels with all ceilings and walls installed and with final paint and finishes applied. It is CFISD's intention to adjust the trim points to a minimally acceptable light level and only adjust as needed due to light fixture lumen depreciation over the lifetime of the light fixtures. This will increase energy savings and extend the lifetime of the lighting system.

3.3 SEQUENCES OF OPERATION FOR SPECIFIC AREAS – REFER TO PLAN DETAILS FOR ADDITIONAL PROJECT SPECIFIC INFORMATION AND INSTRUCTIONS

- A. CORRIDORS, STUDENT AND PUBLIC TOILETS/RESTROOMS ACCESSIBLE DIRECTLY FROM CORRIDORS, AND STAIRS: Includes all hallways and other egress pathways, including attached open access without doors, ancillary spaces such as flex or collaboration spaces, student and public toilets/restrooms with or without a door open to corridor, (This does not include large areas open to the corridor pathway such as the adjoining seating areas of cafeteria, dining, commons, nor shall it include administrative staff toilets or restrooms).
 - 1. Control through BMCS. BMCS occupied (turn ON) or unoccupied (turn OFF) state sent to DLM room controllers. Single DLM occupancy sensor and Hubbell key switch at each security keypad. Sensor to be used for auto ON only; sensor shall not turn corridor lights OFF. Dimming only if required for code required daylight harvesting.
 - 2. Provide DLM occupancy sensor for body movement detection in corridors (maximum spacing 50-feet) to only turn all corridor lights ON. Provide hand motion sensor coverage in adjoining toilets/restrooms. Provide a DLM Hubbell momentary SPDT key switch next to each security keypad to manually turn corridor lights ON only (to be used if there is a DLM sensor failure or BMCS failure or if BMCS is in un-occupied state). Key switch shall not turn lights OFF. Any corridor occupancy sensor shall trigger all corridor DLM room controllers to turn lights ON at any time of day and will remain ON until a BMCS unoccupied

- state in which the lights shall turn OFF.
3. Corridors and their attached open access ancillary general use spaces and attached student/public toilets with or without corridor doors shall be grouped together. Do not switch general use ancillary spaces including student/public toilets with or without doors separately from the corridor that have direct access from an adjoining corridor.
 4. Flex or collaboration spaces open to corridors shall be a separate dimming control zone but shall be grouped with the adjoining corridor's occupancy sensors and BMCS control for BMCS ON/OFF and sensor ON.
 4. Corridor Hubbell SPDT key switch shall be located at each security system control keypad and shall have both load terminals shunted so that either up or down position will turn the lights ON. Label key switches as "CORRIDOR LTG ON".
 5. Do not provide a fire alarm interface since sensors do not turn lights OFF.
 6. DLM locations and quantities shall be kept to a minimum. Multiple corridors shall be grouped and controlled together as much as practical. Individual corridors do not require individual local controls. All corridors are either all on or all off.
 7. Lighted display cases in corridors: Circuit with corridor lighting and with additional local manual line voltage key switch required by IECC identified as "CASE LTG".
 8. Provide separate local switching or dimming for open ancillary flex spaces only if indicated.
 9. No light switches in enclosed stairs. Switch and control all stair floor landings with the first-floor corridor except that one or more light fixture at each floor landing shall be controlled with that respective floor's corridor lighting. Do not provide sensors in stairs. Un-enclosed stairs shall be considered an extension of the adjoining corridor or space and shall share the adjoining corridor or space-controlled lighting line voltage circuits/zone. Do not provide a separate zone for un-enclosed stairs open to adjoining spaces.
- B. INSTRUCTION AND ADMINISTRATIVE AREAS, OFFICES, LOUNGES/BREAK ROOMS, COPY/PRINT ROOMS, AND SIMILAR AREAS, STORAGE ROOMS THAT ARE 100 SQUARE FEET AND LARGER.
1. SEQUENCE: Provide vacancy sensor control (DLM system manual ON/OFF, auto OFF, DIM).
 2. Instructional areas, classrooms, and large group instruction up to 99-person occupancy provide single zone dimming with DLM control at each entry door. Provide additional zones if the room is equipped with room divider partitions.
 3. Large Group Instruction over 100-person occupancy: Provide up to three dimming zones, one over the presentation display area, one over the seating area, and one for any other specialty lighting or enhanced zone functionality. Provide DLM system master control station only at the main entry door or near the presentation area. Provide entry station(s) at each entry door to provide ON/OFF general lighting.
- C. SHOPS, KITCHEN, FOOD SERVING QUEUE, AND NATATORIUM
1. BMCS to interface with DLM room controllers for occupied/un-occupied state. Un-occupied state shall turn lights off. No occupant sensors for safety and security. Local DLM switches also function as a local override. No dimming
 2. Kitchen/serving: Manual local DLM switches. Locate kitchen/serving switches in supervised locations for on/off control. Occupancy sensor for auto ON only, sensor shall not turn kitchen/serving lights OFF. No dimming (health code

- lighting requirement supersedes IECC).
3. Shops: Provide lighting with less than 0.6-Watts per square foot for IECC exception to not require lighting reduction controls or dimming. Occupancy sensor for auto ON only, sensor shall not turn shop lights OFF. No dimming.
 4. Natatorium: Safety and security: BMCS unoccupied state shall turn lights OFF. No automatic sensor lighting controls, no dimming, no light reduction controls. ON/OFF with Hubbell key switches located at main entry/exit door and as directed by CFISD. Provide manual DLM switch for ON/OFF control in swimming coaches' office or other supervised location as directed by CFISD. The DLM room controller for the natatorium shall be located above an accessible low height ceiling, preferably next to the coaches' office DLM room controller, or as directed by CFISD.
- D. CAFETERIA, CAFETORIUM, GYMS, LIBRARY, STAGE, LOCKER ROOMS
1. BMCS to interface with DLM room controllers for occupied/un-occupied state. Un-occupied state shall turn lights OFF. No occupant sensors for safety and security. Local DLM switches also function as a local DLM override. Dimming only as required for light reduction, code required daylight harvesting, and as indicated on drawings.
 2. Cafeterias and cafetorium's: DLM Hubbell SPDT key switches at cafetorium main entry. Dimming switches at main entry and on stage. Cafeterias require only one dimming zone. Cafetorium with stage: Provide up to three dimming zones, zoned from front of house to back of house.
 3. School stage general lighting: General lighting for stages and platforms with proscenium curtains or wall dividers shall be controlled as a separate zone. Provide a separate zone for back-of-house stage access ramps. Provide DLM ON/OFF control for the stage general lighting at each entry/exit point to the stage. Provide ramp lighting ON/OFF DLM control at each end of the ramp. Verify zoning and switch locations with theatrical consultant drawings.
 4. Elementary School Cafetorium Theatrical Track Lighting: Locate four ganged wall box 120-volt line voltage dimmer controls on stage at an accessible location, not obstructed by stage curtains, as indicated or as directed by CFISD.
 5. Library: Manual DLM control located in supervised area (behind circulation desk or as directed by CFISD). Hubbell SPDT key switch at main entry door location as directed by CFISD. If dimming zones are provided locate dimming controls in a secured area (circulation desk). Key switch ON function shall force all lights to full bright.
 6. Gyms: Manual DLM Hubbell SPDT key switch. Provide separate zones with Hubbell key switch to enable UIL competition light level for UIL Sports Lighting Standards. Label key switch for UIL competition light level control as court as "UIL COMPETITION ONLY".
 7. Locker rooms: Occupancy sensors control for auto ON/OFF: Set sensors to full-bright on and 20-minute time delay off for safety and security. Manual ON/OFF with DLM Hubbell momentary SPDT key switches located at main entry doors and as directed by CFISD. Provide lighting in these areas with less than 0.6-Watts per square foot for IECC exception to not require lighting reduction controls.
- E. CLOSED-DOOR ADMINISTRATIVE OR PRIVATE TOILETS/RESTROOMS, DRESSING ROOMS, OTHER TOILETS/RESTROOMS WITH DOORS NOT DIRECTLY CONNECTED TO A CORRIDOR:
1. SEQUENCE: Occupancy sensors (DLM system manual ON/OFF, automatic ON/OFF).

2. Provide dual technology occupancy sensor control for automatic ON/OFF based on occupancy. Set occupancy time delay and sensitivity to device setting maximum for safety and security.
 3. Student/public restrooms with doors not connected to an adjacent egress corridor: Provide CFSID standard Hubbell momentary key switch at student and public toilets/restrooms entry door location for manual DLM ON/OFF.
 4. Private or administrative toilets/restrooms: Provide standard DLM ON/OFF switch for all other restrooms and dressing rooms with doors.
- F. MECHANICAL, ELECTRICAL, PLUMBING, ELEVATOR, AND TECHNOLOGY ROOMS
1. Provide line voltage mechanical time switch withhold at each entry door, wired in parallel as required. Refer to Line Voltage Wiring Device specifications.
- G. CUSTODIAL, JANITORIAL, STORAGE LESS THAN 100SF, UTILITY ROOMS, FREE STANDING REMOTE BUILDINGS (CONCESSION, PRESS BOX, TICKETING, ETC.)
1. DLM vacancy sensor, no dimming except for press box viewing space.
- H. BLACK BOX THEATRES
1. Black box theatres shall be provided with standalone instructional lighting, lighting controls and emergency lighting typical of instructional areas and classrooms.

3.4 IDENTIFICATION FOR LIGHTING CONTROL SYSTEM EQUIPMENT

- A. Above ceiling lighting control system equipment locators: Provide plastic tape machine typed name plate to bottom of ceiling T-grid below relay location. White letters on black background with ¼" high letters on ½" tall label for digital lighting module indicate as: DLM.
- B. Room controller identification: Label each digital room controller with 120/277 Volt circuit (i.e., "HD-27") and room graphic name and number. Do not use architectural room name or number on drawings, use room graphic identification only.
- C. All low voltage wiring shall have "WattStopper" printed on the wire jacket.

3.5 ATTIC STOCK

- A. Provide a minimum of 2 or 5 percent of the project total, whichever is greater, of all other hardware components used.
- B. Provide five configuration handheld remote tools for new facilities or three remote configuration handheld remote tools for renovation facilities.

3.6 FACTORY COMMISSIONING

- A. The installing electrical contractor shall complete, prior to request of WattStopper factory start up and site commissioning, complete installation of all devices, their respective loads landed and confirmed operations, switches installed and confirmed operation of each and every local room network. 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 installing electrical contractor shall provide a preliminary as-built drawing prior to commissioning. Drawing shall include room by room device ID's and locations of all WattStopper devices.
- C. The factory commissioning shall include the following services. Programming of all button stations, configuration of all occupancy sensors and photocells. Verification of a complete working system.
- D. 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.)
- E. The electrical contractor shall provide in writing, both the manufacturer and Owner, with 21-Owner business days written notice of the requested system startup and adjustment date.
- F. 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.
- G. 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.
- H. Re-commissioning – After 90 days from occupancy 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.
- I. Close-out commissioning - After 11-months from substantial completion, re-calibrate sensor time delays and sensitivities to Owner's Satisfaction at no additional cost to the Owner. Provide a detailed report to the Architect / Owner of re-commissioning activity.

END OF SECTION

SECTION 26 12 17
ULTRA HIGH EFFICIENCY K-RATED TRANSFORMERS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Copper-wound three-phase transformer exceeding US Department of Energy 2016 Efficiency Standards, with extremely low no load losses.
 - 1. Transformers shall be designed to an efficiency standard higher than NEMA Premium.
- B. Load Mix: Transformer shall be UL 1561 Listed to feed a mix of equipment load profiles such as computers without derating or significant degradation of efficiency.

1.2 REFERENCES

- A. FEDERAL REGISTER – US Department of Energy, Office of Energy Efficiency and Renewable Energy. 10 CFR Part 431. Energy Conservation Program for Commercial and Industrial Equipment: Energy Conservation Standards for Distribution Transformers; 2016 Standards
- B. DOE Test Method For Measuring The Energy Consumption Of Distribution Transformers Under Appendix A To Subpart K Of 10 CFR Part 431.
- C. Metering Standards:
 - 1. Computational algorithms per IEEE Std 1459-2000
 - 2. UL 916, UL 61010C-1 CAT III
- D. IEEE-1100 – Recommended Practice for Powering and Grounding Sensitive Electronic Equipment
 - 1. IEEE Standard 1100 documents how typical transformers feeding electronic equipment produce substantially higher losses under electronic equipment load compared to under linear load, requiring derating.
- E. LEED – Leadership in Energy and Environmental Design, U.S. Green Building Council.
- F. ISO 9000:2000 – International Standards Organization - Quality Management System
- G. ISO 14000:2004 – International Standards Organization - Environmental Management System
- H. NFPA 70 - National Electrical Code (Latest Edition)
- I. NEMA ST20-2014 - Dry-Type Transformers for General Applications
- J. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment
- K. US Department of Energy, 10 CFR Part 431, 2015. Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule.
- L. IEEE C57.110-2008 – IEEE Recommended Practice for establishing transformer capability when feeding non-sinusoidal load currents.
- M. ISO 17025 – International Standards Organization - General requirements for the competence of testing and calibration laboratories.
- N. UL 1561 - Dry-Type General Purpose and Power Transformers.

1.3 SUBMITTALS

- A. Submit product data including the following:
 - 1. Copy of ISO 14001:2004 Certification of manufacturing operation.
 - 2. Copy of ISO 9001:2000 Certification of manufacturing operation.
 - 3. Construction Details including enclosure dimensions, kVA rating, primary & secondary nominal voltages, voltage taps, BIL, unit weight

4. Basic Performance characteristics including insulation class, temperature rise, core and coil materials, impedances & audible noise level, unit weight
 5. Inrush Current (typical 3 cycle recovery)
 6. Short Circuit Current data: Primary (Sym. O/P S/C) & Secondary (L-N/G S/C)
 7. Efficiency Data
 - a. No load and full load losses per NEMA ST20
 - b. Linear load Efficiency data @ 1/6 load
 - c. Linear load efficiency data @ 1/4, 1/2, 3/4 & full load
 - d. Linear Load Efficiency @ 35% loading tested per NEMA TP-2.
 - e. Efficiency under specified K rating load profile at 15%, 25%, 50%, 75%, 100% of nameplate rating.
 8. Copy of Factory ISO 9001 documentation describing nonlinear load test program
 - a. Meter and CT details including model, accuracy, serial numbers and calibration information.
 9. Copy of Linear & Nonlinear load test report for a representative 75kVA transformer
 10. 25 year Product Warranty Certificate
- B. Description of manufacturer's factory nonlinear load test program.
1. In light of the significant degradation of transformer performance when feeding nonlinear load compared to linear load, it is mandatory that the manufacturer test the transformers under nonlinear load representative of real world load mix. Transformers that have not been subject to testing under nonlinear load will not be considered for this project due to the uncertainty related to their real world performance.
 2. Given the lack of a standard for testing transformers under nonlinear load, the manufacturer must have a nonlinear Load Test Program operating in the production environment that is audited and documented per quality standard ISO 9001.
 3. The nonlinear load bank shall consist of a phase-neutral loading with a specified K rating load profile, representative of a mix of typical commercial equipment.
 4. Meters and CTs shall both be revenue class accurate. CTs shall be operated within their approved accuracy loading range. Dual meters shall gather simultaneous primary and secondary energy and harmonic data. Meter and CT details including model, accuracy, serial numbers and calibration information.
 5. Efficiency: Measurements shall be taken at multiple load levels and plotted to show compliance with specification and correlation to the designed efficiency curve.
 6. Efficiency shall be determined purely by measurements using method and instrumentation per NEMA TP-2 Standard. Other methods are not acceptable.
 7. Harmonic data including current and Voltage THD at the different load levels shall be included with the test report.

1.4 SPECIFICATION COMPLIANCE REVIEW

- A. Mark up a complete copy of the specification section for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect/Engineer/Owner (Does Not

Comply, Explanation:) Do not submit an outline form of compliance, submit a complete copy with the product data.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store and protect products
- B. Store in a warm, dry location with uniform temperature. Cover ventilation openings to keep out dust, water and other foreign material.
- C. Handle transformers using lifting eyes and/or brackets provided for that purpose. Protect against unfavorable external environment such as rain and snow, during handling.

1.6 WARRANTY

- A. Transformer shall carry a 25-year pro-rated warranty, which shall be standard for the product line.

1.7 INTERNATIONAL STANDARDS ORGANIZATION REGISTRATION OF MANUFACTURING PLANT

- A. Registration to current ISO standard is required.
- B. Independent annual audits are conducted.
- C. Product shall be manufactured in registered facility
- D. ISO 9001:2000 Registered – Quality Management System
- E. ISO 14001:2004 Registered – Environmental Management System
 - 1. Transformer manufacturing can produce significant emissions of volatile compounds and significant other waste. To minimize environmental impact, the transformer must be the product of a manufacturing process that has been independently audited to comply with the ISO 14001:2004 Environmental Management System Standard, where strict quality control of raw material sourcing and construction techniques maximize product efficiency and minimize emissions and waste byproducts.
 - 2. ISO 14001:2004 ensures that a facility has had an independent environmental impact assessment of raw material sourcing and all manufacturing processes, and has implemented an independent annually audited program that minimizes environmental impact during manufacturing process and includes a strictly monitored continuous improvement program.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS/PRODUCT

- A. Powersmiths E-Saver OPAL
- B. Power Quality International (Z3 e-Rated)
- C. Mirus - ULLTRA

2.2 TRANSFORMER SPECIFICATION

- A. Minimum UL Listed and Labeled K-Rating: K7
- B. Copper-wound, 3-phase, common core, ventilated, dry-type, isolation transformer built to NEMA ST20 and relevant NEMA, UL and IEEE standards; 200% rated neutral; 60Hz rated; Transformers 750 kVA and less, 600 volt primary and less, shall be UL Listed and bear the label. All terminals, including those for changing taps, must be readily accessible by removing a front cover plate. Windings shall be continuous with terminations brazed or welded. 10kV BIL.
- C. Insulation System:

1. Shall be NOMEX-based with an Epoxy Co-polymer impregnate for lowest environmental impact, long term reliability and long life expectancy
 - a. Class: 220 degrees C
 - b. Impregnate Properties for low emissions during manufacturing, highest reliability and life expectancy
 - c. Epoxy co-polymer
 - d. VOC: less than 1.65 lbs./gal (low emissions during manufacturing)
 - e. Water absorption (24hrs @25C): less than 0.05% (superior insulation, longer life)
 - f. Chemical Resistance: Must have documented excellent performance rating by supplier
 - g. Dielectric Strength: minimum of 3200 volts/mil dry (for superior stress, overvoltage tolerance)
 - h. Dissipation Factor: max. 0.02 @25C to reduce aging of insulation, extending useful life
- D. Operating Temperature Rise: Maximum 115 degree C in a 40 degree C maximum ambient
- E. Noise levels:
 1. 3dB Below NEMA ST-20
 2. Production Test every unit. Data to be available upon request.
- F. Exceed minimum efficiency requirements of US Department of Energy, 10 CFR Part 431, April 18, 2013, Energy Conservation Program: Energy Conservation Standards for Distribution Transformers: Final Rule which takes effect January 1, 2016, and comply with the table of maximum no Load Losses, efficiency requirements at 1/6 load, efficiency at 35% load per 10 CFR Part 431, and efficiency at 25% load under the transformer specified K-rating load profile.
- G. Maximum losses and minimum efficiency under linear load conditions per Table 1.

Table 1													
Max and Min Values for Losses and Efficiency for “High Efficiency” Transformers Under K1 Linear and Specified K-Rating Nonlinear Loading													
kVA Rating	No Load	16.5% Load				25% Load				35% Load			
		K1 Linear		Nonlinear		Linear		Nonlinear		K1 Linear		Nonlinear	
	Max Loss (kW)	Min Eff. (%)	Max Loss (kW)	Min Eff. (%)	Max Loss (kW)	Min Eff. (%)	Max Loss (kW)	Min Eff. (%)	Max Loss (kW)	Min Eff. (%)	Max Loss (kW)	Min Eff. (%)	Max Loss (kW)
15	0.054	0.066	97.38	0.067	97.36	0.082	97.86	0.085	97.78	0.109	97.97	0.117	97.82
30	0.091	0.112	97.79	0.113	97.77	0.138	98.19	0.144	98.12	0.183	98.29	0.200	98.13
45	0.124	0.152	98.00	0.154	97.97	0.187	98.36	0.197	98.28	0.248	98.45	0.276	98.28
75	0.181	0.221	98.24	0.225	98.22	0.273	98.56	0.288	98.49	0.362	98.64	0.404	98.48
112.5	0.245	0.300	98.41	0.305	98.38	0.370	98.70	0.393	98.62	0.490	98.77	0.555	98.61
150	0.303	0.370	98.53	0.377	98.50	0.457	98.80	0.486	98.72	0.605	98.86	0.688	98.71

225	0.410	0.501	98.67	0.510	98.64	0.619	98.91	0.659	98.84	0.820	98.97	0.937	98.82
300	0.509	0.622	98.76	0.636	98.73	0.769	98.99	0.829	98.91	1.018	99.04	1.194	98.88
500	0.741	0.906	98.91	0.928	98.89	1.119	99.11	1.213	99.04	1.482	99.16	1.754	99.01

- H. Voltage Taps: For transformers 30kVA-300kVA, provide two 2-1/2% full capacity taps above and below nominal primary voltage. For transformers 15kVA and smaller as well as 500kVA and larger provide one 5% full capacity tap above and below nominal primary voltage.
- I. Impedance: Between 3.0% and 6.0% unless otherwise noted.
- J. Enclosure type: Ventilated NEMA 2; NEMA 3RX aluminum or stainless steel when located outdoors, or as indicated otherwise
- K. Finish Color: Provide light gray ANSI-61 paint finish for transformers located outdoors. Provide manufacturer’s standard paint finish color indoors.
- L. Transformer Options:
 - 1. Electrostatic Shield: Each winding is independently single shielded with a full-width copper electrostatic shield
- M. Closed delta 120/240-Volt secondary, 3-phase, 4-wire with center tap neutral winding transformers:
 - 1. KVA rating indicated shall be for balanced 3-phase loading. Center tap winding shall allow for a maximum nominal 70-percent of three-phase kVA rating for unbalanced single phase neutral connected 120/240-Volt loads. The center tap winding shall be individually rated or constructed at twice the capacity of each of the other delta connected windings. (Example: a 225kVA rated center tap transformer would consist of two 75-kVA windings and one 150-kVA center tap winding).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install transformers where shown, in accordance with the manufacturer's written instructions and industry practices to ensure that the transformers meet the specifications. Comply with requirements of NEMA and NEC standards, and applicable portions of NECA Standard of Installation, for installation of transformers. Transformers shall be floor mounted. Ceiling mounted transformers are not acceptable.
- B. Dry-Type Transformer Mounting: Indoor, floor mount transformer on properly sized Amber/Booth Type RVD rubber-in-shear vibration isolators. Transformer enclosures shall make no contact with wall surfaces.
- C. Conduit directly connected to transformer enclosures shall be flexible liquid tight conduit extending for a minimum of 18-inches and a maximum of 24 inches from transformer enclosure as measured along the conduit centerline. Include a ground wire, size in accordance with NEC, internal in each length of flexible conduit.
- D. Grounding: Ground and bond transformers as a separately derived system unless noted otherwise, refer to NEC 250. Installation of bonding strap or bonding conductor between ground and neutral bus shall be witnessed by the Engineer prior to applying power and terminating secondary conductors.

- E. Check for damage and loose connections.
- F. Set the transformer plumb and level.
- G. Provide Seismic restraints where required.
- H. Coordinate all work in this Section with that in other sections.
- I. Verify all dimensions in the field.
- J. Adjust transformer secondary voltages to provide the required voltage at the loads.

3.2 TESTING

- A. Insulation Tests: Before energizing, check transformer windings for continuity.
- B. Winding Current: During initial no-load energizing, check current in each primary winding.
- C. Tap Settings: Measure and record load current and voltage of transformers while loaded to verify proper transformer tap settings.
- D. Submittals: Furnish instruments and personnel required for tests. Submit four copies of certified test results to Engineer for review. Reports include transformer tested, date and time of tests, relative humidity, temperature, and weather conditions.
- E. Performance Validation: To ensure that the products shipped to the job site meet this specification, provide on-site revenue class accurate efficiency and harmonic measurements of transformers once installed and operating at customer's site. Data shall be collected from primary and secondary sides of the transformer simultaneously on a synchronized cycle by cycle basis. The use of two discrete meters that are not synchronized is not acceptable. Sampling shall be of 10% of transformers on the project once installed and operating, as selected by customer. Submit a detailed report to the project engineer.
- F. Identify non-compliant products to the engineer and replace at no cost to the Owner.
- G. Notification: Notify Engineer in writing of any deviation from manufacturer's pre-shipment test data.

END OF SECTION

SECTION 26 24 13 SWITCHBOARDS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Work Included: Switchboard work as shown, scheduled, indicated, required, and specified.

1.2 QUALITY ASSURANCE

- A. UL Labels: Provide switchboards UL labeled for service entrance and meeting requirements of UL 891.
- B. NEMA Compliance: Comply with National Electrical Manufacturers Association (NEMA) Standard PB2, "Dead-Front Distribution Switchboards."

1.3 SUBMITTALS

- A. Indicate:
 - 1. Detailed dimensions for equipment foot print, front and side elevations.
 - 2. Conduit entrance locations and requirements and restrictions.
 - 3. Enclosure material, finish, and NEMA classification type.
 - 4. Nameplate legends.
 - 5. Size and number of bus bars
 - 6. Switchboard instrument details.
 - 7. Electrical characteristics including voltage, ampacity, overcurrent device frame size and trip ratings, withstand ratings, and time current curves of all overcurrent devices and components.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Schneider Electric - Square D
- B. ABB General Electric Co.
- C. Siemens

2.2 MATERIALS AND COMPONENTS

- A. Except as otherwise indicated, provide switchboard manufacturer's materials and components as indicated and as required for a complete installation.

2.3 DEAD-FRONT DISTRIBUTION SWITCHBOARDS

- A. The overcurrent protective device short circuit, coordination and arc flash studies performed by the overcurrent protective device manufacturer shall be used by the respective switchgear vendor(s) to select appropriate equipment, switchgear, and overcurrent protective device characteristics such as but not limited to: equipment bracing, AIC rating, circuit breaker frame size and trip settings, and fuse type/class. The appropriate equipment suitable and required by the studies for code compliance shall be included with the submittal data for review and provided at no additional cost to the Owner. The appropriate equipment recommended by the studies for enhanced selective coordination or enhanced arc flash energy reduction beyond code compliance shall be included with the submittal data for review and consideration purposes by the engineer.
- B. Provide a factory-assembled, dead-front construction, metal enclosed, self supporting, switchboard of voltage, phase, ampacity, and short circuit interrupting rating and bracing shown.
 - 1. Switchboard shall consist of the required number of front and rear aligned

- vertical sections bolted together to form one metal enclosed rigid switchboard. The switchboard shall be designed as a free-standing with only front access. Rear and/or side access only where indicated to reduce switchboard depth and where NEC required rear access clearance is available.
2. Switchboard shall include protective devices and equipment shown with interconnections, instrumentation, and control wiring. Small wiring, necessary fuse blocks, and terminal blocks in the switchboard shall be provided. Groups of control wires leaving the switchboard shall be furnished with terminal blocks with numbering strips.
 3. Factory installed permanent lock-off provision for pad-locking in the off position for all protective devices.
- C. Enclosure Construction: The switchboard framework shall be fabricated for floor mounting. The framework shall be formed code gauge steel, welded and bolted together to support cover plates, busing, and component devices.
1. Each section shall have an open bottom and individually removable top plates for installation and termination of conduit. Top and bottom conduit areas shall be shown and dimensioned on the shop drawings. Front plates used for mounting meters, selector switches, or other front-mounted devices shall be hinged, with wiring installed and laced, and with flexibility at the hinged side. Closure plates shall be screw removable and small enough for easy handling by one technician.
 2. Weatherproof enclosure front door(s) shall be pad-lockable and suitable for the intended environmental conditions. When indicated or specified, rear doors shall also be pad-lockable.
- D. Busing: The switchboard busing shall be copper.
1. The bus bars shall be braced to comply with the integrated equipment rating of the switchboard. The main horizontal bus bars between sections shall be located on the back of the switchboard to permit maximum available conduit entry area. The horizontal main bus bar supports, connections, and joints shall be bolted or welded, as required, so as not to require periodic maintenance. Bolted joint connections shall have at least two bolts per joint per phase. Half lapped bus joint construction is not acceptable.
 2. Buses shall be arranged A-B-C, left-to-right, top-to-bottom, and front-to-rear throughout. A ground bus shall be secured to each vertical section structure and extend the entire length of the switchboard.
 3. The main horizontal bus and incoming line shall be isolated and insulated from outgoing busing and cable connections.
 4. Each group mounted section shall have maximum full height bus. Where space is indicated, space shall be bused to install future switches or future circuit breakers sized as shown or a 600 Amp frame size circuit breaker or switch, whichever is greater.
 5. The main horizontal bus shall be non-tapered, fully rated, extended and drilled for future additions and splice plates.
- E. Integrated Equipment Rating: Each switchboard, as a complete unit, shall be given a single integrated equipment rating by the manufacturer. The integrated equipment short circuit rating shall certify that equipment can withstand the stresses of a fault equal to that shown in RMS symmetrical amperes. Ratings shall have been established by actual tests by the manufacturer on similar equipment construction as the subject switchboard. This test data shall be available and furnished, if requested, with or before the submittal of shop drawings.
- F. Indicating Instruments: Switchboard instrumentation shall be digital display, panel mounted, rated for 120V, 60 hertz. The display unit shall be UL listed in accordance with

- UL 508. The electronic metering device shall have the following features:
1. Voltmeter, phase to phase and phase to ground or neutral.
 2. Current, per phase RMS and 3 phase coverage.
 3. Demand current per phase.
 4. Power factor per phase and 3 phase average.
 5. Real power, 3 phase total.
 6. Reactive power, 3 phase total.
 7. Apparent power, 3 phase total.
 8. Frequency.
 9. Average demand real power.
 10. Adjustable demand interval (5 to 60 minutes).
 11. Nonvolatile memory.
 12. Password protected set-up and reset.
 13. 3 current transformers with primary to match bus size and 5 ampere secondary with metering class accuracy.
 14. Full scale readouts with the following accuracy:
 - a. Current and voltage measurement +/-0.1%
 - b. Power and energy +/-0.2%
 - c. Frequency +/-0.5%
 - d. Power Factor +/-1.0%
 - e. Data update time 0.5 seconds (4 wire)
 15. Metering Output.
 - a. Pulse output based on kWh, kvarh, or kVAh.
 - b. Analog output 4-20mA based on kWh, kvarh, or kVAh.
 16. Monitoring:
 - a. Harmonic analysis through 63rd with THD and TIF.
 - b. Event recorder.
 - c. Waveform capture.
 - d. Data logger.
 - e. Triggered trace memory.
 17. Communication:
 - a. Front port and dual rear mounted RS485 ports.
 - b. BACnet protocol (coordinate with BMCS contractor).
 - c. Mini RTU: digital 4 in/4 out.
 - d. Analog 1 in/4 out.
 - e. Local/remote display of all values.
 18. Software:
 - a. Windows based software shall be provided to enable setpoint programming.
- G. The Main Protective Device(s) shall be individually mounted molded case circuit breaker(s):
1. Adjustable: current, I²t settings, ground fault (where required), instantaneous trip, and short time trip. Solid state true RMS sensing, without fusible elements, 100-percent continuous current rating.
 2. Main protective devices with frame rated at 1000 Amps or greater shall have integral ground fault interrupter and provided with a portable test set or test switch.
 3. Circuit breakers with 1,200 Amp frame and above shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).
 4. Provide shunt trip capability and wiring to terminal block for remote shunt trip switch wiring termination weather remote trip device is indicated or not.

- H. Feeder and Branch Protective Devices greater than 1,200 Amps shall be individually mounted:
 - 1. Molded case circuit breakers:
 - a. Adjustable: current, I²t settings, ground fault (where required), instantaneous trip, and short time trip. Solid state trip true RMS sensing, without fusible elements; 100-percent continuous current rating.
 - b. Energy Reducing Maintenance System switch with local status indicator (ERMS).
 - c. Shunt trip capability and wiring to terminal block for remote shunt trip switch wiring termination weather remote trip device is indicated or not.
 - 2. Fusible switches:
 - a. Each switch shall have an individual door over the front, equipped with a voidable interlock that prevents the door from being opened when the switch is in the ON position unless the interlock is purposely defeated by activation of the voiding mechanism. All switches shall have externally operated handles.
 - b. Fused switches 600 Amps and below, equipped for class J fuses.
 - c. Fused switches 601 Amps and above shall be equipped with Class R or L rejection type fuse holders. Class RK1 or L of ampere rating and type as indicated on the plans suitable for application of the system.
 - d. When required by the latest edition of the NEC or the AHJ, 1,200 Amp switches regardless of fuse size installed shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).
- I. Feeder and Branch Protective Devices 1,200 Amps and below shall be group mounted:
 - 1. Molded case circuit breakers:
 - a. Greater than 250 Amp: Solid state true RMS sensing with adjustable: current, I²t settings, ground fault (where required), instantaneous trip, and short time trip; 80-percent continuous current rating.
 - b. 250 Amp and smaller: Solid state true RMS sensing with fixed current setting by rating plug or dial. Breaker shall have adjustable instantaneous trip function with short time tracking.
 - c. 1,200 Amp frame circuit breakers regardless of trip shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).
 - 2. Fusible switches:
 - a. Quick-make, quick-break units utilizing the double-break principle of circuit interrupting to minimize arcing and pitting and shall conform to the ratings shown.
 - b. Individual door over the front, equipped with a voidable interlock that prevents the door from being opened when the switch is in the ON position unless the interlock is purposely defeated by activation of the voiding mechanism. All switches shall have externally operated handles.
 - c. 600 Amps and below equipped for Class J fuses.
 - d. 601 Amps and above shall be equipped for Class R or L rejection type fuse holders.
 - e. When required by the latest edition of the NEC or the AHJ, 1,200 Amp fused switches regardless of fuse size installed shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).
- J. Ground Fault Interrupter (GFI) protection: Where shown or required, ground fault protection shall be achieved with adjustable pickup for ground fault currents, field-

adjustable from 200 amperes and instantaneous to 60 cycle time delay. The ground fault protection system shall include necessary current sensors, internal wiring, and relays to coordinate opening the monitored faulted circuits.

1. Ground fault protection shall be set at minimum setting for both current and time during construction. The switchboard manufacturer shall include in the submittal data for the switchboard, the minimum setting of the devices and the recommended setting for normal building operation.
 2. The ground fault system shall be factory-tested before shipment as specified:
 - a. The switchboard manufacturer shall provide a factory ground fault protection system test for circuit testing and verification of tripping characteristics. The manufacturer shall pass predetermined values of current through the sensors and measure the tripping time for each phase and neutral. The measured time-current relationships shall be compared to the trip-characteristic curves. If the ground fault device trips outside the range of values indicated on the curve, the ground fault device shall be replaced or recalibrated.
 - b. Relays, electrically operated switches, shunt-trip switches, circuit breakers, and similar items shall have proper voltages applied to their circuits and satisfactory operation demonstrated.
 - c. Upon completion of the factory ground fault protection system test, the current and time on each ground fault device shall be set to minimum values.
- K. Mimic bus: Indicate busing, connections, and devices in single line form on the front panels of the switchboard using red colored plastic strips, fastened flat against the panel face with screws.

PART 3 - EXECUTION

3.1 INSTALLATION OF SWITCHBOARDS

- A. Install switchboards where shown, in accordance with the manufacturer's written instructions, and industry practices to ensure that the switchboards meet the specifications. Provide weatherproof NEMA 3R enclosure housing outdoors, at wet locations, or where indicated on the drawings. Provide NEMA 3RX enclosure housing at corrosive locations of either aluminum or stainless-steel construction suitable for the intended environment when indicated on the drawings.
- B. Comply with the requirements of NEMA and NEC, and NECA Standard of Installation, for installation of switchboards.
- C. Where switchboard is used or indicated as the utility service building disconnect, provide main bonding jumper and neutral to ground bond connected to the building's grounding system. Do not bond neutral to ground when there is a neutral to ground bond upstream from the same derived neutral system serving the switchboard.
- D. Torque bus connections and tighten mechanical fasteners.
- E. Install fuses, of ratings shown, in each switchboard. Provide spare fuse cabinet with three fuses of each size provided. Locate in central plant as directed by Owner.
- F. Concrete Pads: Install switchboards on a 4" reinforced concrete housekeeping pad. The housekeeping pad shall extend 3" beyond the housing of the switchboard unless shown otherwise. Switchboard shall be bolted to the housekeeping pad using 3/8" minimum galvanized bolts and anchors on 30" maximum centers. Furnish the exact position of any block outs, dimensions, and location of the housekeeping pads to prevent delay of the concrete work.
- G. Adjustment: Adjust operating mechanisms for free mechanical movement. Adjust circuit breaker time characteristic curves as recommended by the Fault Current and

Coordination Analysis or as directed by the Engineer.

- H. Indicating Instruments: Provide initial factory start-up and programming with Owner present. Integrate with the Building Management System for monitoring and logging of all system data.

3.2 TESTING

- A. Notify Owner's Commissioning Authority (CxA) prior to performing any tests so that the CxA may witness tests at the CxA's discretion.
- B. Pre-energization checks: Before energizing, check switchboards for continuous of circuits and for short circuits.
- C. Switchboard insulation resistance test: Each switchboard bus shall be insulation resistance tested after installation is complete except for line and load side connections. Tests shall be made using Biddle Megger or equivalent test instrument at a voltage of not less than 1000 vDC. Resistance shall be measured from phase-to-phase and from phase-to-ground. Minimum acceptable value for insulation resistance is 2 megohms.
- D. Ground Fault Interrupter (GFI) test: After completion of construction and before final acceptance testing, the ground fault protection system shall be field-tested and reset to the manufacturer's settings for both current and time by a representative of the manufacturer's engineering service department. After the test, set ground fault to 50 percent of overcurrent device rating or 1,200 Amperes, whichever is lower.
- E. Provide thermal infrared scan of switchboard under full load as directed and witnessed by Owner. Correct any deficiencies causing abnormal heating and repeat the scan. Provide digital video documentation with deficiencies corrected for comparison to future test. Make corrections as needed as soon as possible as directed by the Owner. Repeat the scan at the 11-month prior to closeout, and make corrections prior to close-out.
- F. Submittals: Furnish instruments and personnel required for tests. Submit 4 copies of certified test results to the Architect for review. Test reports shall include switchboard tested, date and time of test, relative humidity, temperature, and weather conditions.

3.3 TRAINING

- A. Provide minimum 2 hours of dedicated training provided by a factory authorized representative to Owner's personnel regarding programming, operating, and use of switchboard components including all indicating instruments and safety features.

END OF SECTION

SECTION 26 24 14
TESTING, MAINTENANCE, AND MODIFICATIONS TO EXISTING SWITCHBOARDS
AND FEEDER DISTRIBUTION PANELBOARDS

PART 1 -GENERAL

1.1 WORK INCLUDED

- A. Work Included: Switchboard and distribution panel work to existing switchboards or distribution panelboards 800 Amps or more and 600 volts or less as shown, scheduled, indicated, and specified.
- B. Types: Work for the project includes switchboards and feeder distribution panelboards.

1.2 QUALITY ASSURANCE

- A. Original Equipment Manufacturer's (OEM's) Installation and Maintenance Instructions. Coordinate with the OEM's field service representative for specific recommendations for the equipment involved prior to evaluation, testing, and maintenance procedures.
- B. NEMA Compliance: Comply with National Electrical Manufacturers Association (NEMA) Standard PB1 "Panelboards", and Standard PB2, "Dead-Front Distribution Switchboards."
- C. Testing shall be performed by the OEM an InterNational Electrical Testing Association (NETA) National Accredited Company (NAC) and by NETA Certified Technicians with the appropriate NETA level of certification for the testing required.

1.3 SUBMITTALS

- A. Indicate Original Manufacturer's Installation and Maintenance Instructions for testing, exercising, cleaning, and lubrication where available.
- B. Include electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and time current curves of all equipment and components.
- C. Original Manufacturer's Inspection Report when available.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Replacement parts shall be manufactured by Original Equipment Manufacturer, (OEM) when available. When OEM parts are not available, third party, UL recognized, manufactured parts may be used. Provide written confirmation on Manufacturer's letterhead indicating OEM parts are not available.

2.2 MATERIALS AND COMPONENTS

- A. Except as otherwise indicated, provide manufacturer's standard materials and components as indicated by published product information, designed, and constructed as recommended, and as required for a complete installation.

2.3 NEW OVERCURRENT DEVICES AND/OR NEW ACCESSORIES

- A. New Indicating Instruments where indicated: Switchboard instrumentation shall be digital display, panel mounted, rated for 120V, 60 hertz. The display unit shall be UL listed in accordance with UL 508. The electronic metering device shall have the following features:
 - 1. Voltmeter, phase to phase and phase to ground or neutral.
 - 2. Current, per phase RMS and 3 phase coverage.
 - 3. Demand current per phase.
 - 4. Power factor per phase and 3 phase average.
 - 5. Real power, 3 phase total.

6. Reactive power, 3 phase total.
 7. Apparent power, 3 phase total.
 8. Frequency.
 9. Average demand real power.
 10. Adjustable demand interval (5 to 60 minutes).
 11. Nonvolatile memory.
 12. Password protected set-up and reset.
 13. 3 current transformers with primary to match bus size and 5 ampere secondary with metering class accuracy.
 14. Full scale readouts with the following accuracy:
 - a. Current and voltage measurement +/-0.1%
 - b. Power and energy +/-0.2%
 - c. Frequency +/-0.5%
 - d. Power Factor +/-1.0%
 - e. Data update time 0.5 seconds(4 wire)
 15. Metering Output.
 - a. Pulse output based on kWh, kvarh, or kVAh.
 - b. Analog output 4-20mA based on kWh, kvarh, or kVAh.
 16. Monitoring:
 - a. Harmonic analysis through 63rd with THD and TIF.
 - b. Event recorder.
 - c. Waveform capture.
 - d. Data logger.
 - e. Triggered trace memory.
 17. Communication:
 - a. Front port and dual rear mounted RS485 ports.
 - b. BACnet protocol (coordinate with BMCS contractor).
 - c. Mini RTU: digital 4 in/4 out.
 - d. Analog 1 in/4 out.
 - e. Local/remote display of all values.
 18. Software:
 - a. Windows based software shall be provided to enable setpoint programming.
- B. New Feeder and Branch Protective Devices greater than 1,200 Amps shall be individually mounted:
1. Molded case circuit breakers:
 - a. Adjustable: current, I²t settings, ground fault (where required), instantaneous trip, and short time trip. Solid state trip true RMS sensing, without fusible elements; 100-percent continuous current rating.
 - b. Energy Reducing Maintenance System switch with local status indicator (ERMS).
 - c. Shunt trip capability and wiring to terminal block for remote shunt trip switch wiring termination weather remote trip device is indicated or not.
 2. Fusible switches:
 - a. Each switch shall have an individual door over the front, equipped with a voidable interlock that prevents the door from being opened when the switch is in the ON position unless the interlock is purposely defeated by activation of the voiding mechanism. All switches shall have externally operated handles.
 - b. Fused switches 600 Amps and below, equipped for class J fuses.
 - c. Fused switches 601 Amps and above shall be equipped with Class R or L

- rejection type fuse holders. Class RK1 or L of ampere rating and type as indicated on the plans suitable for application of the system.
- d. When required by the latest edition of the NEC or the AHJ, 1,200 Amp switches regardless of fuse size installed shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).
- C. Feeder and Branch Protective Devices 1,200 Amps and below shall be group mounted:
1. Molded case circuit breakers:
 - a. Greater than 250 Amp: Solid state true RMS sensing with adjustable: current, I²t settings, ground fault (where required), instantaneous trip, and short time trip; 80-percent continuous current rating.
 - b. 250 Amp and smaller: Solid state true RMS sensing with fixed current setting by rating plug or dial. Breaker shall have adjustable instantaneous trip function with short time tracking.
 - c. 1,200 Amp frame circuit breakers regardless of trip shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).
 2. Fusible switches:
 - a. Quick-make, quick-break units utilizing the double-break principle of circuit interrupting to minimize arcing and pitting and shall conform to the ratings shown.
 - b. Individual door over the front, equipped with a voidable interlock that prevents the door from being opened when the switch is in the ON position unless the interlock is purposely defeated by activation of the voiding mechanism. All switches shall have externally operated handles.
 - c. 600 Amps and below equipped for Class J fuses.
 - d. 601 Amps and above shall be equipped for Class R or L rejection type fuse holders.
 - e. When required by the latest edition of the NEC or the AHJ, 1,200 Amp fused switches regardless of fuse size installed shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).

PART 3 - EXECUTION

3.1 INSTALLATION, MAINTENANCE, AND MODIFICATION OF SWITCHBOARDS AND FEEDER DISTRIBUTION PANELBOARDS

- A. Comply with the requirements of NEMA, NEC, and NECA Standards for installation, for installation of switchboards and panelboards. Comply with Original Manufacturer's Operation and Maintenance Instructions for testing and periodic maintenance.
- B. Torque all existing and new bus connections and tighten mechanical fasteners to manufacturer's specifications.
- C. Install fuses, of ratings shown, in each new or modified fused switch.
- D. Adjustment: Adjust operating mechanisms for free mechanical movement. Adjust circuit breaker time characteristic curves as directed by the OEM for coordination with downstream overcurrent devices.
- E. Existing Indicating Instruments: Test and calibrate to original manufacturer's specifications. Replace batteries in existing digital instruments where batteries are required. Replace defective indicating instruments with new digital instruments. Provide new digital indicating instruments where indicated on the drawings.
- F. Cleaning: Vacuum the interior of the existing enclosures of all dust and foreign matter. Clean all existing switch contacts according to manufacturer's instructions.
- G. Lubrication: Lubricate all existing exposed switch contacts, pivot points and bearings

- according to manufacturer's instructions.
- H. Remove any existing circuit breakers or fusible switches that are not functional or not suitable to be reused as "spares".
 - I. Provide filler plates where required.
 - J. Existing enclosures which indicate rust or corrosion shall be repainted; paint indoor non-stainless steel enclosures with ALKYD enamel coat, and outdoor non-stainless steel enclosures with epoxy enamel coat to match existing color. Do not paint over labels or listings.
 - K. Mimic bus: Update the existing mimic bus or provide new mimic bus to indicate busing, connections, and devices in single line form on the fronts of switchboards. Use red colored plastic strips or match exiting material and color format, fastened flat against the panel face with screws.

3.2 TESTING

- A. Provide the services of a NETA NAC or Original Manufacturer's Field Services personnel for initial testing at no additional cost to the Owner. The NETA NAC or Original Manufacturer's Field Services personnel shall provide at minimum, a visual inspection of the existing switchboards or panelboard and shall provide a written report with recommendations regarding the existing condition and recommendations to further testing, maintenance, and in regard to the specified modifications of the existing switchboard or panelboard. The report shall include any deficiencies of the existing switchboard in relation to each component's intended function. In addition, provide deficiencies of the existing switchboard or panelboard with regard to the current National Electrical Code. Provide the written report to the Architect within 14 days of notice to proceed and prior to any demolition or construction. All other testing, maintenance, and modifications shall be provided by the Contractor as specified at no additional cost to the Owner.
- B. Pre-Energization Checks: Before energizing, check for continuous of circuits and for short circuits. Test existing Bolted Pressure Switches according to Original Manufacture's Instructions.
- C. Insulation Resistance Test: Each bus shall be insulation resistance tested after installation and modification is complete except for line and load side connections. Tests shall be made using Biddle Megger or equivalent test instrument at a voltage of not less than 1000 vDC. Resistance shall be measured from phase-to-phase and from phase-to-ground. Minimum acceptable value for insulation resistance is 2 megohms.
- D. Ground Fault Protection System Test: After completion of construction and before final acceptance testing, the ground fault protection system shall be field-tested and reset to the manufacturer's recommended settings for both current and time by a representative of the manufacturer's engineering service department. After the test, set ground fault to 1,200 Amps or 50-percent of the circuit breaker or fused switch frame size, whichever is lowest.
- E. All circuit breakers with adjustable trip settings shall fully tested to verify all fixed and adjustable overcurrent and ground fault trip settings are set to the proper setting and function within manufacture's recommended tolerances.
- F. Provide thermal infrared scan of the under full load prior to testing/maintenance and modifications and of the modified or new equipment sections after construction as directed and witnessed by Owner. Make corrections as needed as soon as possible as directed by the Owner. Repeat the scan at the 11-month prior to close out and make corrections prior to close-out. Provide digital video documentation with test results for comparison between prior condition and post construction modifications and future tests.
- G. Submittals: Furnish instruments and certified personnel required for tests. Submit 4

copies of certified test results to the Architect for review. Test reports shall include project location, testing contractor and testing technician's contact information, equipment tested, date and time of test, relative humidity, temperature, and weather conditions.

END OF SECTION

SECTION 26 24 16
PANELBOARDS AND ENCLOSURES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Panelboards and enclosures, including cabinet, as shown, scheduled, indicated, and specified.

1.2 QUALITY ASSURANCE

- A. UL Standards: Panelboards and enclosures shall confirm to all applicable UL standards and shall be UL labeled.

1.3 SUBMITTALS

- A. Indicate:
 - 1. Detailed dimensions.
 - 2. Enclosure material, finish, and NEMA classification type.
 - 3. Location of main circuit breaker.
 - 4. Mounting and trim.
 - 5. Acceptable incoming conductors' size.
 - 6. Electrical characteristics including voltage, ampacity, overcurrent device frame size and trip ratings, bus material and rating, withstand ratings, lugs, and time current curves of all overcurrent devices and components.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Schneider Electric - Square D
- B. ABB-General Electric Co.
- C. Siemens

2.2 MATERIALS AND COMPONENTS

- A. General: Panelboards shall be dead-front type equipped with fusible switches or circuit breakers as shown and as required.
- B. The overcurrent protective device short circuit, coordination and arc flash studies performed by the overcurrent protective device manufacturer shall be used by the respective switchgear vendor(s) to select appropriate equipment, switchgear, and overcurrent protective device characteristics such as but not limited to: equipment bracing, AIC rating, circuit breaker frame size and trip settings, and fuse type/class. The appropriate equipment suitable and required by the studies for code compliance shall be included with the submittal data for review and provided at no additional cost to the Owner. The appropriate equipment recommended by the studies for enhanced selective coordination or enhanced arc flash energy reduction beyond code compliance shall be included with the submittal data for review and consideration purposes by the engineer.
- C. Busing Assembly: Panelboard phase, neutral, and equipment ground busing shall be copper. Bus structure and mains shall have ratings as shown and scheduled. Furnish a bare uninsulated ground bus inside each panelboard enclosure. Two section panelboards shall be connected with copper cable, with an ampacity conforming to the upstream overcurrent device. Neutral bus termination quantity for branch circuit panelboards shall match or exceed the maximum number of single pole circuit breakers the panelboard will accept.
- D. Main circuit breakers and feeder / branch circuit breakers:
 - 1. Less than 125 Amps: Thermal magnetic with factory fixed trip.

2. 125-600 Amps: Thermal magnetic with adjustable instantaneous trip of 5X – 10X with short time tracking.
3. 601 Amps and larger: Solid state true RMS sensing with adjustable: current set by rating plug or adjustable dial, I²t settings, ground fault (where required), instantaneous trip, and short time trip; 80-percent continuous current rating.
4. Provide permanent lock-off device for all fire alarm system branch circuit breakers, for all smoke control fans and equipment, and where indicated or required for circuit breaker to be used as a remote safety disconnect switch.
5. General requirements:
 - a. Make prepared space provisions for additional breakers or fused switches so that no additional bus or connectors will be required to add circuit breakers or fused switches in the available device mounting space.
 - b. Two and three pole breakers shall have internal common trips.
 - c. All circuit breakers used as the main or branch mounted back-fed main shall be bolt-on. All circuit breakers used in 600 Amp and smaller panelboards shall be bolt-on breakers. Circuit breakers for distribution panelboards rated 601 amps and larger shall have plug-on or bolt-on circuit breakers.
 - d. Branch circuit panelboard shall have interrupting capacity as shown or as required, but in no case less 10k AIC for 120/208/240-Volt systems, and 18k AIC for 277/480-Volt systems.
 - e. 15 and 20 Amp circuit breakers for lighting circuits shall be UL listed switch duty (SWD).
 - f. Personnel ground fault interrupter (GFI) circuit breakers, where shown, shall be maximum 5 mA ground fault trip and shall include a TEST button.
 - g. Equipment ground fault interrupter (EGFI/EGPD) circuit breakers, where shown or required shall be 30mA ground fault trip and shall include TEST button.
 - h. Circuit breakers with 1,200 Amp and larger frame shall have Energy Reducing Maintenance Switching with local status indicator (ERMS).
- E. Fusible Switches for distribution panelboards: Fusible switches shall be quick-make, quick-break type. Each switch shall be enclosed in a separate steel enclosure. The enclosure shall employ a hinged cover for access to the fuses. Interlock cover with the operating handle to prevent opening the cover when the switch is in the ON position. This interlock shall be constructed so that it can be overridden for testing fuses without interrupting service. The switches shall have padlocking provisions in the OFF position. Switches shall include positive pressure rejection type fuse clips for use with UL Class J fuses and be UL labeled for 200,000 AIC.
- F. Spaces: Where space for future breakers or switches is shown, panelboard enclosure shall include removable blank panels or knockouts to allow installation of future breakers or switches, prepared spaces, and panelboard busing shall be complete, including required connectors.
- G. Integrated Equipment Rating: Do not apply series ratings. Each panelboard, as a complete unit, shall have a short-circuit rating equal or greater than the available short circuit current. Rating shall have been established by tests on similar panelboards with the circuit breakers or fusible switches installed.
- H. GFCI circuit breakers not available in the required panel AIC rating shall be series rated with the upstream over current protection device to provide the panelboard with required AIC rating. Coordinate series rating requirements with manufacturer. Mark the panel per NEC 110. The marking shall be visible and state the following: "CAUTION-

**ENGINEERED SERIES COMBINATION SYSTEM RATED XXX AMPERS.
IDENTIFIED REPLACEMENT COMPONENTS REQUIRED”.**

- I. Panelboard Enclosures:
 1. Provide sheet steel enclosures, minimum 16-gauge nominal thickness, with multiple knockouts, unless shown otherwise. Provide all NEMA 1 panelboard fronts with spring-loaded door pulls, and flush lock and key, panelboard enclosures keyed alike to match the Owner’s standard key system; coordinate with Owner.
 2. All NEMA 1 enclosure panelboards shall be hinged “door-in-door” type with interior hinged door with hand operated latch or latches, as required providing access only to circuit breaker or fusible switch operating handles, not to exposed energized parts. Outer hinged door shall be securely mounted to the panelboard box with factory bolts, screws, clips, or other fasteners, requiring a tool for entry. Hand operated latches are not acceptable. Push inner and outer doors shall open left to right. Manufacturer hardware (OEM), screws, and bolts shall be used to secure dead fronts and covers. Do not use third party hardware. Do not use power tools to secure panel hardware. Provide gray powder coat finish over a rust inhibitor.
 3. Equip with interior circuit directory frame, card, and clear plastic covering for panelboards.
 4. Panelboards located in kitchen preparation or natatorium areas shall have Type 316 stainless steel front, door, and trim with a NEMA 1 rating for the entire enclosure.
 5. Panelboards at exterior locations shall be NEMA 4X Type 316 stainless steel.
 6. Panelboards at hose down areas, cooling towers, in greenhouses, and other corrosive locations shall be NEMA 4X 316 stainless steel.
 7. Enclosure shall be for recessed or surface mounting as shown or as required.
 8. Enclosures shall be fabricated by the same manufacturer as panelboards to be enclosed. Multi-section panelboards shall have same physical dimensions.

PART 3 - EXECUTION

3.1 INSTALLATION OF PANELBOARDS AND ENCLOSURES

- A. General: Install panelboards and enclosures, as shown, including electrical connections, in accordance with the manufacturer's written instructions, the requirements of NEC, NECA Standard of Installation, and industry practices. Circuit breakers shall be factory installed except for required field modifications due to actual site conditions.
- B. Coordination: Coordinate installation of panelboards and enclosures with conductor and raceways installation work.
- C. Anchoring: Anchor enclosures to walls and structural surfaces ensuring that they are permanently and mechanically secured.
- D. Directory Card: Provide a typed circuit directory card(s) upon completion of work. Directory card shall be of super heavy-weight index card stock, 110 lb, white. Directory shall include type of load (i.e.: receptacles, lighting, exhaust fan, etc.) and location (i.e.: Room 102, Office, etc.) Room number shall be identified as the actual graphics room number assigned to the space and not the room number identified on the Plans. Circuits with shunt trip shall be identified with the control circuit operating the shunt trip (i.e.: Kitchen Hood No. 2). Shunt trip breakers with common trip circuit shall be grouped in the panelboard (i.e.: circuits 1, 3, 5 and 7).
- E. Fuses: Install fuses, of the ratings and class shown.
- F. Circuit Arrangement: Branch circuits shall be arranged to provide the best possible phase balance, unless shown otherwise.

- G. Panelboards not intended to be used as service entrance (SE) rated or for establishing a separately derived neutral system shall have the factory installed neutral to ground bonding screws and straps removed and disposed of.
- H. Recessed or flush mounted panelboards: Terminate spare conduits in junction box 18-inches above accessible ceiling close to panelboard location. Label junction box cover as “not used” and include panel identification.
 - 1. Provide (3) 1-inch and (3) ¾-inch spare conduits above accessible ceiling to j-box from each panelboard section.
 - 2. Where recessed panelboard is located above another building floor, also provide (3) 1-inch and (3) ¾-inch conduits to j-box in ceiling space on floor below.
- I. Conductors shall be bent neatly opposite the fuse switch or circuit breaker to which they are to be attached. Vertically installed conductors shall be neatly tie-wrapped. Conductors shall be connected in a neat and professional manner. Conductors brought in from the top or bottom of the cabinet shall be bent neatly opposite the fuse or circuit breaker to which they are to be attached. Each conductor shall be run along the full height of the panel and returned to the circuit breaker or fuse location to allow relocation of the conductor to any position along the bus. Panelboard shall be cleaned of all construction debris prior to substantial completion review. Neutral and grounding conductors shall be installed similar to the phase conductors.
- J. Circuit breakers and conductors installed for SPD devices shall be located on the same side as the SPD to allow the shortest and straightest run of conductors in respect to the location of the SPD device. Route all conductors to the SPD device with straight as possible run, using longest sweep bends and the shortest conductor length possible. Twist all SPD conductors and secure with tie straps wherever possible.
- K. Install copper ground bus for copper ground conductors. Ground conductors size #1 and larger are to be landed to panelboard enclosure with mechanical lugs and not to ground bus.
- L. Install panels so that breaker number 1 is the top left breaker.
- M. In panels that contain multi-layered neutral bus, install neutrals beginning with the back neutral bus row and work forward. Do not make up neutrals on front neutral bus row unless all other rows are full.
- N. Label breaker mounting space with stick-on number labels.
- O. Mount the fully aligned panelboard such that the maximum height of the top circuit breaker above the finished floor shall not exceed 78-inches. Mount panelboards as high as practical and such that the bottom of the cabinets will not be less than 6 inches above the finished floor.

3.2 TESTING

- A. Before energizing, energization, check for continuity of circuits and short circuits.
- B. Provide thermal infrared scan of panelboards under full load as directed and witnessed by Owner. Correct any deficiencies causing abnormal heating and repeat the scan. Provide digital video documentation with deficiencies corrected for comparison to future test. Make corrections as needed as soon as possible as directed by the Owner. Repeat the scan at the 11-month prior to closeout and make corrections prior to close-out.

END OF SECTION

SECTION 26 24 25 ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Safety and disconnect switch work where required, scheduled, indicated, specified, and required. For switches indicated or rated above 1,200 Amps, provide switchboard construction as specified for switchboards.
- B. UL Approved: Safety and disconnect switches shall have UL approval and the UL label.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Schneider Electric - Square D
- B. ABB-General Electric Co.
- C. Siemens

2.2 ENCLOSED SWITCHES

- A. General: Provide heavy duty type, dead-front, sheet steel enclosed, surface-mounted safety switches of the type and size indicated. Safety switches shall be rated for the voltage of the circuit where they are installed. Safety switches used as motor disconnects shall be rated for the motor horsepower served.
- B. The overcurrent protective device short circuit, coordination and arch flash studies performed by the overcurrent protective device manufacturer shall be used by the respective switchgear vendor(s) to select appropriate equipment, switchgear, and overcurrent protective device characteristics such as but not limited to: equipment bracing, AIC rating, circuit breaker frame size and trip settings, and fuse type/class. The appropriate equipment suitable and required by the studies for code compliance shall be included with the submittal data for review and provided at no additional cost to the Owner. The appropriate equipment recommended by the studies for enhanced selective coordination or enhanced arc flash energy reduction beyond code compliance shall be included with the submittal data for review and consideration purposes by the engineer.
- C. Switch Mechanism:
 - 1. Safety switches shall be quick-make, quick-break type with permanently attached arc suppressor. Constructed so that switch blades are visible in the OFF position with the door open. The operating handle shall be an integral part of the box, not the cover. Switch shall have provision to padlock in the OFF position. Safety switches shall have a cover interlock to prevent unauthorized opening of the switch door when the switch mechanism is in the ON position, or closing of the switch mechanism when the switch door is open.
 - 2. Cover interlock shall have an override mechanism to permit switch inspection by authorized personnel. Current-carrying parts shall be constructed of high conductivity copper with silver-plated switch contacts. Lugs shall be suitable for copper conductors and front removable.
- D. Neutral: Provide safety switches with number of switched poles indicated. Where a neutral is present in the circuit, provide a solid neutral with the safety switch. Where a ground conductor is present in the circuit, provide a separate solid ground with the safety switch.
- E. Auxiliary Contacts: Disconnect switches related to all smoke control fans shall have auxiliary contacts for fire alarm system monitoring of the position of the disconnect switch.

2.3 ENCLOSED SWITCHES WITH OVERCURRENT AND/OR GROUND FAULT PROTECTION

- A. Overcurrent protective devices 1,200 Amps and below:
1. Where switch is intended as a building service disconnect provide solid neutral and ground bus and service entrance SE rating.
 2. Molded case circuit breakers:
 - a. Greater than 800 Amp: Solid state true RMS sensing with adjustable: current, I^2t settings, ground fault (where required), instantaneous trip, and short time trip; 80-percent continuous current rating.
 - b. 800 Amp and smaller: Solid state true RMS sensing with fixed current setting by rating plug or dial. Breaker shall have adjustable instantaneous trip function with short time tracking.
 - c. 1,200 Amp and larger frame circuit breakers regardless of trip shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).
 3. Fusible switches:
 - a. Quick-make, quick-break units utilizing the double-break principle of circuit interrupting to minimize arcing and pitting and shall conform to the ratings shown.
 - b. Individual door over the front, equipped with a voidable interlock that prevents the door from being opened when the switch is in the ON position unless the interlock is purposely defeated by activation of the voiding mechanism. All switches shall have externally operated handles.
 - c. 600 Amps and below equipped for Class J fuses.
 - d. 601 Amps and above shall be equipped for Class R or L fuses.
 - e. When required by the latest edition of the NEC or the AHJ, 1,200 Amp fused switches regardless of fuse size installed shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).
- B. Ground Fault Interrupter (GFI) protection: Where shown or required, ground fault protection shall be achieved with adjustable pickup for ground fault currents, field-adjustable from 200 amperes and instantaneous to 60 cycle time delay. The ground fault protection system shall include necessary current sensors, internal wiring, and relays to coordinate opening the monitored faulted circuits.
1. Ground fault protection shall be set at minimum setting for both current and time during construction. The manufacturer shall include in the submittal data the minimum setting of the device and the recommended setting for normal building operation.
 2. The ground fault system shall be factory-tested before shipment as specified:
 - a. The manufacturer shall provide a factory ground fault protection system test for circuit testing and verification of tripping characteristics. The manufacturer shall pass predetermined values of current through the sensors and measure the tripping time for each phase and neutral. The measured time-current relationships shall be compared to the trip-characteristic curves. If the ground fault device trips outside the range of values indicated on the curve, the ground fault device shall be replaced or recalibrated.
 - b. Relays, electrically operated switches, shunt-trip switches, circuit breakers, and similar items shall have proper voltages applied to their circuits and satisfactory operation demonstrated.
 - c. Upon completion of the factory ground fault protection system test, the

current and time on each ground fault device shall be set to minimum values.

2.4 ENCLOSURES

- A. Enclosures in indoor locations shall be NEMA 1 unless shown otherwise.
- B. Enclosures in exterior locations shall be NEMA 4X stainless steel.
- C. Enclosures at kitchen and food preparation locations, exterior kitchen supply and exhaust fans, hose down areas, cooling towers, in greenhouses, and in other corrosive areas shall be NEMA 4X, stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install safety and disconnect switches where required or indicated, in accordance with the manufacturer's written instructions, requirements of the NEC, NECA Standard of Installation, and industry practices. Provide fuse identification label when fused switches are required showing type and size inside door of each switch. Include devices in coordination study to indicate overcurrent devices will selectively coordinate.
- B. Location: Provide safety switches within 50' and in sight of motor served. There shall be minimum code required clearance in front of safety switch and a clear path in which to access the switch. (i.e.: not having to walk and/or stand on obstacles such as drain pans on floor to service).
- C. Supports: Provide all safety and disconnect switches with galvanized angle or other supports where mounting on wall or other rigid surface is impractical. Switches shall not be supported by conduit alone. Where safety and disconnect switches are mounted on equipment served, the switch shall not inhibit removal of service panels or interfere with access areas, not void the warranty of the equipment served. Provide mounting hardware that will allow removal of safety and disconnect switches with common work tools. Do not utilize drive pin anchors through enclosure.
- D. Ground Fault Interrupter (GFI) test and settings: Where adjustable ground fault interrupter settings are provided or required, after completion of construction and before final acceptance testing, the ground fault protection system shall be field-tested and reset to the manufacturer's settings for both current and time by a representative of the manufacturer's engineering service department. After the test, set ground fault to 50-percent of the overcurrent device rating.
- E. Safety and Disconnect Switches: Install disconnect switches for motor-driven equipment, appliances, motors, and motor controllers within sight of the controller position unless indicated otherwise.
- F. Variable Frequency Drive (VFD) Warning Plaque: Provide VFD warning plaque at safety disconnect switches which are located down-stream of VFDs. Secure plaque to disconnect switch or immediately adjacent to disconnect switch with fasteners. Plaque shall be Yellow-White-Yellow 3-layer plastic laminated engraved with: "WARNING" (1/2 Inch Letters). "TURN OFF VFD BEFORE OPENING THIS SWITCH FOR MAINTENANCE." (1/4 inch letters).
- G. Provide disconnect switch for electric duct heaters.
- H. Where disconnect switch is used or indicated as the utility service building disconnect, provide main bonding jumper and neutral to ground bond connected to the building's grounding system. Do not bond neutral to ground when there is a neutral to ground bond upstream from the same derived neutral system serving the disconnect switch.
- I. Disconnect switches related to all smoke control fans shall have auxiliary contacts for fire alarm system monitoring of the position of the disconnect switch, coordinate with Division 28. Coordinate with fire detection and alarm contractor for the fire alarm and

detection system to monitor all disconnect switches open/closed position that serve the smoke control system. All fire alarm and control wiring directly related to the monitoring of the supply power disconnect switches and control of the smoke control fans shall be installed in conduit.

3.2 TESTING

- A. General: Before energizing, check for continuity of circuits and short circuits.
- B. Provide thermal infrared scan of the enclosed switches rated 200 Amps or larger under full load prior to testing / maintenance and modifications and of the modified and new switchboard sections after construction as directed and witnessed by Owner. Make corrections as needed as soon as possible as directed by the Owner. Repeat the scan at the 11-month prior to closeout, and make corrections prior to closeout. Provide digital video documentation with test results for comparison between prior condition and post construction modifications and future tests.

END OF SECTION

**SECTION 26 24 30
FUSES**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Fuse work as shown and scheduled, and as specified.
- B. Types: Fuses required for the project include the following:
 - 1. 250 volt current limiting fuses
 - 2. 600 volt current limiting fuses

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Provide products produced by Bussman or Littlefuse.

2.2 CURRENT LIMITING FUSES - 600 VOLTS AND LESS

- A. General: Provide 200,000 amperes interrupting capacity (AIC) current-limiting fuses of the current ratings shown and voltage rating equal to or greater than the voltage at the point of application.
- B. Types:
 - 1. Fuses in circuits supplying individual motors, groups of motors, or loads including motors, 600 amperes or less, shall be UL Class RK1 or Class J, time delay fuses, Bussman LPS-RK (600V) LPJ-SP (600V), LPN-RK (250V).
 - 2. Fuses in circuits supplying individual motors, groups of motors, or loads including motors, 601 to 4000 amperes, shall be UL Class L time delay fuses, Bussman KRPC "HI-CAP".
 - 3. Fuses in circuits supplying other than motor loads, 600 amperes or less, shall be UL Class RK1, time delay fuses, Bussman LPS-RK (600V), LPN-RK (250V).
 - 4. Fuses supplying surge protection devices (SPD) shall be surge rated for use with SPD devices.

2.3 SPARE FUSES

- A. General: Provide spare fuses in the amount of 10% of each type and size installed, but not less than 3 spares of a specific size and type. Deliver to the Owner at the time of project acceptance. Fuses shall be encased in a labeled steel enclosure with padlock provision, to be wall mounted where directed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install fuses in fuse holders immediately before energizing of the circuit where the fuses are installed. Fuses shall not be installed and shipped with equipment.
- B. Labels: Place fuse identification labels, showing fuse size and type installed, inside the cover of each switch.

END OF SECTION

SECTION 26 27 73 LINE VOLTAGE WIRING DEVICES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide wiring device work as shown, scheduled, indicated, and specified. Low voltage and/or digital control switches required for lighting controls and lighting control systems shall be as specified and required for the low voltage and / or digital control lighting system. Refer to drawings or other specification sections for low voltage / digital lighting control systems. Cover plates for lighting control systems shall be as specified in this section unless specifically required otherwise by the low voltage / digital control device bulkhead or form factor.
- B. The following devices shall not be used: Wago connectors, plug tail devices, decora style devices, USB charging devices, quad receptacles.

1.2 QUALITY ASSURANCE

- A. UL Label: Wiring devices shall be UL labeled.
- B. NEMA Standard WD1 and WD6.
- C. Fed. Spec. WC596, W-S-896

1.3 SUBMITTALS

- A. Mark up a complete copy of the specification section for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect/Engineer/Owner (Does Not Comply, Explanation:.) Do not submit an outline form of compliance, submit a complete copy of the specification section with the product data.
- B. Submit a sample of each style and color of 120-Volt duplex receptacle and each 120/277-Volt switch with related cover plate. Attach plate to wiring device and label back side of plate with job description with permanent black marker.
- C. Submit manufacturer's product data sheet for each style of device and plate on the project.
- D. Submit drawings of plans, elevation and sections of receptacles and outlets in casework, cabinetwork and built-in place furniture. Coordinate dimensions with millwork shop drawings and related architectural drawing series.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Toggle switches, straight blade and twist lock devices, interior cover plates. Devices with manufacturer provided pig tails or plug-in pig tail are prohibited:
 - 1. Leviton
 - 2. Hubbell
 - 3. Pass and Seymour
- B. Dimming
 - 1. Leviton
 - 2. Lutron

2.2 WIRING DEVICE COLOR

- A. Device color shall be gray except 20A, 125V receptacles and toggle wall switches which are directly supplied from an emergency source and located in mechanical, electrical, or

technology rooms shall be red, and heavy duty 30 Amp and larger simplex devices which shall be black in color where the building standard color is not available. All wiring devices supplied from an emergency source located in other than mechanical, electrical, or technology rooms shall be gray.

- B. Provide equivalent hospital grade devices where red is not available in grade specified. Verify with Owner / Architect prior to submitting for approval. Color change kits as required for dimming switches. Low voltage lighting control devices specified elsewhere shall match the line voltage wiring device color specified in this section.

2.3 RECEPTACLES

- A. Industrial grade tamper resistant smooth face duplex receptacles, 2 pole, 3 wire grounding, with ground connection and poles internally connected to mounting yoke, with metal mounting straps, back and side wired with screw type terminals, NEMA indicated, (X=color designation).
1. 20A, 125V duplex NEMA #5-20R: Leviton #5362-SGX
 2. 20A, 125V isolated ground duplex NEMA #5-20R: Leviton #5362-IGX
 3. 20A, 125V ground fault circuit interruption (GFCI) NEMA #5-20R weather and tamper resistant: Leviton #G5362-WTX
 4. 20A, 125V weather resistant (WR), tamper resistant: Leviton #TWR20-GY
 5. 20A, 125V plug load control, split circuit marked for "controlled", tamper resistant: Leviton #TDR20-S1G
 6. 15A, with 20A feed-through, NEMA #5-15R, 125V duplex, arc fault (AFCI), tamper resistant: Leviton #AFTR1-HGX
- B. Heavy-Duty Simplex: Single heavy-duty type receptacles, with green hexagonal equipment ground screw, with metal mounting straps, back or side wiring, black molded phenolic compound.
1. 15-60A, 125-250V, straight blade, NEMA configuration as indicated or as required by Owner.
 2. 15-50A, 125-480V, twist lock, NEMA configuration as indicated or as required by Owner.
- C. Hospital grade receptacles, 2 pole, 3 wire grounding, with ground connection and poles internally connected to mounting yoke, with metal mount straps, back and side wired with screw type terminals, molded phenolic compound, NEMA configuration indicated. Hospital grade devices are required for all audio/visual system equipment outlets, refer to Specification Section 27 41 00 Performance and Broadcast Audio/Video Systems for more information.
1. 20A, 125V grounded duplex NEMA #5-20R: Leviton #8300-X
 2. 20A, 125V isolated ground duplex NEMA #5-20R: Leviton #8300-LIG (Orange color devices)
 3. 20A, 125V ground fault circuit interruption (GFCI) with indicator light: Leviton NEMA 5-20R-8898-HGX
 4. 20A/125V Tamper Resistant Duplex NEMA 5-20R: Leviton 8300-SGX

2.4 WALL SWITCHES

- A. Toggle: Industrial grade flush toggle switches, with mounting yoke insulated from mechanism, equipped with plaster ears, switch handle, back and side-wired screw terminals.
1. Single-pole, 120/277V, 20A switch: Leviton #1221-2X
 2. Double pole 120/277V, 20A switch: Leviton #1222-2X
 3. Three-way, 120/277V, 20A switch: Leviton #1223-2X
 4. Four-way, 120/277V, 20A switch: Leviton #1224-2G

5. Pilot light single-pole, 120/277V, 20A switch: Leviton #1221-PL
6. Momentary, 120/277V, 20A, single-pole double throw, center off: Hubbell only, #HBL 1557G
- B. Toggle key operated switch (verify manufacture and key type with Owner prior to construction).
 1. Single-pole, 120/277V, 20A key operated switch: Hubbell HBL #1221GY
 2. Two-pole, 120/277, 20A key operated, Hubbell HBL #1222GY
 3. Three-way, 120/277V, 20A key operated switch: Hubbell HBL #1223GY
 4. Four-way, 120/277V, 20A key operated switch: Hubbell HBL #1224GY
 5. Momentary, single pole double throw, center off, 20A key switch: Hubbell #HBL 1557LG
 6. Key: Hubbell #HBL 1209. Key switches shall be keyed alike to match the Owner's standard key system. Coordinate with Owner.
- C. Spring wound 12 hours countdown timer switch with hold.
 1. Spring wound, 120/277V, 20A, 12Hours max, with hold: Intermatic FF12HHC

2.5 WALL DIMMERS

- A. Wall Box Dimmers: Self-contained, wall box mounted, linear slide square law dimmers with ON/OFF switch. Dimmers shall operate continuously at rated load in an ambient temperature up to 40°C and an input of 100 to 277V. Heat sink fins may be removed only as approved by Owner / Engineer for narrow ganging after applying de-rating.
 1. Single-pole, 120/277V, 1000/2308 Watt incandescent / magnetic low voltage: Leviton #AWSMT-MBW.
 2. Single-pole, 120/277V, 1500/3463 Watt incandescent / magnetic low voltage, 2-gang heat sink: Leviton #AWSMT-MCW.
 3. Single-pole, 120/277V, 1920/4432-Watt LED / fluorescent 0-10V dc, 75 mA current sink: Leviton #AWSMT-7DW.
 4. Three, four- or five-way remote switch: Leviton #AWSRT-00W.
 5. Color change kit as required.

2.6 GFCI – GROUND FAULT CIRCUIT INTERRUPTER, BLANK FACE

- A. 20A, 125V, GFCI, switch rated, blank face feed through, Hubbell #GFBF20GYL, gray finish, stainless steel cover plate black laser engraved with device protected, (example: VENDING MACHINE GFCI).

2.7 INTERIOR WALL COVER PLATES AND FASTENERS

- A. Type 302 non-magnetic stainless-steel with satin finish (also required for wall box device cover plates for low voltage and digital lighting controls specified elsewhere).
- B. Cover plate laser plate engraving for device identification (other than low voltage lighting controls).
 1. Provide laser cover plate engraving with black filling for all wiring devices indicating panelboard name, circuit, and voltage.
 2. Wiring devices connected to emergency/stand-by generator or inverter shall include the word "EMERGENCY" in black.
 3. Text orientation shall be upright, readable from left to right when cover plate is installed.
 4. Remotely located lighting switches shall also indicate the room or area and zone controlled by each switch. Coordinate specific wording with Owner/Architect.
 5. Blank face GFCI cover plates shall also intuitively indicate the load or equipment served, device, or area protected downstream ("RM RECEPTS", "HOOD RECEPTS", "VENDING", "REFRIG", etc.) For other loads, Owner/Architect

shall determine name plate wording.

2.8 EXTERIOR COVER PLATES

- A. Thomas & Betts CK Series, cast aluminum standard depth, locking mount, while-in-use, wet location, universal configuration.
 - 1. Vertical mount receptacle: #CKSUV
 - 2. Horizontal mount receptacle: #CKMU
 - 3. Two-gang: #2CKU
 - 4. 30-60 Amp Devices: #CKLSUV

2.9 CORD REELS AND DROP CORDS

- A. Cord Reels:
 - 1. Lighted cord reels: Industrial grade, LED hand Lamp only, 125V, 45-foot 16/3 SJO cord, white finish, LED hand lamp. Hubbell #HBLI45163LED with #HBL340PB pivot base.
 - 2. 20 Amp (2) duplex receptacle cord reels: Industrial grade, 125V, (2) 20A duplex receptacles, GFCI protection, 45-foot 12/3 SJO cord, white finish, yellow outlet box. Hubbell #HBLI45123GF220 with #HBL340PB pivot base.
 - 3. 30 Amp receptacle cord reels: Industrial grade, 125/250V, 30A, 45-foot 10/4 SJO cord, white finish, yellow outlet box. Hubbell #HBLI45104 with #HBL340PB pivot base. 30 Amp NEMA receptacle termination as required by Owner.
 - 4. 50 Amp receptacle cord reels: Industrial grade, NEMA 4 wet location, 600V, 55A, 50-foot 6/4 SOOW cord, yellow finish, self-retracting, with NEMA 50-Amp maximum receptacle termination as required by Owner. KH-Industries RTMH4L-WW-K6K.
 - 5. Recessed enclosure for 20 and 30-Amp cord reels recessed above T-grid drop ceilings: Hubbell #HBLIPRBOX recessed cord reel enclosure, white finish, plenum rated.
- B. Drop cord receptacles:
 - 1. 20A, 125V, 25-feet 600 VAC, 3-conductor 12 AWG SOOW cable, twist lock plug, two 125V, 20A duplex WR GFCI outlets, safety yellow rubber outlet box, mesh strain relief cord grips. KH Industries #PP4DD-520-B12F-520.
 - 2. 20A, 125/250V, 25-feet 600 VAC, 4-conductor 12AWG SOOW cable, twist lock plug, four 125/250V NEMA L1420P outlets, safety yellow rubber outlet box, mesh strain relief cord grips. KH Industries #PP7DD-520-B12F-L1420.
 - 3. 30-60 Amp, voltage, NEMA plug/receptacle as required by Owner, SOOW cable, number of conductors and length as required, mesh strain relief cord grips.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Cover plates for receptacles and toggle switches shall be of the same manufacturer throughout unless otherwise noted.
 - 1. Key switches and keys shall be as specified and also as approved by Owner.
 - 2. Submit samples for each specified toggle switch and duplex receptacle color to Architect.
- B. Install wiring devices where shown and as required, in accordance with manufacturer's written instructions, requirements of NEC, and in accordance with industry practices. Do not install devices until wall construction and wiring is completed.
- C. Install receptacles and switches only in electrical boxes that are clean, free from building materials, debris, and similar matter.
- D. Install wiring devices plumb and aligned in the plane of the wall, floor, ceiling or

- equipment rack.
- E. Install switches in boxes on the strike side of doors as hung. Install so the up position will close the circuit or will be the highest level of illumination. Where more than one switch is in the same location, install switches in a multi-gang box with a single cover plate.
 - F. Provide a cover plate for every wiring device and blank cover plates for unused rough-in-only boxes that matches the building standard. Fasten all plates outdoors with type 302 Allen Head "tamper-proof" screws.
 - G. Mounting heights of all wiring devices shall comply with local accessibility standards and local codes, except where wiring devices are indicated for special purpose and access is only required by maintenance or service personnel.
 - H. Refer to Architectural drawing and elevations, etc. for exact location of wiring devices. Coordinate location of all wiring devices with other trades, specialty items, and millwork and resolve all conflicts prior to rough-in. Field coordinate exact mounting location with all trades to avoid and resolve conflicts during construction.
 - I. Locate receptacles for electric drinking fountains/coolers and bottle fill stations below equipment so that the receptacle is accessible and concealed as much as practical from public view by the equipment open cowling so that the receptacle remain readily accessible. For dual level basin equipment, locate receptacle under the upper basin.
 - J. Provide convenience outlet receptacle within 25-feet of all new electrically operated mechanical equipment.
 - K. Where exterior receptacles are intended for continuous use, mount in horizontal position with while in use cover plate. (Exterior electric drinking fountains, ice makers, ice storage bins, landscape lighting low voltage transformers, seasonal decorative lighting, etc.)
 - L. Install wall box dimmers to achieve full rating specified after de-rating for ganging as recommended by manufacturer.
 - M. Do not share neutral conductor on load side of dimming switches.
 - N. Install receptacles with grounding pole down, or as directed by Owner only for equipment with a corded plug that requires a different orientation (i.e., flat plug assembly), to ensure cord remains plugged and cord hangs down tight against wall. If installed horizontally, install with neutral pole on top.
 - O. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.
 - P. Provide field installed pigtail to each receptacle and each switch. Neutral and phase conductors shall be installed using side or rear entry lugs only. Do not wrap conductors around screw terminals. Tighten all screws and lugs as recommended by the manufacturer.
 - Q. All receptacles and switches shall have a minimum of two wraps of Scotch 33 or equivalent tape around terminal screws.
 - R. Provide toggle switch within sight of all trap primers, circulation pumps, 120-Volt motors and motorized equipment to serve as the equipment disconnect switch.
 - S. Mount cord reels and cord reel recessed enclosures to structure with galvanized steel struts and as recommended by manufacturer. Field verify exact location of cord reels with Owner/Architect. Mounting location shall avoid conflicts with piping, light fixtures and ductwork, etc. when cord reel is extended and retracted. Set ball stop as directed by Owner / Architect. Provide hand lamp only type cord reels in commercial / educational automotive garages with classified (hazardous) locations. Provide local toggle switch at standard switch height for hand lamp only cord reels.
 - T. Mount drop cord suspension hook or j-box to structure to support the cord's weight and additional normal use pulling tension and as recommended by manufacturer. Use cable grips, either with cord grip hanging hook at open ceilings or with chrome plated

escutcheon cover plate mounted to recessed j-box at finished ceilings. Field verify exact location, drop height, and NEMA outlet configuration of drop cords with Owner/Architect. Provide weatherproof receptacle cap or covers if located in wet location. Mounting location shall avoid conflicts with piping, light fixtures and ductwork, etc.

3.2 GROUND FAULT PROTECTION FOR PERSONELL

- A. When GFCI personnel protection receptacles are not commercially available or cannot be installed at a readily accessible location or indicated otherwise on the drawings, GFCI personnel protection shall be provided by a remote blank face GFCI wiring device or by an up-stream GFCI receptacle that also provides downstream GFCI protection and located in a readily accessible location. When branch circuit breaker device with integral GFCI protection is required or specified, it shall be within the manufacture's recommended distance limitations of the connected receptacle(s) or load(s) for proper GFCI personnel protection at the farthest outlet.
- B. GFCI personal protection locations include but are not limited to the following:
 - 1. For other than dwelling units: All single phase 125-250-Volt (150-Volts to ground or less) receptacles 50-Amperes or less, and all three phase 125-250-Volt (150-Volts to ground or less) receptacles 100-Ampres or less in the locations indicated below.
 - 2. Dwelling units: All single phase 125-250-Volt receptacles installed in the following locations indicated below.
 - 3. Provide personnel GFCI protection as indicated above in the following locations and all additional locations as required by the NEC.
 - a. Outdoors (with exceptions for not readily accessible receptacles with dedicated branch circuits for snow melting, deicing, pipeline/vessel heat receptacles. Provide these loads with 30mA EGFI circuit breaker protection).
 - b. Bathrooms/toilets/restrooms
 - c. Janitors/custodial closets and mop sinks.
 - d. Laundry areas
 - e. Parking structures, service garages, garages and accessory buildings
 - f. Basements, crawl spaces (including 120-Volt lighting)
 - g. Within 6-feet of all water sources including sinks, mop-sinks, lavatories, bathtubs, shower stalls, faucets, eye wash stations, emergency shower stations
 - h. Indoor damp and wet locations
 - i. Locker rooms
 - j. Indoor swimming pools and natatoriums areas and adjacent corridor/hall convenience receptacle outlets located within 25-feet of all access doors.
 - k. Non-dwelling unit therapeutic tubs/pools/whirlpool areas and adjacent corridor/hall convenience receptacle outlets located within 25-feet of all access doors.
 - l. Receptacles serving dwelling unit kitchen counter tops
 - m. Vending machines
 - n. Elevators, dumb waiters, escalators, moving sidewalks: receptacles in pits, hoist ways, well ways or those mounted on the cars of elevators and dumb waiters.
 - o. Electric vehicle charging equipment.
 - p. All receptacles serving kitchen or food preparation counter tops.
 - q. Automotive vacuum machines

- r. Drinking water fountains/coolers and bottle fill stations
 - s. Corded high-pressure spray washing machines
 - t. Tire inflation machines
 - u. Dish washers
 - v. Receptacles at end of cord reels or drop cords.
 - w. Boat houses, boat hoist, and all pier/dock receptacles and lighting (excludes shore power that requires GFPE).
 - x. Central plant, mechanical rooms and electrical rooms
 - y. Wood, metal, or other material fabrication or vocational training shops.
 - z. Receptacles that serve educational science and science prep room counter tops.
- C. Where a GFCI protected receptacle outlet is required or indicated behind vending machine, refrigerators or other equipment, provide remote GFCI blank face in same room as protected receptacle and at a readily accessible location with standard receptacle outlet behind equipment. Refrigerators shall be GFCI protected only where located within 6-foot of power cord distance from the edge of a sink to the surface of the refrigerator.
- D. Unless indicated otherwise, locate blank face GFCI device near light switches at same height as light switches or ganged with the light switch. Provide GFCI protection for all receptacle outlets located below 42-inches in all infant through 2-year old day care and similar areas designated for occupancy by infant through 2-year old day care occupants so the GFCI device can easily be intentionally tripped or tested and reset.
- E. Provide branch circuit breaker 30mA (EDP) or 100mA (EPE) equipment protection for utilization equipment as required by the NEC and where indicated on the drawings.

3.3 PERFORMANCE AND BROADCAST AUDIO VISUAL SYSTEMS RECEPTACLES

- A. All 125-Volt receptacles providing power to A/V systems from dedicated A/V power transformers shall be hospital grade, isolated ground type receptacles. The isolated ground conductor connection shall be in addition to the solid green raceway/box grounding conductor.

3.4 TESTING

- A. Before energizing, check for continuity of circuits, short circuits, and grounding connections.
- B. After energizing, check wiring devices to demonstrate proper operation and receptacles for correct polarization, voltage and phase orientation if intended 3-phase equipment is phase orientation dependent for proper motor rotation or operation.
- C. Test each individual GFCI receptacle and all downstream receptacles protected by an upstream GFCI device with simulated ground fault tester, make corrections as necessary.
- D. Operate each wall switch with circuit energized and verify proper operation.

3.5 ATTIC STOCK

- A. For each type of wiring device cover plate requiring the word "EMERGENCY", provide attic stock of 20 cover plates of each type (simplex, duplex, triplex, etc.).

END OF SECTION

SECTION 26 43 00 SURGE PROTECTION DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The Surge Protection Device (SPD) covered under this section includes service entrance type surge protection devices suitable for use as Type 1 or Type 2 Devices per UL1449 5th Edition, applied to the line or load side of the utility feed inside the facility. SPDs shall be connected in parallel with the facility's wiring system. The unit shall be manufactured in the USA by a qualified manufacturer of suppression filter system equipment, which has been engaged in the commercial design and manufacture of such products for a minimum of five years.
- B. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified and required to finish and install surge protection devices.

1.2 QUALITY ASSURANCE

- A. Reference Standard: Comply with the latest edition of the applicable provisions and recommendations of the following, except as otherwise stated in this document:
 - 1. UL 1449 Fifth Edition
 - 2. ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
 - 3. ANSI/IEEE C62.45, Guide for Surge Testing for equipment connected to Low-Voltage AC Power Circuits.
 - 4. IEEE 1100 Emerald Book.
 - 5. National Fire Protection Association (NFPA 70 (NEC), 75, and 78).
 - 6. UL 1283 – Electromagnetic Interference Filters
- B. When requested for verification, provide copies of the following:
 - 1. Copies of actual let through voltage data in the form of oscilloscope results for both ANSI/IEEE C62.41 Category C3 (combination wave) and B3 (Ring wave) tested in accordance with ANSI/IEEE C6245.
 - 2. Copies of test reports from a recognized independent testing laboratory, capable of producing 200kA surge current waveforms, verifying the suppressor components can survive published surge current rating on both a per mode and per phase basis using the ANSI/IEEE C62.41 impulse waveform C3 (8 x 20 microsecond, 20kV/10kA). Test data on an individual module is not acceptable.

1.3 SUBMITTALS

- A. Submit shop drawings complete with all technical information for specific unit dimensions, let through voltage data, detailed installation instructions, maintenance manual, and wiring configuration.
- B. Provide detailed marked-up copy of this specification with line-by-line compliance or exception statements to all provisions of this specification.
- C. Copies of Manufacturer's catalog data, technical information and specifications on equipment.
- D. Copies of documentation stating that the Surge Protection Device is listed from a Nationally Recognized Testing Laboratory (NRTL) (UL, ETL, etc.) and are tested and multi-listed to UL 1449 5th Edition and UL 1283.
- F. Copy of warranty statement clearly establishing the terms and conditions to the building/facility owner/operator.

1.4 WARRANTY

- A. The manufacturer shall provide a minimum 20-year warranty for high and very high exposure SPDs. Very high exposure unit warranties shall include exposure to temporary extended over-voltage conditions. Provide a minimum 15-year warranty for all medium exposure SPDs, and a minimum 10-year warranty for all other SPDs for parts from date of substantial completion against failure. Contractor shall assist the Owner with manufacturer warranty registration.

PART 2 – PRODUCTS

2.1 APPROVED MANUFACTURER

- A. Low exposure, minimum 10-year parts warranty, minimum 50k Amps per mode, 100k Amps per phase, Type 1 and Type 2.
1. Recessed mount panelboard extension with brushed stainless-steel front:
 - a. ACT Communications:471- ###V-050-SS-F-PB flush series.
 - b. ABB Current Technology PX3-050-VVV- #X-SF-X-F- # series.
 - c. SSI Surge Suppression, Inc. CSMx12-FMPxSS series.
 - d. SST Southern Tier Technologies T45-VVVV-50-AWAJ2-C-RKSS(Stainless Steel front).
 2. Branch panelboard surface mounted:
 - a. ACT Communications 455 series.
 - b. ABB Current Technology CG3 60 series.
 - c. SSI Surge Suppression, Inc. CSMx12 series.
 - d. SST Southern Tier Technologies T45-VVVV-50AWAJ2-C
- B. Medium exposure, minimum 15-year parts warranty, minimum 120k Amps per mode, 240k Amps per phase, Type 2.
1. ACT Communications 471 series.
 2. ABB Current Technology CGP3 125 series.
 3. SSI Surge Suppression, Inc. CSMx24 series.
 4. SST Southern Tier Technologies T45-VVVV-120A series
- C. High exposure, minimum 20-year parts warranty, minimum 200k Amps per mode, 400k Amps per phase, Type 2 SPD.
1. ACT Communications 471 x200 series.
 2. ABB Current Technology TG3 200 series.
 3. SSI Surge Suppression, Inc. CHLxM series.
 4. SST Southern Tier Technologies T45-VVVV-200A series
- D. Very high exposure at service entrance 1,201 Amps and above: Minimum 20-year parts warranty; minimum 200k Amps per mode; 400k Amps per phase, Type 1 and 2 SPD:
1. ACT Communications 471 x200 SEL series.
 2. ABB Current Technology SEL3 200 series.

The service entrance protector shall incorporate a combination of TPMOV and Selenium technology allowing for transient surge and temporary over voltage protection. The unit shall be able to prevent common temporary over voltages and high impedance faults from damaging the MOVs, increasing their longevity and ability to protect the critical load. Limited and Intermediate current TOVs can be caused by a loss of the neutral conductor in a split phase or three phase power system. The available fault current will be determined by the impedance of the loads connected to the phases opposite the SPD and are typically in the range of 30A to 1000A. Minimum 20-year parts warranty, extended over-voltage protection, minimum 200k Amps per mode, 400k Amps per phase, Type 2 SPD. The Selenium elements must limit voltage to the MOV as a percent of nominal as outlined below:

Overvoltage seen by MOVs as % of Nominal				
	available current			
time	30A	100A	500A	1000A
1 cycle	120%	130%	150%	160%
10 cycles	130%	150%	160%	160%
30 cycles	140%	150%	160%	160%

*To verify damage to the MOVs has been mitigated, the percent overvoltage seen at the MOV must be less than 200% for split-phase applications or 173% for three-phase applications (100% is nominal).

2.2 MANUFACTURED UNITS / ELECTRICAL REQUIREMENTS

- A. Declared Maximum Continuous Operating Voltage (MCOV) shall be greater than 115 percent of the nominal system operating voltage and in compliance with test and evaluation procedures outlined in the nominal discharge surge current test of UL1449, section 37.7.3. MCOV values claimed based on the component's value or on the 30-minute 115% overvoltage test in UL1449 will not be accepted.
- B. Unit shall have not more than 10% deterioration or degradation of the UL1449, Voltage Protection Rating (VPR) due to repeated surges.
- C. Protection Modes SVR (6kV, 500A) and UL1449 VPR (6kV, 3kA) for grounded WYE/delta and High Leg Delta circuits with voltages of (480Y/277), (208Y/120), (600Y/347). 3-Phase, 4 wire circuits, (120/240) split phase shall be as follows and comply with test procedures outlined in UL1449: Values Depicted are based on a system Without Disconnect / With Disconnect

System Voltage	Mode	MCOV	C3 Wave	UL 1449 VPR Rating
120/240	L-N	150	650/775	700/800
120/208	L-G	150	650/825	700/900
	N-G	0	500/500	900/1000
	L-L	300	950/1250	900/1200
277/480	L-N	320	1125/1225	900/1200
	L-G	320	1075/1225	1200/1200
	N-G	0	900/900	1200/1500
	L-L	550	1950/2200	1800/1800

- D. Electrical Noise Filter- each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric noise shall be as follows using the MIL-STD-220A insertion loss test method.
 - 1. 14 dB from 10 kHz to 1 MHz.
- E. Each Unit shall provide the following features:
 - 1. Phase Indicator lights, Form C dry contacts, counter and audible alarm.
 - 2. Field testable while installed.
 - 3. High performance interconnecting cable.
 - 4. The UL 1449 Voltage Protection Rating (VPR) shall be permanently affixed to the SPD unit.
 - 5. The UL 1449 Nominal Discharge Surge Current Rating shall be 20kA
 - 6. The SCCR rating of the SPD shall be 200kAIC without requiring an upstream protection device for safe operation.
 - 7. The unit shall be listed as a Type 2 SPD per UL1449.
 - 8. Power wiring: SPD shall be equipped with mechanical lugs that can accept up to #2 AWG wire on High Exposure units and up to #6 on Medium and Low Exposure units.

2.3 POWER CABLES FOR CONNECTION

- A. Power wiring: Conductors between all high and very-high SPDs and switchgear shall be high performance interconnect system "Low Z Cable" cables with Ultra Low impedance characteristics at 10kHz and above.
- B. High Performance Low Impedance cable shall be #6 AWG minimum for Very High, High, and Medium Exposure SPDs and #10 AWG minimum for Low Exposure SPDs.

PART 3 – EXECUTION

3.1 GENERAL INSTALLATION

- A. The unit shall be installed as close as practical to the facility's wiring system in accordance with applicable national/local electrical codes and the manufacturer's recommended installation instructions. Connection shall be with high performance, low impedance cables in conduit and shall not be any longer than necessary, avoiding unnecessary bends. Minimum wire size and overcurrent protection device for disconnect shall be provided and as recommended by the manufacturer.
- B. Units specified for lighting and appliance panel boards as panelboard extensions (EGPE) shall be mounted directly above or below the first section of the panel board it is protecting. Any other mounting location will not be acceptable and shall be corrected, without exception, at no additional cost to the Owner.
- C. Units specified for panelboards, switchboards, or motor control centers shall be mounted directly above or adjacent to the panelboard, switchboard or motor control center using unistrut supports secured to structure as required. Conduit length between power distribution panelboard or switchboard shall be less than two inches. Mounting above equipment is not acceptable.
- D. Overcurrent device and conductors for devices shall be the maximum recommended by the manufacturer. Manufacturer's recommendations shall prevail over the information given in the plans and specifications.
- E. Provide recessed mounted panelboard extension type enclosures for devices protecting recessed panelboards. Enclosure front shall match panelboard front material and finish. Provide brushed stainless-steel front at kitchens and food processing areas.

3.2 UNIT SELECTION BASED ON EXPOSURE LEVEL

- A. (SPDVH) Provide very-high exposure SPDs with Selenium and TPMOV technology for the following new electrical equipment or where indicated:
 - 1. Service entrance rated 1,201 Amps and above.
- B. (SPDH) Provide high exposure SPDs for the following new electrical equipment or where indicated:
 - 1. Service entrance rated 801 – 1,200 Amps.
 - 2. Switchboards located outside.
- C. (SPDM): Provide medium exposure SPDs at the following new electrical equipment or where indicated:
 - 1. Service entrance rated 401 - 800 Amps.
 - 2. Panelboards above 600 Amps.
 - 3. Motor control centers.
 - 4. Non-service entrance switchboards.
- D. (SPDL): Provide low exposure SPDs at the following new electrical equipment or where indicated:
 - 1. Service entrance rated 400 Amps and below.
 - 2. Panelboards 600 Amps and below.

3.3 TESTING

- A. Factory Trained Representative shall provide start-up to include initial verification of proper installation, shortest cable connection, and initiate factory warranty. The technician will be required to do the following as a minimum:
 - 1. Verify the installation follows applicable national / local electrical codes related

- to SPDs and the manufacturer's Installation, Operation and Maintenance Instructions and recommendations.
2. Verify overcurrent device rating.
 3. Verify all wiring connections and installation conforms to manufacturer's recommendations.
 4. Record information for each product installed and include in O&M Manual
- B. A copy of the Factory diagnostic test report and written approval of the installation shall be included with the Electrical Operating and Maintenance Manual. The Contractor shall make all adjustments, changes, corrections, etc. as required by the Factory Trained Representative so that the installation follows the manufacturer's installation and operation instructions without additional charge to the Owner.

END OF SECTION

SECTION 26 51 13 LIGHTING FIXTURES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Work Included: Lighting fixture work is as shown, scheduled and specified.
- B. Applications: The applications of lighting fixtures required for the project include the following:
 - 1. General lighting
 - 2. Emergency lighting
 - 3. Outdoor area lighting

1.2 QUALITY ASSURANCE

- A. Provide interior building LED fixtures that comply with the Design Lights Consortium (DLC) standards and are DLC or DLC Premium listed as a Qualifying Product at time of proposal submittal date.
- B. UL Standards: Lighting fixtures shall conform to applicable UL standards, and be UL or ETL labeled.
- C. Light fixtures shall conform to the requirements of NFPA 101, and 70 (NEC).

1.3 SUBMITTALS

- A. Submit product data for light fixtures, and emergency lighting equipment, including generator transfer devices.
- B. Specification Compliance Review: Mark up a complete copy of the specification section for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect / Engineer / Owner (Does Not Comply, Explanation:) Do not submit an outline form of compliance, submit a complete copy with the product data.
- C. Submittal data shall include luminaire efficiency parameters.
- D. Submittal data for exterior luminaires shall include IESNA BUG ratings, backlight, uplight, and glare ratings of each unique luminaire for the orientation and tile specified. Indicate total absolute lumens per luminaire and absolute lumens emitted above horizontal based by each luminaire for the orientation and tile specified.

1.4 WARRANTY

- A. Provide 5-year warranty on all light fixtures, including internal or remote LED drivers, all other electrical internal electrical or electronic components except for emergency battery packs or emergency load control device relays. Refer to other specific component warranty requirements below.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Provide products produced by manufacturers shown or scheduled for each type of lighting fixture. Refer to drawings for additional approved manufacturers.
 - 1. Light fixtures:
 - US LED
 - Extra Light
 - Acuity
 - Hubbell

- Signify
- Cooper Lighting Solutions
- Pinnacle
- HE Williams
- GE Current
- LSI
- 2. LED Drivers:
 - Philips
 - Osram Optotronic
 - Eldo LED
- 3. Emergency Battery Packs with self-testing drivers/inverters:
 - Bodine
 - Chloride
 - Lithonia
 - Dual Lite
 - IOTA
- 4. Emergency Generator/Inverter Load Control Bypass Relay (ELC); UL924 listed and 0-10Vdc compatible:
 - Bodine
- 5. Emergency Generator / Inverter Branch Circuit Transfer Switch, UL 1008 listed and 0-10Vdc compatible:
 - Bodine GTD20A

2.2 MATERIALS AND COMPONENTS

- A. General: Provide lighting fixtures of the size, type, and rating indicated, with all accessories for a complete aesthetic installation.
- B. Fixture Types:
 - 1. General:
 - a. LED Lay-in edge lit or back flat panel / troffer fixtures: Opaque, edge or back lighted, 4000 Kelvin color temperature. 0-10 Vdc dimmable, L70: 60,000 minimum hours.
 - b. Safety chains and wire guards at fixtures in mechanical and electrical rooms, and high abuse areas. Provide safety chains only for gymnasium fixtures which shall be inherently vandal proof, no wire guards.
 - c. Fixtures located outdoors, in interior unconditioned spaces, and in wet locations shall be of aluminum construction.
 - d. Fixtures with door frames shall be of aluminum construction, white finish where located in kitchens, food prep areas, toilets, restrooms, locker rooms, dressing rooms, showers, and unconditioned spaces.
 - e. DLC, DLC Premium or Energy Star qualified unless specified otherwise.
 - f. Outdoor fixtures shall include a discrete / replaceable surge suppression device in addition to the surge suppression incorporated in the LED driver.
 - g. Operating temperature rating shall be between -40 degrees F and 120 degrees F.
 - i. Color Rendering Index (CRI): ≥ 80 Indoor; ≥ 65 Outdoor
 - j. The manufacturer shall have performed JEDEC (Joint Electron Devices Engineering Council) reliability tests on the LEDs as follows: High Temperature Operating Life (HTOL), Room Temperature Operating Life (RTOL), Low Temperature Operating Life (LTOL), Powered Temperature Cycle (PTMCL), Non-Operating Thermal Shock (TMSK),

Mechanical Shock Variable Vibration Frequency, and Solder Heat Resistance (SHR).

2. Downlight Fixtures: Provide recessed downlight fixtures with trim rings compatible with the ceiling material where fixture is to be installed.
 3. LED Exit Signs: Provide red lettering. The exit lighting fixtures shall meet the requirements of Federal, State, and Local Codes.
 - a. Gymnasiums, locker rooms, athletic/PE wing and associated corridors, black box theaters, auditorium stages, cafeteriums and kitchens: Vandal resistant, wet location cast aluminum with polycarbonate protective cover exit signs, Lithonia Extreme Series.
 4. Emergency Lighting Units: Lead Calcium batteries with self-diagnostics. Provide full light output at 90 minutes of battery operation. LED lamps.
 5. Gymnasium light fixtures, glass or acrylic refractors or lenses, round profile, single point swivel pendant or hook mounting, designed to be vandal proof without the need for wire guards, no wire guards.
- C. LED drivers:
1. NEMA 410 compliant for in-rush current.
 2. Starting Temperature: -40° F [-40° C].
 3. Input Voltage: 120 to 480 (±10%) V.
 4. Power Supplies: Class I or II output.
 5. Surge Protection: The system must survive 250 repetitive strikes of “C Low” (C Low: 6kV/1.2 x 50 μs, 10kA/8 x 20 μs) waveforms at 1-minute intervals with less than 10% degradation in clamping voltage. “C Low” waveforms are as defined in IEEE/ASNI C62.41.2-2002, Scenario 1 Location Category C.
 6. Power Factor (PF): ≥ 0.90.
 7. Total Harmonic Distortion (THD): ≤ 20%.
 8. Comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.
 9. Drivers shall be reduction of hazardous substances (ROHS)-compliant.
- D. Voltage: Equipment for use on 120V systems shall be suitable and guaranteed for voltage range of 100V to 130V. Equipment on 277V systems shall be suitable and guaranteed for voltage range of 225V to 290V. Universal voltage equipment shall be suitable and guaranteed for a voltage range of 100V to 290V.
- E. Light fixture housing for exterior use: Provide aluminum or stainless housing. Where stainless steel hardware is used, both male and female fasteners shall be stainless steel.
- F. Emergency LED battery self-testing drivers and inverters; 5-year warranty. Basis of Design:
1. Bodine BSL-ST Series for OEM installation
 2. Bodine BSL310-SI Series for field installation
 3. Bodine ELI-S Series for line voltage sine wave inverter field installation
- G. Emergency Battery Packs – Exit Signs: Nickel Cadmium battery with self- diagnostics; Minimum 3-year non-prorated replacement warranty.
- H. Emergency Generator / Inverter Load Control Device (ELC):
1. 16 Amp minimum ballast / driver load
 2. Compatible with 0-10 Volt dimmer switches
 3. UL 924
 4. Minimum 3-year warranty
 5. Integral or remove test switch.
- I. Emergency Generator / Inverter branch circuit transfer switch:
1. UL 1008
 2. 20 Amp ballast/driver load
 3. 0-10Vdc dimming compatible

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install lighting fixtures of the types indicated, where shown, and at indicated heights in accordance with the fixture manufacturer's written instructions and industry practices to ensure that the fixtures meet the specifications. Fixtures shall fit the type of ceiling system scheduled.
- B. Standards: Comply with NEMA standards, applicable requirements of NEC pertaining to installation of interior lighting fixtures, and with NECA Standard of Installation.
- C. Attachment: Fasten fixtures to the indicated structural support members of the building. Provide four separate wire supports for recessed ceiling mounted lighting fixtures, one at each corner of fixture. Check to ensure that solid pendant fixtures are plumb. Provide T-bar locking clips on all four sides for lay-in fixtures.
- D. Coordination: Field coordinate and locate lighting fixtures in open ceiling areas including mechanical and electrical rooms so that light is not obstructed by piping, ductwork, etc. Locate light fixtures in front of electrical and mechanical equipment to provide adequate illumination for testing and maintenance. Relocate installed light fixtures as directed by Owner / Architect at no additional cost.
- E. Final adjustment of all aimable exterior light fixtures shall be in coordination with, and to the satisfaction of, the Owner's designated representative. Pre-aim all fixtures prior to scheduled final aiming and adjustment with Architect / Owner. Verify that all rotatable optics are in their proper orientation prior to final aiming.
- F. Provide vandal resistant exit signs without wire guards in all physical education and athletic sports areas, including egress corridors adjacent to these areas, black box theaters, auditorium stages, vocational shops, cafeteriums and kitchens.
- G. Provide exit sign directional arrows as required. Provide a minimum of two and a maximum of 10% spare exit signs to be installed as directed by Architect.
- H. Install in accordance with manufacturers instructions.
- I. Install suspended luminaires using pendants supported from swivel hangers. Provide pendant length required to suspend luminary at indicated height.
- J. Locate recessed ceiling luminaires as indicated on the Architectural reflected ceiling plan.
- K. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prohibit movement.
- L. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure. Provide auxiliary members spanning ceiling Ts to support surface mounted luminaires. Fasten surface mounted luminaires to ceiling T using bolts, screws, rivets, or suitable clips.
- M. Install recessed luminaires to permit removal from below.
- N. Install recessed luminaires using accessories and fire stopping materials to meet regulatory requirements for fire rating.
- O. Install wall-mounted luminaires at height as directed by Architect.
- P. Install accessories furnished with each luminary.
- Q. Connect luminaires to branch circuit outlets using flexible conduit as specified.
- R. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaires.
- S. Bond products and metal accessories to branch circuit equipment grounding conductor.
- T. Provide emergency transfer devices for light fixtures powered by generator or inverter emergency lighting circuits which are used for normal lighting and to be switched with the switched normal lighting circuit in the same room, corridor or area.
- U. Provide un-switched, constant-hot circuit to all battery powered emergency lighting equipment and emergency load control devices (ELC). Where normal light fixture circuit

- is switched or contactor controlled, non-switched battery charging or ELC circuit shall originate from same branch circuit breaker as switched lighting circuit.
- V. Provide emergency powered light fixture in front of all electrical switchgear, including but not limited to panelboards, switchboards, motor control centers, low voltage control panels, transfer switches, motor controllers and disconnect switches.
 - W. Provide emergency battery operated light fixtures at all transfer switch locations and at all central battery emergency lighting inverters.
 - X. Provide automatic controls for exterior light fixtures. Exterior building mounted light fixtures shall be circuited through lighting contactors. Lighting contactors shall be controlled by the Building Management System. Provide separate lighting contactors for:
 - 1. Parking Lot Lighting
 - 2. Building Mounted Lighting
 - 3. Exterior Signage
 - Y. Lighting contactors shall not be installed above ceiling and shall be readily accessible, located in same room as panelboard serving load.
 - Z. Wall mounted light fixtures shall be attached to the studs in the walls. Attachment to gypsum board only is not acceptable. Where wall mounted fixtures attach to junction box only, firmly secure junction box to adjoining studs in wall.
 - AA. Lighting Fixture Supports:
 - 1. Shall provide support for all of the fixtures. Supports may be anchored to channels of the ceiling construction to the structural slab or to structural members within a partition, or above a suspended ceiling.
 - 2. Shall maintain the fixture positions after cleaning and relamping.
 - 3. Shall support the lighting fixtures without causing the ceiling or partition to deflect.
 - BB. Hardware for surface mounting fixtures to suspended ceilings:
 - 1. In addition to being secured to any required outlet box, fixtures shall be bolted to a grid ceiling system at four points spaced near the corners of each fixture. The bolts shall be not less than 1/4 inch secured to channel members attached to and spanning the tops of the ceiling structural grid members. Non-turning studs may be attached to the ceiling structural grid members or spanning channels by special clips designed for the purpose, provided they lock into place and require simple tools for removal.
 - 2. In addition to being secured to any required outlet box, fixtures shall be bolted to ceiling structural members at four points spaced near the corners of each fixture. Pre-positioned 1/4-inch studs or threaded plaster inserts secured to ceiling structural members shall be used to bolt the fixtures to the ceiling. In lieu of the above, 1/4-inch toggle bolts may be used on new or existing ceiling provided the plaster and lath can safely support the fixtures without sagging or cracking.
 - CC. Lighting Fixture Supports for aluminum canopies:
 - 1. Light fixtures mounted under aluminum canopies shall be UL wet location from above listed without a protective ceiling or cover. Light fixture shall not have conduit penetrations or mounting hole penetrations field made in the top of the fixture. Conduit penetration shall be at the end of the fixture only.

3.2 TESTING

- A. General: Upon installation of lighting fixtures, and after building circuits are energized, apply electrical energy to demonstrate proper operations of lighting fixtures, emergency lighting, and controls. When possible, correct malfunctioning units at the site, then retest to demonstrate proper operation; otherwise, remove and replace with new units, and proceed with retesting.

- B. Pre-Inspection Tasks: Immediately before final inspection, clean fixtures inside and out, including plastics and glassware, adjust trim to fit adjacent surfaces, replace broken or damaged parts, and lamp and test fixtures for electrical and mechanical operations. Any fixtures, or parts of fixtures that show signs of rust or corrosion at the time of completion, shall be removed, and replaced with protected metal parts.
- C. Final aiming and Adjustment: Aim and adjust aimable and adjustable lighting fixtures for their intended purpose. Re-aim and re-adjust as required to the satisfaction of the Architect / Owner, including nighttime adjustment of exterior lighting in the presence of the Architect / Owner.

END OF SECTION

SECTION 265561

THEATRICAL LIGHTING AND RIGGING SYSTEMS REFERENCE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Theatrical Lighting System.
- B. Theatrical Rigging System.

1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of the Construction Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.
- B. Theatrical lighting system TL series drawings and 11 61 00 specification.
- C. Theatrical rigging system TE series drawings and 11 61 33 specification.

1.03 RESPONSIBILITY AND RELATED WORK

- A. Coordinate scheduling of work with the Owner and Owner's Architect.
- B. Refer to TL0.00 and TE0.00 for division of responsibilities related to the theatrical lighting and rigging systems.

1.04 DEFINITION OF TERMS & ABBREVIATIONS:

- A. Provide: to supply and install.
- B. Furnish: to supply to another contractor for installation.
- C. Supply: to supply but not install.
- D. Install: to install but not supply.
- E. OFE: Owner furnished (supplied) equipment. Equipment will be provided to contractor for installation.
- F. NIC: Not In Contract. Refers to items that are not included in the scope of work outlined in this section but may be shown for coordination purposes or reference.
- G. Future: Equipment that will be provided by owner later. Accommodations shall be provided for future equipment as shown on the drawings.

PART 2 PRODUCTS

2.01 NOT APPLICABLE

END OF SECTION

SECTION 26 56 67 SPORTS FIELD LIGHTING SYSTEM

PART 1 – GENERAL

1.1 SUMMARY

- A. Work covered by this section of the specifications shall conform to the contract documents, engineering plans as well as state and local codes.
- B. The purpose of these specifications is to define the lighting system performance and design standards for athletic fields using an LED Lighting source. The manufacturer / contractor shall supply lighting equipment to meet or exceed the standards set forth in these specifications. Basis of design manufacture: Musco.
- C. The sports lighting will be for the following venues:
 - 1. Tennis
- D. The primary goals of this sports lighting project are:
 - 1. **Guaranteed Light Levels:** Selection of appropriate light levels impact the safety of the players and the enjoyment of spectators. Therefore, light levels shall be guaranteed to not drop below specified target values for a period of 25 years from date of delivery of equipment to the site.
 - 2. **Environmental Light Control:** It is the primary goal of this project to minimize spill light to adjoining properties and glare to the players, spectators, and neighbors.
 - 3. **Life-cycle Cost:** In order to reduce the operating budget, the preferred lighting system shall be energy efficient and cost effective to operate. All maintenance costs shall be the responsibility of the manufacturer as indicated and included at no additional cost to the Owner for the duration of the warranty.
 - 4. **Control and Monitoring:** Provide a remote on/off control system for the lighting system. Fields shall be proactively monitored to detect luminaire outages over the 25-year life cycle. All communication and monitoring costs for 25-year period shall be included at no additional cost to the Owner.
- E. All lighting designs shall comply with local lighting ordinances.

1.2 SPECIFICATION COMPLIANCE REVIEW

- A. Provide a complete written, item-by-item specification review indicating compliance or deviation in full description.
- B. Mark up a complete copy of the specification section for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect / Engineer / Owner (Does Not Comply, Explanation:) Do not submit an outline form of compliance, submit a complete copy of the specification with the product data.

1.3 WARRANTY AND GUARANTEE

- A. **25-Year Warranty:** Manufacturer shall provide a signed warranty covering the entire system for 25 years from the date of delivery to the site. The warranty shall guarantee specified light levels. The manufacturer shall maintain specifically funded financial reserves to assure fulfillment of the warranty for the full term. Warranty does not cover acts of God, weather conditions events such as lightning or hail damage, improper installation, vandalism or abuse, unauthorized repairs or alterations, or products made by other manufacturers.
- B. **Maintenance:** Manufacturer shall monitor the performance of the lighting system,

including on/off status, hours of usage and luminaire outage for 25 years from the date of equipment shipment. Parts and labor shall be covered such that individual luminaire outages will be repaired when the usage of any field is materially impacted. Manufacturer shall provide all preventative and spot maintenance, including parts and labor for 25 years from the date of equipment shipment. Individual outages shall be repaired when the usage of any field is materially impacted. In event of an outage, Owner shall verify for the manufacturer that power is available to each lighting circuit controller, fuses, and lighting contactors.

PART 2 – PRODUCTS

2.1 ILLUMINATION PERFORMANCE REQUIREMENTS

- A. Illumination Levels and Design Factors: Playing surfaces shall be lit to an average target illumination level and uniformity as specified in the chart below. Lighting calculations shall be developed, and field measurements taken on the grid spacing with the minimum number of grid points specified below. Appropriate light loss factors including but not limited to dirt depreciation and optical material deterioration shall be applied and submitted for the basis of design. Average illumination level shall be measured in accordance with the IESNA LM-5-04 (IESNA Guide for Photometric Measurements of Area and Sports Lighting Installations). Illumination levels shall not drop below desired target values in accordance to IES RP-6-15, Page 2, Maintained Average Illuminance and shall be guaranteed for the full warranty period. Due to various dimensions of some athletic fields the actual quantity of grid points may vary, however the grid spacings shall be taken over the entire playing surface and the exact quantity adjusted accordingly.

Area of Lighting: Average annual usage	Average Target Illumination Levels	Maximum to Minimum Uniformity Ratio	Minimum Grid Points	Grid Spacing
Tennis	50 foot-candles	1.5:1.0	60/court	20' x 20'

- B. Color: The lighting system shall have a-color temperature of 4000K-5700K and a minimum CRI of 75.
- C. Mounting Heights: To ensure proper aiming angles for reduced glare and to provide better playability, minimum mounting heights shall be as described below. Provide mounting heights as required based on pole locations and setback from the field of play. Higher mounting heights may be required based on photometric report and ability to ensure the top of the field angle is a minimum of 10 degrees below horizontal.
- D. Aiming of any luminaire shall not be greater than 60 degrees from nadir.
- E. Center of luminaire cluster height at top of light poles: Typical average mounting height of a light cluster $H = [(1/3 W) + SB] \times \tan 30$. Width (W)= width of playing surface from foul line or inbound/outbound line to the opposite foul line or inbound/outbound line in the direction of the principal aiming of respective light standard pole. Pole Set Back (SB) = the distance from the nearest foul line or inbound/outbound line to the proposed light standard pole location.
- F. Unless indicated otherwise the center of an individual luminaire cluster’s mounting height shall be as recommended by IES due to pole set back but in no case, shall any aiming angle of any luminaire aimed to the sports field exceed 60 degrees from nadir.

2.2 ENVIRONMENTAL LIGHT CONTROL

- A. Light Control Luminaires: All luminaires shall utilize spill light and glare control devices

- including, but not limited to, optical lensing, internal shields, louvers, or external shields.
- B. The first page of a photometric report for all luminaire types proposed showing horizontal and vertical axial candle power shall be provided to demonstrate the capability of achieving the specified performance. Reports shall be certified by a qualified independent testing laboratory with a minimum of five years' experience or by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products. A summary of the horizontal and vertical aiming angles for each luminaire shall be included with the photometric report.

2.3 SPORTS LIGHTING SYSTEM CONSTRUCTION

- A. Manufacturing Requirements: All components shall be designed and manufactured as a system. All luminaires, wire harnesses, drivers and other enclosures shall be factory assembled, aimed, wired and tested prior to shipment.
- B. Durability: All exposed components shall be constructed of corrosion resistant material and/or coated to help prevent corrosion. All exposed carbon steel shall be hot dip galvanized per ASTM A123. All exposed aluminum shall be powder coated with high performance polyester or anodized. All exterior reflective inserts shall be anodized, coated, and protected from direct environmental exposure to prevent reflective degradation or corrosion. All exposed hardware and fasteners shall be stainless steel of 18-8 grade or better, passivated and coated with aluminum-based thermosetting epoxy resin for protection against corrosion and stress corrosion cracking. Structural fasteners may be carbon steel and galvanized meeting ASTM A153 and ISO/EN 1461 (for hot dipped galvanizing), or ASTM B695 (for mechanical galvanizing). All wiring shall be enclosed within the cross-arms, pole, or electrical components enclosure.
- C. System Description: Lighting system shall consist of the following:
1. Galvanized steel poles with maintenance platform/cage, climbing pegs, and cross-arm assembly.
 2. Non-approved pole technology:
 - a. Square static cast concrete poles will not be accepted.
 - b. Direct bury steel poles which utilize the extended portion of the steel shaft for their foundation will not be accepted due to potential for internal and external corrosive reaction to the soils and long-term performance concerns.
 3. Lighting systems shall use concrete foundations.
 - a. For a foundation using a pre-stressed concrete base embedded in concrete backfill, the concrete shall be air-entrained and have a minimum compressive design strength at 28 days of 3,000 PSI. 3,000 PSI concrete specified for early pole erection, actual required minimum allowable concrete strength is 1,000 PSI. All piers and concrete backfill must bear on and against firm undisturbed soil.
 - b. For anchor bolt foundations or foundations using a pre-stressed concrete base in a suspended pier or reinforced pier design pole, erection may occur after 7 days, or after a concrete sample from the same batch achieves a specified strength approved by the structural engineer.
 4. Manufacturer shall supply all LED drivers and supporting electrical equipment
 - a. Remote drivers and supporting electrical equipment shall be mounted approximately 10 feet above grade in aluminum NEMA 3RX enclosures. The enclosures shall be touch-safe and include drivers and fusing with indicator lights on fuses to notify when a fuse is to be replaced for each luminaire. Disconnect per circuit for each pole structure shall be located

in the enclosure.

5. Manufacturer shall provide surge protection at the pole equal to or greater than 40 kA for each line to ground (Common Mode) as recommended by IEEE C62.41.2_2002.
 6. Wire harness shall be complete with an abrasion protection sleeve, strain relief and plug-in connections for fast, trouble-free installation.
 7. All luminaires, visors, and cross-arm assemblies shall withstand 150 mph winds and maintain luminaire aiming alignment.
 8. Control cabinet shall provide remote on-off control and monitoring of the lighting system.
 9. Manufacturer shall provide lightning protection and grounding as defined by NFPA 780 and be UL Listed per UL 96 and UL 96A.
 - a. Integrated grounding via concrete encased electrode grounding system.
 - b. If grounding is not integrated into the structure, the manufacturer shall supply grounding electrodes, copper down conductors, and exothermic weld kits. Electrodes and conductors shall be sized as required by NFPA 780. The grounding electrode shall be minimum size of 5/8 inch diameter and 8 feet long, with a minimum of 10 feet embedment. Grounding electrode shall be connected to the structure by a grounding electrode conductor with a minimum size of 2 AWG for poles with 75 feet mounting height or less, and 2/0 AWG for poles with more than 75 feet mounting height.
- D. Safety: All system components shall be UL listed for the appropriate application.

2.4 ELECTRICAL

- A. Electric Power Requirements for the Sports Lighting Equipment:
 1. Maximum total voltage drop: Voltage drop to the disconnect switch located on the poles shall not exceed three (3) percent of the rated voltage.
- B. Equipment requiring electrical distribution more than that indicated or required by the basis of design shall be provided by the contractor at no additional cost to the Owner.

2.5 STRUCTURAL PARAMETERS

- A. Wind Loads: Wind loads shall be based on the latest published edition of the International Building Code and all local code requirements. Wind loads shall be calculated using ASCE 7-10, an ultimate design wind speed of 120 mph and exposure category C.
- B. Manufacturer Pole Structural Design: The stress analysis and safety factor of the poles shall conform to the latest published edition of AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (LTS-5).
- C. Manufacturer Foundation Design: The foundation design shall be based on soil parameters as outlined in the geotechnical report. If a geotechnical report is not utilized, the foundation design shall be based on class 5 soils.
- D. Manufacturer Foundation Drawings: Project specific foundation drawings stamped by a registered engineer in the state where the project is located are required. The foundation drawings must list the moment, shear (horizontal) force, and axial (vertical) force at ground level for each pole.

2.6 CONTROL

- A. Instant On/Off Capabilities: System shall provide for instant on/off of luminaires.

- Contactors shall be rated 60A/3P to utilize existing 40 Amp feeder circuits.
- B. Lighting contactor cabinet(s) constructed of minimum NEMA Type 3RX aluminum, designed for easy installation with contactors, labeled to match field diagrams and electrical design. Manual off-on-auto (momentary ON/OFF reverting to the AUTO position) rotary (non-keyed) selector switches shall be provided. The system shall be programmed for manual ON/OFF operation only.
 - C. Remote Lighting Control System: System shall allow Owner and users with a security code to schedule on/off system operation via a web site, phone, fax, or email up to ten years in advance. Manufacturer shall provide and maintain a two-way TCP/IP communication link. Trained staff shall be available 24/7 to provide scheduling support and assist with reporting needs.
 - 1. The owner may assign various security levels to schedulers by function and/or fields. This function must be flexible to allow a range of privileges such as full scheduling capabilities for all fields to only having permission to execute "early off" commands. The scheduling tool shall be capable of setting curfew limits.
 - 2. Controller shall accept and store 7-day schedules, be protected against memory loss during power outages, and shall reboot once power is regained and execute any commands that would have occurred during outage.
 - D. Remote Monitoring System: System shall monitor lighting performance and notify manufacturer if individual luminaire outage is detected so that appropriate maintenance can be scheduled. The controller shall determine switch position (manual or auto) and contactor status (open or closed).
 - E. Management Tools: Manufacturer shall provide a web-based database and dashboard tool of actual field usage and provide reports by facility and user group. Dashboard shall also show current status of luminaire outages, control operation, and service. Mobile applications shall be provided suitable for IOS, and Android devices.
 - F. Hours of Usage: Manufacturer shall provide a means of tracking actual hours of usage for the field lighting system that is readily accessible to the owner.
 - 1. Cumulative hours: shall be tracked to show the total hours used by the facility
 - 2. Report hours saved by using early off and push buttons by users.
 - G. Communication Costs: Manufacturer shall include communication costs for operating the controls and monitoring system for a period of 25 years.

2.7 CONTROL OF EXISTING NON-MUSCO LIGHT POLES

- A. Provide three additional controlled 60A/3P lighting contactors for control of existing HID tennis court lighting. Include spare cabinet space as needed for future equipment/controls for monitoring of these three additional contactor circuits for future HID replacement to Musco LED.

PART 3 – EXECUTION

3.1 SOIL QUALITY CONTROL

- A. It shall be the Contractor's responsibility to notify the Architect/Engineer/Owner immediately if unforeseen soil conditions exist other than those on which the foundation design is based or indicated in the project's Geotechnical Report, or if the soil cannot be readily excavated.
 - 1. Provide engineered foundation embedment design by a registered engineer in the State where the project is located for soils other than specified soil conditions.
 - 2. Provide additional materials required to achieve alternate foundation design.
 - 3. Excavate and remove from the site materials other than normal soils, such as rock, caliche, etc.

3.2 FIELD QUALITY CONTROL

- A. Illumination Measurements: Upon substantial completion of the project and in the presence of the Contractor, Project Engineer, Owner's Representative, and Manufacturer's Representative, illumination measurements shall be taken and verified. The illumination measurements shall be conducted in accordance with IESNA LM-5-04.
- B. Field Light Level Accountability
 1. Light levels shall be guaranteed not to fall below the target maintained light levels for the entire warranty period of 25 Years.
 2. The contractor/manufacturer shall be responsible for an additional inspection one year from the date of substantial completion or commissioning of the lighting system and shall also utilize the Owner's light meter in the presence of the Owner at the Owner's request.
 3. The contractor/manufacturer shall make all changes needed to bring the fields back to compliance for light levels and uniformities. Contractor/Manufacturer shall be held responsible for any damage to the fields during these repairs and make repairs to the satisfaction of the Owner at no additional cost.
- C. Correcting Non-Conformance: If, in the opinion of the Owner or his appointed Representative, the actual performance levels including foot-candles and uniformity ratios are not in conformance with the requirements of the performance specifications and submitted information, the Contractor/Manufacturer shall make all adjustments required to meet specifications and satisfy the Owner at no additional cost to the Owner.

END OF SECTION

SUBMITTAL INFORMATION
Design Submittal Data Checklist and Certification

All items listed below are mandatory, shall comply with the specification and be submitted according to pre-bid submittal requirements

Include d	Tab	Item	Description
	A	Letter/ Checklist	Listing of all information being submitted must be included on the table of contents. List the name of the manufacturer's local representative and his/her phone number. Signed submittal checklist to be included.
	B	On Field Lighting Design	Lighting design drawing(s) showing: a. Field Name, date, file number, prepared by, and other pertinent data b. Outline of field(s) being lighted, as well as pole locations referenced to the center of the field (x & y), or home plate for baseball / softball fields. Illuminance levels at grid spacing specified c. Pole height, number of fixtures per pole, as well as luminaire information including wattage, lumens and optics d. Height of meter above field surface e. Summary table showing the number and spacing of grid points; average, minimum and maximum illuminance levels in foot candles (fc); uniformity including maximum to minimum ratio, coefficient of variance and uniformity gradient; number of luminaries, total kilowatts, average tilt factor; light loss factor. f. Alternate manufacturers shall provide both initial and maintained light scans using a maximum 0.70 Light Loss Factor to calculate maintained values.
	C	Off Field Lighting Design	Lighting design drawings showing spill light levels in footcandles as specified in section 1.3 A.
	D	Photometric Report	Provide photometric report for a typical luminaire used showing candela tabulations as defined by IESNA Publication LM-35-02. Photometric data shall be certified by laboratory with current National Voluntary Laboratory Accreditation Program or an independent testing facility with over 5 years experience.
	E	Life Cycle Cost calculation	Document life cycle cost calculations as defined in the specification. Identify energy costs for operating the luminaires, maintenance cost for the system including spot lamp replacement, and group relamping costs. All costs should be based on 25 Years.
	F	Luminaire Aiming Summary	Document showing each luminaire's aiming angle and the poles on which the luminaries are mounted. Each aiming point shall identify the type of luminaire.
	G	Structural Calculations	Pole structural calculations and foundation design showing foundation shape, depth backfill requirements, rebar and anchor bolts (if required). Pole base reaction forces shall be shown on the foundation drawing along with soil bearing pressures. Design must be stamped by a structural engineer in the state of Texas.
	H	Control and Monitoring	Manufacturer shall provide written definition and schematics for automated control system to include monitoring. They will also provide examples of system reporting and access for numbers for personal contact to operate the system.
	I	Electrical distribution plans	If bidding an alternate system, manufacturer must include a revised electrical distribution plan including changes to service entrance, panels and wire sizing, signed by a licensed Electrical Engineer in the state of Texas.
	J	Performance Guarantee	Provide performance guarantee including a written commitment to undertake all corrections required to meet the performance requirements noted in these specifications at no expense to the owner. Light levels must be guaranteed per specification for 25 years.

			Constant light systems shall provide independent 3 rd party test data stamped by a registered engineer.
	K	Warranty	Provide written warranty information including all terms and conditions.
	L	Project References	Manufacturer to provide a list of project references of similar products completed within the past three years.
	M	Product Information	Complete set of product brochures for all components, including a complete parts list and UL Listings.
	N	Non-Compliance	Manufacturer shall list all items that do not comply with the specifications.
	O	Compliance	Manufacturer shall sign off that all requirements of the specifications have been met at that the manufacturer will be responsible for any future costs incurred to bring their equipment into compliance for all items not meeting specifications and not listed in item N – Non-Compliance

Manufacturer:

Signature:

Contact Name:

Date: ____/____/____

**SECTION 27 01 00
OPERATION AND MAINTENANCE (O&M) MANUALS
OF COMMUNICATIONS SYSTEMS**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Compile product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare operating and maintenance data as specified in this Section and as referenced in other sections of specifications.
- B. Instruct Owner's personnel in operation and maintenance of equipment and systems.
- C. Submit three (3) electronic copies, on separate devices (USB Flash Drive or some type of pre-approved solid-state storage device), of complete O&M manuals in final form. The submitted manual shall be the system manufacturer's operations manual, supplemented with operations and maintenance instructions custom tailored for the system installed. Electronic documentation shall be provided in a non-proprietary PDF format, without password restrictions.
- D. Hard copies shall be provided upon request of the Owner, Architect, and/or Consultant.
- E. Recorded video of all training sessions shall be included in each copy, of each system's final submitted O&M.
- F. The final submitted manual shall include a sign-in sheet and owner/consultant signed acceptance of all training sessions.

1.2 ELECTRICAL OPERATING AND MAINTENANCE MANUAL SUBMITTAL SCHEDULE

- A. Thirty (30) days after receipt of reviewed submittals bearing the Project Technology Consultant's stamp of acceptance (including re-submittals), submit for review, an electronic copy of the first draft of the System's O&M Manual. This copy shall contain as applicable to the specific system, a minimum of the following:
 - 1. Table of Contents for each element
 - 2. Contractor information
 - 3. All shop drawings, coordination drawings and product data, bearing the Project technology Consultant's stamp of acceptance.
 - 4. All parts and maintenance manuals for items of equipment
 - 5. Warranties (without starting dates)
 - 6. Certifications that have been completed; submit forms and outlines of certifications that have not been completed
 - 7. Operating and maintenance procedures.
 - 8. Form of Owner's Training Program Syllabus (including times and dates)
 - 9. Control operations / equipment wiring diagrams
 - 10. Coordination Drawings
 - 11. Schedule of Speakers, Amplifiers, Sound Equipment, Etc.
 - 12. Schedule of Handsets and other Peripheral Devices, Etc.
 - 13. Schedule of Cable, Jacks, Outlets, Etc.
 - 14. Access Control Door Schedules
 - 15. Video Surveillance Camera Schedules
 - 16. Other required operating and maintenance information that are complete.
 - 17. Cable pathway layout drawings and station map, including through wall and floor penetration locations and sleeve sizes.
- B. Copy will be returned to the Contractor within 15 days with comments for corrections.
- C. Submit the electronic completed manuals (hard copies upon request) in final form to the Project's Technology Consultant.
 - 1. Prior to substantial completion for Owner's use after the Owner accepts facility maintenance.

2. Include all specified data, test reports, drawings, dated warranties, certificates, training videos. along with other materials and information.
- D. The Project's Technology Consultant shall review the manuals for completeness within 15 days.
- E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Project's Technology Consultant. The manuals will not be retransmitted.
- F. Electronic and/or hard copies of the accepted manuals shall be delivered to the Owner prior to substantial completion.

PART 2 - PRODUCTS

2.1 BINDERS

- A. Upon the request for hard copies of the O&M manuals, the binders shall consist of the following configuration:
 1. Commercial quality black, 3-ring binders with clear, durable, cleanable plastic covers.
 2. Minimum ring size: 1"; Maximum ring size: 3".
 3. When multiple binders are used, correlate the data into related groupings.
 4. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 - EXECUTION

3.1 SYSTEM OPERATION AND MAINTENANCE MANUAL

- A. Form for Manuals Submitted in Hard Copy Format:
 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 flyleaf 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.
 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 / normal operating instructions
 - 2) Regulation, control, stopping, shut down and emergency instructions
 - 3) 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. Manufacturer's printed operating and maintenance instructions.
 - e. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
 - f. Complete equipment field accessible wiring diagrams
 - g. Each Contractor's coordination drawings
 - h. 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 27.
 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.

END OF SECTION

SECTION 27 05 00
COMMUNICATIONS BASIC MATERIALS, METHODS, AND GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of Division 01 General Requirements, and other provisions and requirements of the Contract Documents apply to work of Division 27 Communications.
- B. Applicable provisions of this section apply to all sections of Division 27, Communications.
- C. The general provisions of the Contract and the requirements of the following Sections apply to the Work specified in this Section. See following sections for related general and specific requirements following sections shall associate with this specification as applicable.
 - 1. Division 26 in its entirety.
 - 2. Division 27 in its entirety.
 - 3. Division 28 in its entirety.
- D. The entire drawing and specification package apply to the work specified in the communication 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.

1.2 CODES AND STANDARDS

- A. All equipment and work performed shall comply with current and applicable Codes, Standards, Rules, Ordinances, Regulations, and Best Practices (both published and best practices) 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 (including those not specifically listed in this Specification). Applicable Codes and Standards shall consist of, but not be limited to the following:
 - 1. Americans with Disabilities Act (ADA)
 - 2. Authorities Having Jurisdiction (AHJ) - Local
 - 3. American National Standards Institute (ANSI)
 - 4. American Society of Testing and Materials (ASTM) *Communications Cables - B694, B736, D4565, D4566, D4730, D4731, D4732*
 - 5. Building Industry Consulting Services International (BICSI)
 - 6. Code of Federal Regulations - Title 47
 - 7. Electronics Industries Association (EIA) *Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Connecting and Terminating Devices - EIA-455 Series*
 - 8. Federal Communications Commission (FCC) - Communications Act and FCC Rules
 - 9. Federal Information Processing Standards (FIPS) *Federal Building Standard for Telecommunications Pathways and Spaces - FIPS PUB 175, FIPS PUB 176*
 - 10. The Insulated Cable Engineers Association (ICEA) *Communications Cable Stands - P-47-434, S-56-434, S-80-576, S84-608, S-85-625, S-86-634, S-87-640, S-89-648, S-90-661, S-98-688, S-99-689, S-100-685*
 - 11. International Electro-technical Commission (IEC)
 - 12. Institute of Electrical and Electronic Engineers (IEEE) *Local Area Networks/Metropolitan Networks Standards Collection - LAN/MAN 802 Series*
 - 13. International Organization for Standardization (ISO) (ISO/IEC) *Premise Wiring*

- Core and LAN/MAN Core Equivalents-11801, 8802, 14763-1*
14. International Telecommunication Union (ITU-T) *Telecommunications Standardization*
 15. National Electrical Code (NEC) *National Electrical Code - NFPA 70*
 16. National Electrical Contractor's Association (NECA) *Standards of Installation*
 17. National Electrical Manufacturers Association (NEMA) *Performance Standard for Twisted Pair Premise Voice and Data Communications Cable-WC 63.1, WC 63.2, WC 66*
 18. National Electrical Safety Code (NESC)
 19. National Fire Protection Association (NFPA) - *National Fire Alarm Code NFPA 72, Life Safety Code NFPA 101*
 20. Society of Cable Telecommunications Engineers (SCTE)
 21. Local Accessibility Standards
 22. Telecommunications Industries Association (TIA) *(ANSI/TIA/EIA) Wiring and Cabling Standards - 526, 568, 569, 570, 571, 598, 606, 607, 758, TSB 31-B, 63, 67, 72, 75 and 95*
 23. Uniform Building Code (UBC)
 24. Underwriters Laboratories, Inc. (U.L.) - *497A, 910, 1077, 1863, 1283, 1459, 1604, 1651, 1681, 1690, 1778, 1977*
- B. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.
- C. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.
- D. Obtain all permits required.

1.3 SUMMARY

- 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 a new and/or an extension of the existing installation, as shown in the associated specifications and drawings, complete in every respect.
- C. Provide complete and working Communications Systems including equipment, conduit, wiring, material, labor and training as described in this Specification and the Drawings. The Communications Systems Drawings and Specifications are the sole property of the Architect and are not to be duplicated, scanned, loaned or in any way made available to persons not designated as authorized by the Architect. All Communications Systems plans, and specifications are to be returned to the Architect following completion of bid.

1.4 CONTRACTOR'S QUALIFICATIONS

- A. An approved contractor for the work under this division shall be:
 1. A specialist in this field and have the personnel, experience, training, and skill, and the organization to provide a practical working system.
 2. Able to furnish evidence of having contracted for and installed not less than ten (10) systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.
 3. Perform work by persons qualified to produce workmanship of specified quality. Persons performing work shall be required to be licensed. Onsite supervision shall have minimum of the following:
 - a. Licenses, as applicable to the system being installed

- b. Manufacturer's Certifications
 - 1) Firm Certification
 - 2) Installer Certification
 - 3) Programmer's Certification
 - 4) System Designer Certification.

1.5 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 Consultant for review. No departures shall be made without prior written acceptance of the Consultant.
- 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 Consultant in writing, shall be performed or furnished. In the case that 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. The approximate locations of system equipment and components are indicated on the Drawings. These Drawings are not intended to give complete and accurate details in regard to location of equipment, field devices, etc. Exact locations are to be determined by actual measurements at the building and will in all cases be subject to the Review of the Owner or Consultant, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.
- E. Items specifically mentioned in the Specifications but not shown on the Drawings and/or items shown on 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.
- F. Any discrepancies between the Contract Documents and actual job site conditions shall be reported to the Owner or Consultant, so that they will be resolved prior to the bidding, where this cannot be done at least 7 working days prior to bid; the greater or costlier of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.
- G. It is the intention of this Section of the Specifications, and associated drawings, to outline minimum requirements to furnish the Owner with a turnkey and fully operating system in cooperation with other trades.
- H. The contract documents are schematic in nature in that they are only to establish scope and a minimum level of quality. They are not to be used as actual working construction drawings. The actual working construction drawings shall be the shop drawings accepted by project's consultant.
- I. 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 project's consultant 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.
- J. These documents are conceptual in nature. It shall be the responsibility of the approved installer to furnish a complete and functional system, including the items shown on the drawings, in the specifications, and items not designated in either. The installer's shop

drawings and product data submittals shall represent a complete system and documents accepted by the project's consultant shall not relieve the installer from being required to provide any materials, equipment, or labor to furnish a complete and functional system as recognized by the Project's Technology Consultant and the Owner.

1.6 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, ordinances, and standards; 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 closed ceiling space and/or furred chases unless specifically noted or indicated to be exposed. Work shall be installed to avoid crippling of structural members. 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 Consultant. The Consultant 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.
- E. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.7 RELATION WITH OTHER TRADES

- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements. Extend electrical services and final connections to all items requiring same.
- B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.
- C. Where cabling pass through walls or floors, metal sleeves shall be provided and shall be sealed to prevent spread of fire and smoke. In walls, they shall extend 3" beyond the finished surface. In pipe chases, they shall extend 8" inches above floor slab and be cemented in a watertight manner. Size of these sleeves shall be at least as required to maintain a maximum 40% conduit fill ratio. 1/2 inch greater than outside diameter of the conduit.
- D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.
- E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under other Division. Determine from the General Contractor / Construction Manager for the various trades, the Owner, and by direction from the Architect / Engineer, the exact location of all items. The construction trades involved

shall furnish all roughing-in drawings and wiring diagrams required for proper installation of the electrical work.

1. Make final connections to all communications equipment indicated on the drawings, except as noted.
- F. Request all Shop Drawings required in ample time to permit proper installation of all electrical provisions.
- G. Extend services as indicated to the various items of equipment furnished by others. Rough-in for the various items and make final connections ready for operation upon placing of the equipment.

1.8 CONCEALED AND EXPOSED WORK

- A. When the word "concealed" is defined as hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is defined as open to view, in plain sight.

1.9 GUARANTEE

- A. Guarantee work for a minimum of two years or as noted longer elsewhere from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

1.10 MATERIAL AND EQUIPMENT

- A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.11 NOISE AND VIBRATION

- A. Select equipment to operate with minimum noise and vibration. If noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, and judged objectionable by the Owner, Architect, or Engineer, rectify such conditions at no additional cost to the Owner. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.12 ACCEPTABLE MANUFACTURERS

- A. Manufacturers names and catalog number specified under sections of Division 27 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer shall be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before proposal due date. Submit complete design and performance data to the Architect. The Architect and Owner issue approvals of acceptable manufacturers as addenda to the Construction Proposal Documents.
- 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.

1.13 UTILITIES, LOCATIONS AND ELEVATIONS

- A. Locations and elevations of the various utilities included within the scope of this work:

1. Obtained from utility maps and other substantially reliable sources.
 2. Are offered separate from the Contract Documents as a general guide only without guarantees to accuracy.
- B. Examine the site and verify the location and elevation of all utilities and of their relation to the work. Existing utilities indicated on the site plans are for reference only and shall be field verified by the Contractor with the respective public or private utility.

1.14 CONTRACT DRAWINGS

- A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.
- B. It is the responsibility of the Contractor to compare the scale of all electrical drawings with the scale of the architectural drawings and make adjustments to all electrical drawings which have the incorrect drawing scale so that his material takeoffs are not in error due to an incorrectly labeled drawing scale and his proposal is complete.

1.15 ABBREVIATIONS AND DEFINITIONS

A/V	Audio/Visual
AWG	American Wire Gauge
BCR	Building Communications Room
CATV	Cable Antenna Television
CCTV	Closed Circuit Television
CMP	Communications Media Plenum
CMR	Communications Media Riser
dB	Decibel
EMI	Electromagnetic Interference
ER	Equipment Room
FACP	Fire Alarm Control Panel
FCR	Floor Communications Room
Gbps	Giga Bits Per Second
Hz	Hertz
IC	Intermediate Cross-connect
IDF	Intermediate Distribution Frame
IM	Information Management
IS	Information Systems or Information Services (also see MIS)
IT	Information Technology
Km	Kilometer
LCD	Liquid Crystal Display
LED	Light Emitting Diode
M	Micron
MATV	Master Antenna Television (<i>A.K.A. Main Antenna Television</i>)
Mbps	Mega Bits Per Second
MC	Main Cross-connect
MDF	Main Distribution Frame
MHz	Megahertz
MIS	Management Information Systems or Services
NEXT	Near-End Cross Talk
nm	Nanometer
OFN	Optical Fiber Non-conductive

OFNP	Optical Fiber Non-conductive Plenum
OFNR	Optical Fiber Non-conductive Riser
OTDR	Optical Time Domain Reflectometer
PBX	Private Branch Exchange
POS	Point of Sale
PSELFEXT	Power Sum Equal Level Far-End Cross Talk
PSNEXT	Power Sum Near-End Cross Talk
SMATV	Satellite Main Antenna Television
TC	Telecommunications Closet (<i>Now referred to as TR</i>)
T.O.	Telecommunications Outlet
TR	Telecommunications Room (<i>A.K.A. TC - Telecommunication Closet</i>)
UTP	Unshielded Twisted Pair Wire

Definitions:

Administration Subsystem - Cable, connectors, cross-connect and inter-connect hardware, patch cords, and other equipment that allows easy reconfiguration of the telecommunications system to accommodate personnel and floor plans changes.

Campus Backbone Subsystem - Connects telecommunications processing equipment in different buildings on the same campus.

Communications Cabling - Any fiber optic, copper, coaxial or other transmission media used for transmitting or receiving communications systems data.

Communications System - Communications Systems and associated wired or wireless interconnection.

Communications Drawings - All floor plans, elevations, details, schematics, block diagrams, legends, tables, notes or attachments associated with any or all of the Communications Systems.

Distribution Cable - The telecommunications UTP wiring between the telecommunications room and the outlet connectors.

Equipment Subsystem - Telecommunications cable, connectors, support hardware, blocks, and protective devices that serve to connect the network interface and the backbone subsystem through the administrative subsystem.

Horizontal Subsystem - Telecommunications cable, outlets and distribution cords that extend the riser backbone from the administrative points in the TRs to workstations.

Information Systems - Software systems including operating systems, programs, data manipulation and management systems, control software and various forms of proprietary and off-the-shelf software.

Information Technology - The practical application of knowledge associated with designing, installing and maintaining the equipment, hardware and infrastructure utilized for control, distribution, or display of telecommunications, audio, video and data signals. Because computers are central to information management, computer departments within

companies and universities are often called (IT Departments) and are responsible for MIS or IS personnel and services.

Low Voltage Wire - Wire or cable used for one or more systems that operate on 24 volts or less. Low Voltage Wire is used to install and interconnect one or more of the Communications Systems. Low Voltage Wire includes patch cords, jumpers and all portions of cable or wire used to make the Communications Systems operational or for system communications.

Management Information Systems - A class of software that provides managers with tools for organizing and evaluating their department. Typically, MIS systems are written in COBOL and run on mainframes or minicomputers. Within companies and large organizations, the department responsible for computer systems is sometime called the MIS department. Another name for MIS is Information Services (IS).

Multiplexer - A communications device that multiplexes (combines) several signals for transmission over a single medium. A multiplexer is sometimes called a "mux". A demultiplexer is required to complete the process by separating multiplexed signals from a transmission line. Frequently a multiplexer and demultiplexer are combined into a single device capable of processing both outgoing and incoming signals.

Riser Backbone Subsystem - Telecommunications cable, splice enclosures, and associated hardware that provide the main cable routes in a building. It interconnects building floors and larger areas of a single floor. It also interconnects administrative points in satellite TRs to the administrative points in the building main equipment room.

Station Cable - The wiring between the outlet connections and the work area equipment.

Communications Systems - One or more of the following and associated equipment: Data/Networking Systems, Telecommunications Systems, Paging / Intercom Systems, Clock/Control Systems, Master Antenna Television Systems, Cable Antenna Television Systems, Broadcast Video Systems, Audio/Visual Presentations Systems, Microwave/Wireless Systems.

Telecommunications - The transmission, emission or reception of signs, signals, images, sound or intelligence of any nature by wire, radio, optical or other technical transmission system.

Work Area - Location of an employee or student and their data/telecommunications equipment or devices.

Work Area Subsystem - Station mounting cords, extension cords, connectors, adapters, and interface units that provide physical and electrical connectivity between workstation equipment and the horizontal subsystem.

1.16 QUALITY ASSURANCE

- A. Equipment Standards:
 - 1. System and all components shall be brand new stock from manufacturer.
 - 2. All electronics shall be 100% solid state.
 - 3. System and all components shall bear a UL Label.
- B. Contractor Qualifications:

At the time of Proposal, the Contractor shall:

1. Have manufactured, supplied or installed at least three (3) other systems of similar size, complexity, and general operation as the systems described in these specifications. The Contractor shall furnish in writing to Architect proof of compliance with this paragraph at the time of proposal.
2. Hold all legally required Texas State Contractor's licenses necessary to accomplish the installation and activation of the described system at the facilities indicated. The Contractor shall submit copies of licenses to the Architect prior to the start of work
3. Hold all legally required state registrations to meet local requirements for submittal drawings.
4. Have a local office within fifty (50) miles of the project site staffed with factory trained technicians who have experience on systems of similar complexity and function as the systems described in these specifications. These technicians shall be fully capable of system engineering support, installation supervising, system start-up, and providing the Owner with training and service on both hardware and software for the systems specified.
5. Certify complete and total compliance with the provisions of these specifications by letter or submittal of the proposal response forms, signed by an officer of the corporation, or a principal if other ownership currently exists. In addition, the letter or forms shall include a complete listing of exceptions, if any.

1.17 SUBMITTALS

- A. Provide SUBMITTALS according to Division 01 and the following.
- B. Requirements:
 1. Submit paragraph-by-paragraph specification review indicating compliance or deviation with explanation.
 2. Submit proof that all system components and cables are U.L. Listed.
 3. An equipment list with names of manufacturers, model numbers, and technical information on all equipment proposed. Clearly mark exact model number proposed to be installed.
 4. Product technical information sheets for each principal component in the proposed system, including cable, wire, terminal marking, and wire marking material.
 5. Certification from the manufacturer stating that the system Contractor is an authorized distributor or installer of the proposed system when such certifications exist.
 6. A statement listing every technical and operational parameter wherein the submitted equipment varies from that which was originally specified. If the submitter fails to list a particular variance and his submittal is accepted but is subsequently deemed to be unsatisfactory because of the unlisted variance, the submitter shall replace or modify such equipment at once and without cost to the Owner.

1.18 EXAMINATION OF SITE

- A. The Contractor shall have visited the site and familiarized himself with all existing conditions prior to submitting his proposal and shall be prepared to carry out the work within the existing limitations. Failure or neglect to do so shall not relieve the Contractor of his responsibilities not entitle him to additional compensation for work overlooked and not included in his proposal.
- B. The Contractor shall confirm the availability of the proper power source for each piece of

specified equipment, through site visits and Drawings as necessary. Where proper power does not exist, the Contractor shall provide the required power, circuits, outlets, conduits, and wire as specified under Division 26.

1.19 DATA ACCURACY

- A. Absolute accuracy of information regarding existing conditions cannot be guaranteed. The Drawings and Specifications are for the assistance and guidance of the Contractor and exact locations, distances, elevations, etc., shall be governed by actual field conditions. Where variations from the contract documents are required, such variations shall be approved by the Architect / Owner.

1.20 SECURITY

- A. The Contractor is responsible for complying with all of the Owner's and facility security's requirements to prevent theft or damage to equipment, tools and materials. If any deviation from facility security requirements is necessary, approval for such deviation shall be coordinated with the Owner.
- B. The Contractor shall not disclose any confidential information of the Owner. The Contractor acknowledges that such action is highly injurious and can do damage to the Owner. The Contractor will agree to and comply with the standard policies and provisions of the Owner regarding outside Contractors and Consultants.

1.21 UTILITIES

- A. It shall be the responsibility of the Contractor to provide all temporary connection and cables, lighting, light stands and power. The facilities shall be used in accordance with all applicable regulations regarding operations, safety and fire hazards of the governmental Authorities Having Jurisdiction, provided they are not used in a wasteful manner.

1.22 PERMITS

- A. All permits required for the specified performance and completion of the work shall be secured by the Contractor. These permits shall be presented and reviewed at the initial project progress meeting.

1.23 NOTIFICATION

- A. The Contractor shall not shut off any existing systems. The Contractor shall give the Owner at least ten (10) calendar day's notice of any requirements to shut off or interference with existing alarm, regulating, computer or other service systems. The Owner will arrange and execute any shutdown. All work such as splicing, connections, etc., necessary to establish or re-establish any system shall be completed by the Contractor in close coordination with the Owner.

1.24 INTERFERENCES WITH THE OWNER

- A. Transportation and storage of materials at the facility, work involving the facility, and all other matters affecting the habitual use by the Owner of its buildings, shall be conducted so as to cause the least possible interference, and at times and in a manner acceptable to the Owner. The Contractor shall make every effort to delivery equipment per the schedule required by the project.

1.25 PROJECT RECORD DOCUMENTS

- A. Maintain at the job site a separate set of white prints (blue line or black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is significantly at variance with the

contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various major and minor feeders, equipment, and other pertinent items, as installed. Record underground and under-slab cables installed, dimensioning exact location and elevation of such installations.

- B. At conclusion of project, obtain without cost to the Owner, electronic AutoCAD 2014 or later / Revit CAD files of the original drawings and transfer as-built changes to these. Provide the following as-built documents including all contract drawings regardless of whether corrections were necessary and include in the transmittal: "2 sets of CDs and prints for Owner's use, one set of CDs, prints, and mylars for Architect / Engineers Records". Delivery of these as-built electronic, reproducible and prints is a condition of final acceptance.
1. 3 sets of electronic AutoCAD (2014 dwg or later) / Revit CAD drawing files, on CD-ROM media, of each contract as-built drawing.
 2. One reproducible Dayrex mylar film positive of each contract as-built drawing.
 3. Three sets of blue or black-line prints of each contract as-built drawing.
- C. 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 conduit and cables, etc that were deviated from construction drawings.
 6. Indicate exact location of all underground communications raceways, and elevations.
 7. Correct schedules to reflect (actual) equipment furnished and manufacturer.
 8. During the execution of work, maintain a complete set of Drawings and specifications upon which all locations of equipment, devices, and all deviations and changes from the construction documents in the work shall be recorded.
 9. Exact location of all communications equipment in building. Label panel schedules to indicate actual location.
 10. Exact location of all communications equipment in and outside of the building.
 11. Location, size and routing of all communications cables, conduits, equipment, etc. shall be accurately and neatly shown to dimension.
 12. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
 13. Cloud all changes.

1.26 OPERATING TESTS

- A. After all communications 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 and Owner. Provide minimum 24-hour advance notice of scheduling of all tests. 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.

1.27 WARRANTY

- A. All equipment shall be covered for the full manufacturers warranty period and systems shall be warranted by the Contractor for a period of two years commencing with the

filing date of substantial completion. The Warranty shall cover all costs for warranty service, including parts, labor, prompt field service, pick-up, transportation, delivery, reinstallation, and retesting. A contract for service shall cover the period starting with the first expected activation of each system and shall continue without interruption to cover the period to the end of the two-year warranty as defined above. The end of the warranty period shall be handled such that a smooth transition to a maintenance agreement with the Owner shall be achieved with no lapse in coverage.

- B. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.28 BUILDING CONSTRUCTION

- A. It shall be the responsibility of the sub-contractor to consult the Architectural and Engineering drawings, details and specifications and thoroughly familiarize himself as to the construction and all job-related requirements. All construction trades shall cooperate with the General Contractor / Construction Manager job site superintendent and lay out work so that all piping, cables, pathways, raceways, and other items are placed in the walls, furred spaces, chases, etc., so that there shall be no delay in the job.

1.29 TEMPORARY FACILITIES

- A. General: Refer to Division 01 for general requirements on temporary facilities.
- B. Temporary Wiring: Temporary power and lighting for construction purposes shall be provided under Division 26. Installation of temporary power shall be in accordance with NEC Article 305.
- C. Temporary facilities, wire, lights and devices are the property of this Contractor and shall be removed at the completion of the Contract.

1.30 EXTRA MATERIALS

- A. Keys: Provide three (3) sets of all keys for system cabinets.

PART 2 - PRODUCTS

2.1 WORK INCLUDED

- A. All materials listed in PART 2 - PRODUCTS of this Division Sections and on the Drawings shall be provided by the Contractor unless specifically excluded or modified in other portions of this Specification or Addendums.

2.2 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.

2.3 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.

2.4 MANUFACTURE'S INSTRUCTIONS

- A. The Contractor is responsible for furnishing the proper Communication 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 Consultant, in writing, of any conflict between the Contract Documents and the manufacturer's recommendations and shall obtain, from the Consultant, 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 Consultant.

2.5 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.

2.6 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.
- B. All electronic equipment, containing sealed lead acid batteries or gel cells, shall be stored in climate-controlled area until installed or reinstalled. Do not store in non-climate controlled connex storage units.
- C. Storage is to be provided and secured by the contractor. In the event that the Owner should agree to furnish storage space, security of the space and its contents shall remain the responsibility of the contractor.

2.7 CONDITION OF MATERIALS

- A. All materials required for the installation of the Communication 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 installed, or while being tested, until time of final acceptance, shall be replaced by this Contractor without extra cost to Owner.

2.8 NAMEPLATES

- A. Factory assembled components and equipment shall be provided with be factory stamped labeling. Labeling will have information required to specifically identify the component and/or equipment in the future such as the manufacturer's name, catalog number, serial number, etc. All data on the labels shall be legible at the time of final inspection.

2.9 ACCESS DOORS

- A. Wherever access is required in walls or ceilings to concealed junction boxes, pull boxes, equipment, etc., installed under this Division, furnish a hinged access door and frame with flush latch handle to another Division for installation. Doors shall be as follows:

1. Plaster Surfaces: Milcor Style K.
2. Ceramic Tile Surfaces: Milcor Style M.
3. Drywall Surfaces: Milcor Style DW.
4. Install panels only in locations approved by the Architect.

2.10 SPACE LIMITATIONS

- A. Equipment shall be chosen which shall properly fit into the physical space provided and shown on the drawings, allowing ample room for access, servicing, removal and replacement of parts, etc. Adequate space shall be allowed for clearances in accordance with applicable codes and standards. Physical dimensions and arrangement of equipment shall be subject to the approval of the Consultant.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. This project has a critical path, which must be closely followed in order to meet the completion date. The Contractor shall review the proposed schedule at the Award of Contract meeting and be prepared to staff his work force according to the schedule constraints presented at that time.
- B. Aesthetics are an important consideration in this installation. All components shall be installed so as to have aesthetically pleasing results as determined by the Owner and Architect. Actual locations of all visible components shall be coordinated in advance with the Owner and Architect.
- C. Install, make fully operational and test the system as indicated on the Drawings and in the Specifications. Where information is not available the worst-case condition must be assumed to ensure a complete, functional system.
- D. Any interfacing with other systems shall be the Contractor's responsibility under this contract, and the details, both logical and physical, of such interfaces shall be reflected in the Submittals and As-Built drawings.
- E. If appropriate, interfaces with the Owner's Data Network, Telecommunications and Communications System shall be coordinated with the Owner and Architect.
- F. All necessary back boards, back-boxes, pull-boxes, connectors, supports, conduit, cable and wire shall be furnished and installed to provide a complete and reliable system. Exact location of all backboards, boxes, conduit and wiring runs shall be presented to the Owner / Architect for approval in advance of any installation. Provide as required and as specified in Division 26.
- G. Where required provide 120-VAC, 60 Hz power from nearest electrical panel through a junction box, to the system devices. Provide as required and as specified in Division 26.
- H. Where required, install conduit, cable and wire parallel and square with building lines, including raised floor areas. Conduit fills shall not exceed 40%.
- I. Ground busses shall be provided in each any room with communication equipment.
- J. All equipment shall be mounted with sufficient clearance to minimize EMI as well as meet all applicable codes and facilitate observation and testing. Securely hand and/or fasten with appropriate fittings to ensure positive grounding, free of ground loops, throughout the entire system. Units shall be installed parallel and square to building lines.
- K. Communications grounding system shall be a single point grounding from the building entrance electrical ground to each Communications room.
- L. 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 communications grounding system. The conductors shall be a # 6awg solid with a green jacket

- M. Quiet and vibration-free operation of all equipment is a requirement of this installation. Properly adjust, repair, balance or replace any equipment producing objectionable (in the judgment of the Owner or Architect) noise or vibration in any of the occupied areas of any building and provide additional brackets and bracing if necessary. Any such additions or changes shall be at no additional cost to the Owner.
- N. Installation shall comply with the CODES AND STANDARDS portion of this Section. Where more than one code or regulation is applicable, the more stringent shall apply.
- O. Where new equipment is replacing old equipment, the Contractor is responsible for removing and disposing of the old equipment and doing whatever repair work is necessary as specified by the Owner / Architect.
- P. Install firestopping, as specified in Division 26 for all penetrations in slabs and firewalls to meet code at the completion of work and prior to final testing demonstration to the Owner.
- Q. The installation shall be performed in a professional manner.
- R. On a daily basis, clean up and deposit in appropriate containers all debris from work performed under the appropriate specification sections. Stack and organize all parts, tools and equipment when not being used.
- S. Preparation, handling and installation shall be in accordance with the Manufacturer's written instructions and technical data appropriate to the product specified.
- T. All work shall conform to the National Electrical Contractor's Association "Standard of Installation" for general installation practice.
- U. At the conclusion of the installation, all work areas, including all enclosures and boxes, shall be vacuumed and cleaned to remove all debris and grease.

3.2 COORDINATION WITH OWNER / ARCHITECT

- A. Close coordination with the Owner / Architect is vital to achieve a complete, aesthetically pleasing job. The Contractor shall ensure that the Owner / Architect is kept fully apprized of job progress.

3.3 CUTTING, PAINTING, AND PATCHING

- A. Structural members shall not be drilled, bored or notched in such a manner that shall impair their structural value. Cutting of holes in structural members, if required, shall be done with core drills and only with the specific approval of the Owner / Architect for each instance.
- B. All walls that require cutting or repair during the installation process shall be returned to their original condition, including the matching of colors and finishes to the satisfaction of the Owner / Architect, and at no additional cost to the Owner.

3.4 WIRE AND CABLE

- A. All low voltage cable shall be low smoke plenum rated, limited energy, with 300-volt insulation.
- B. All wires in exposed areas shall run through conduit as specified in Division 26.
- C. Provide conduits, cable trays, raceways, wireways, boxes and outlets as specified in Division 26.
- D. After installation, and before termination, all wiring shall be checked and tested to insure there are no grounds, opens, or shorts on any conductors. In addition, all wires between buildings or underground and all coax cables shall have insulation tested with a megohmmeter (megger) and a reading of greater than 20 megohms shall be required to successfully complete the test.
- E. Run wires continuously from termination to termination without splices.

- F. Wire and cable shall be supported in each equipment and terminal cabinet and in each terminal and pull box in vertical risers and horizontal runs with wire duct and strap-type supports. At any point where wire duct is required for good wire management, whether shown on elevations or not, install appropriate duct. Where terminal boards are used, wire ducts shall be supplied on both sides and at no time shall wires cross over terminal boards. Arrange cables neatly to allow inspection, removal and replacement. Lace cables as required. Spot tie wire bundles with plastic cable ties and securely affix to panels. If screw type terminals are specified, terminal strip connections shall be locking, tongue style, pressure crimp, and solderless spade lug.
- G. Visually inspect wire and cable for faulty insulation prior to installation. Protect cable ends at all times with acceptable end caps except during actual termination. At no time shall any coaxial cable be subjected to a bend less than a 6-inch radius. Protect wire and cable from kinks. Install 1 pull rope for all 2" or larger sized conduits.
- H. Provide plastic bushings and strain relief material at all conduit exit points and where necessary, to avoid abrasion of wire and excess tension on wire and cable.
- I. Cables above accessible ceilings shall not rest on ceiling tiles. Use Velcro tie wraps, J-hooks or D-rings to hold cables. Provide independent support for all cables. Support is to be from building structure (do not support from pipes or conduits). Communications cables shall not tie off on HVAC supports, all-thread, ceiling grid hanger wire or electrical / mechanical piping system.
- J. Ground and bond equipment and circuits in accordance with NEC and Division 26.

3.5 IDENTIFICATION AND TAGGING

- A. All cables, wires, wiring forms, terminal blocks and terminals shall be identified by labels, tags to other permanent markings in accordance with TIA/EIA-606. The markings shall clearly indicate the function, source, or destination of all cabling, wiring and terminals. All cables and wires shall be identified, utilizing heat-shrink, machine printed, polyolefin wire markers (Brady Type B-32 *or equal*). Handwritten tags are not acceptable.
- B. Should a situation arise where the wire tagging format as shown on the drawings cannot be used, a substitute format shall be submitted which complies with the intent to provide documentation that will permit end-to-end tracing of all Communications Systems wiring.
- C. All panels shall be provided with permanently attached engraved lamacoid labels with identifying names and functions. All terminal points shall be appropriately labeled. Labels shall be consistent in form, color, and typeface throughout the system and all must contain the name of the system or subsystem as part of the label textual information. Design, color, font and layout shall be coordinated with, and approved by, the Owner.
- D. Identification of Equipment:
 - 1. All major equipment shall have a manufacturer's label identifying the manufacturer's address, equipment model and serial numbers, equipment size, and other pertinent data. Take care not to obliterate this nameplate. The legend on all nameplates or tags shall correspond to the identification shown on the Operating Instructions.
 - 2. A black-white-black 3 layer laminated plastic engraved identifying nameplate shall be permanently secured to each wireway, terminal cabinet, and communications (voice, data, video) cabinet or rack.
 - a. Identifying nameplates shall have 1/2-inch high, engraved letters. For equipment designation and 1/4-inch letters indicating source circuit designation, (i.e.: "IDF(FCR) XXYY –served from MDF (BCR)

XXGG).

3. Permanent, waterproof, black markers shall be used to identify each communications grid junction box, clearly indicating the type of system available at that junction box.
 4. Pull Boxes: Field work each with a nameplate showing identity, and identifying equipment connected to it. Nameplates shall also indicate where pull box is fed from.
 5. Communication hardware located above accessible ceilings: Provide ½-inch high black name plate with white 1/4-inch letters glued to bottom of t-grid ceiling below hardware located above ceiling. Identification shall be as short as possible yet identifying device above ceiling, i.e. "A/V-EQ".
- E. Prohibited Markings: Markings intended to identify the manufacturer, vendor, or other source from whom the material has been obtained are prohibited for installation in public, tenant, or common areas within the project. Also prohibited are materials or devices that bear evidence that markings or insignias have been removed. Certification, testing (example, Underwriters Laboratories), and approval labels are exceptions to this requirement.
- F. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of communications facilities. Provide text of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with industry standards for color and design.
- G. Wire and Cable Labeling: Provide wire markers on each conductor in all boxes, pull boxes, gutters, wireways. Identify with drop/circuit number.
- H. Underground Warning Tape: Thomas and Betts or approved equal. Six-inch wide plastic tape, colored red or orange with suitable warning legend describing buried communications lines. All underground conduits shall be so identified. Tape shall be buried at a depth of 6-inches below grade and directly above conduits or ductbanks. Provide magnetic marking tape below all underground conduits.

3.6 CUTTING AND PATCHING

- A. General: Comply with the requirements of Division 01 for the cutting and patching of other work to accommodate the installation of electrical work. Except as authorized by the Architect / Engineer, cutting and patching of electrical work to accommodate the installation of other work is not permitted.

3.7 INSTRUCTION OF OWNER'S PERSONNEL

- A. Before proceeding with the instruction of Owner Personnel, prepare a typed outline in triplicate, listing the subjects that will be covered in this instruction, and submit the outline for review by the Owner. At the conclusion of the instruction period obtain the signature of each person being instructed on each copy of the reviewed outline to signify that he has a proper understanding of the operation and maintenance of the systems and resubmit the signed outlines.
- B. Prior to substantial completion, conduct an on-site training program to instruct Owner's operating personnel in the operation and maintenance of the communications systems.
1. Provide the training during regular working day.
 2. The Instructors shall be experienced in their phase of operation and maintenance of the systems and with the project.
- C. Time to be allocated for instructions.
The Contractor shall furnish the services of factory trained specialists to instruct the Owner's operating personnel. The Owner's operator training shall include training as specified per system specification,

1. Minimum of four (4) hours dedicated instructor time
2. 2-hour sessions on different, non-consecutive days
3. Additional instruction time for specific systems as specified in other Sections.
- D. Before on-site training, submit the program syllabus; proposed time and dates; for review and approval, minimum 48 hours prior to proposed training time and date.
 1. One copy to the Owner
 2. One copy to the Architect / Engineer
- E. The Owner shall provide a list of personnel to receive instructions and shall coordinate their attendance at the agreed upon times.
- F. Use operation and maintenance manuals as the basis of instruction. Review manual with personnel in detail. Explain all aspects of operation and maintenance.
- G. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shut down of each item of equipment.
- H. Demonstrate equipment functions (both individually and as part of the total integrated system).
- I. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.
- J. Submit a report within one week after completion of training. List time and date of each demonstration, hours devoted to the demonstration, and a list of people present, with their respective signatures.
- K. 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.
- L. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.8 OPENINGS

- A. Framed, cast or masonry openings for boxes, equipment or conduits are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.9 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions, which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
 1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
 2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
- B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.10 VANDAL RESISTANT DEVICES

- A. Where vandal resistant screws or bolts are employed on the project, deliver to the Owner 2 suitable tools for use with each type of fastener used.
- B. Proof of delivery of these items to the Owner shall be included in the Operating and

Maintenance Manuals.

3.11 PROTECTION

- A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.
- B. Do not deliver equipment to this 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 shall be rejected, and the contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.

3.12 EQUIPMENT BACKBOARDS

- A. Backboards: $\frac{3}{4}$ inch, fire retardant, exterior grade plywood, painted gray, both sides.
 - 1. Provide minimum of two 4-ft. by 8-ft. sheets of plywood for each location shown.
 - 2. Provide minimum of two 4-ft. by 4-ft. sheets of plywood for each communications location.

3.13 SITE MANAGEMENT RESPONSIBILITY

- A. The Contractor shall provide an on-site Project Manager as defined in CONTRACTOR'S QUALIFICATIONS portion of this Section.

3.14 DEMOLITION AND RELOCATION

- A. 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.
- B. 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 Consultant. Where items scheduled for relocation and/or reuse are considered unsuitable for reuse, the Contractor shall so notify the Consultant 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 no additional cost to the Owner or the Consultant.
- C. 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.
- D. 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 Consultant.

3.15 EXISTING SYSTEM TESTING

- A. Contractor shall have each low voltage system tested prior to the commencement of construction. Systems shall include all systems that fall under the Division 27 umbrellas, as identified in the Division 27 of the Construction Specifications Institute (CSI) current Master Format . Test shall include the functionality of all field devices and equipment. Any failures or items found to be functioning not to specification, shall be reported prior to construction. Any items found to be improperly or non-functioning upon the completion of the project, shall be replaced and/or repaired, by the contractor, at no additional cost to the project or the owner.
- B. Contractor shall document the location and any ID tag, MAC address, IP address, or bar code of any existing device that is to be removed from its current location. Devices that are to remain, shall be reinstalled in the exact location that they reside in prior to construction, unless noted otherwise.
- C. Any individual/firm that will be removing, relocating, reinstalling, or tampering with any devices; shall be licensed by the state and certified by the manufacturer of the system.
- D. Contractor shall remove any devices where construction occurs to prevent possible damage to the device. Removal of any devices which support user connection or other systems, shall be coordinated with the owner prior to removal and/or taking offline.

3.16 START-UP RESPONSIBILITY

- A. The Contractor shall initiate System operation. The Contractor shall provide competent Start-Up personnel on each consecutive working day until all Communications Systems are functional and ready to start the acceptance test phase. If the Contractor, in the Owner / Architect's judgment, is not demonstrating progress in solving any technical problems, the Contractor shall supply Manufacturer's factory technical representation and diagnostic equipment at no cost to the Owner, until resolution of those defined problems. Where appropriate, the Contractor shall bring the Systems on-line in their basic state (i.e., alarm reporting, facility code access control, etc.) It is the responsibility of the Owner to provide the specific database information that will be utilized for initial system programming.
- B. Properly ground each piece of electronic equipment prior to applying power. Properly ground all shielded wire shields to the appropriate earth ground at the hub end only, not at the remote or device end.
- C. Use a start-up sequence that incrementally brings each portion of the system on-line in a logical order that incorporates checking individual elements before proceeding to subsequent elements until the entire system is operational. The basic steps should include:
 - 1. Establish ground planes at the equipment rooms and hub end of the systems as specified in Division 26.
 - 2. Disconnect power, connect the first device, reconnect power, and verify operational correctness. Repeat until the entire system is verified and operational.

3.17 PREPARATION FOR ACCEPTANCE (SUBSTANTIAL COMPLETION)

- A. All systems, equipment, and devices shall be in full and proper adjustment and operation, and properly labeled and identified.
- B. All materials shall be neat, clean and unmarred, and parts securely attached.
- C. All extra material as specified shall be delivered and stored at the premises as directed.
- D. Test reports of each system and each system's components and As-Built Project Drawings shall be complete and available for inspection and delivery as directed by the

Owner.

3.18 SYSTEM ACCEPTANCE REQUIREMENTS

- A. Before final acceptance or work, the Contractor shall perform and/or deliver each of the following in the order stated.
- B. The Contractor shall deliver three (3) composite "System Operations and Maintenance" manuals in three-ring binders, sized to hold the material below, plus 50% excess. Each manual shall contain in appropriately tabbed sections:
 - 1. A statement of Guarantee including date of termination and the name and phone number of the persons to be called in the event of equipment failure.
 - 2. A set of Operating procedures for the overall System that includes all required Owner activities, and that allows for the Owner operation of all attributes and facilities of the System.
 - 3. A section for each specific type of equipment containing the vendor manuals, instruction sheets, and any related literature that came in the original shipping container for that piece of equipment. Include all warranty cards.
- C. Testing:
 - 1. The Contractor shall perform all tests required by Division 26 and those submitted as part of this Section.
 - 2. The Contractor shall activate all devices for proper system operation, including supervisory and trouble circuit tests. Similarly, audible alarms will not be activated except on a one-time, coordinated basis, to check the actual sounding devices.
 - 3. A test report for each piece of equipment shall be prepared by the Contractor and submitted to the Owner. This report shall include a complete listing of every device, the date it was tested, by whom and the results. The final test reports shall indicate that every device tested successfully. Failure to completely test and document the tests will result in a delay of final testing and acceptance.
- D. As-Built Drawings:
 - 1. After completion of all the tests listed above, and prior to the final acceptance test, The Contractor shall submit the complete As-Built drawings as identified in PART 1 – PROJECT RECORD DRAWINGS.
 - 2. The final As-Built Drawings shall consist on one set of reproducible prints, two (2) sets of Point-to-Point Detail Drawings, Equipment Schedules, and the complete detailed technical data that was shipped by the manufacturer with all installed equipment.
- E. Final Acceptance Test: The Final Acceptance Test shall demonstrate the installed and activated System's performance and compliance with System Specifications. However, before this testing can begin the following must have received and reviewed by the Owner.
 - 1. System Operations and Maintenance Manuals
 - 2. System Test Reports
 - 3. As-Built Drawings

3.19 FINAL ACCEPTANCE

- A. The date of final acceptance shall be the date of owner occupancy, or the date all punch list items have been completed or final payment has been received. Refer to Division 1 for additional requirements
- B. When the Final System Acceptance Requirements described above including the Final Acceptance Test described above have been satisfactorily completed. The Owner / Architect shall issue a Letter of Completion to the Contractor indicating the date of such

completion. The Notice of Completion shall be recorded by the Contractor upon receipt of the Owner / Architect completion letter. This date of record shall be the start of the warranty period.

END OF SECTION

SECTION 27 05 07

COMMUNICATIONS SHOP DRAWINGS, COORDINATION DRAWINGS & PRODUCT DATA

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Prepare submittals as required by Division 01 and as outlined below.
- B. Submit product data shop drawings only for the following and for items specifically requested elsewhere in the Contract Drawings and Specifications. Architect / Engineer reserves the right to refuse shop drawings not requested for review and to imply that materials shall be provided as specified without exception.
- C. The term submittal, as used herein, refers to all:
 - 1. Shop Drawings
 - 2. Coordination Drawings
 - 3. Product data
- D. Submittals shall be prepared and produced for:
 - 1. Distribution as specified
 - 2. Inclusion in the Operating and Maintenance Manual, as specified, in the related section

1.2 SHOP DRAWINGS

- A. Present drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.
- B. Show all dimensions of each item of equipment on a single composite Shop Drawing. Do not submit a series of drawings of components.
- C. Identify field dimensions; show relation to adjacent or critical features or work or products.

1.3 COORDINATION DRAWINGS

- A. Present in a clear and thorough manner. Title each drawing with project name. Identify each element of drawings by reference to sheet number and detail, or room number of contract documents. Minimum drawing scale: 1/4"=1'-0".
- B. Prepare coordination drawings to coordinate installations for efficient use of available space, for proper sequence of installation and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.
- C. For each room containing technology equipment and each rack with technology equipment, submit plan and elevation drawings. Show:
 - 1. Actual technology equipment and components to be furnished.
 - 2. NEC working space and NEC access to NEC working space.
 - 3. Relationship to other equipment and components and openings, doors and obstructions
 - 4. Rack location and dimensions
- D. Identify field dimensions. Show relation to adjacent or critical features of work or products.
- E. Verify location of communications station devices, telephone outlets and other work specified in this Division.
 - 1. Coordinate with drawing details, site conditions and millwork shop drawings prior to installation.
 - 2. Where required for clarification, submit shop drawings prior to rough-in and fabrication.
- F. Submit shop drawings in plan, elevation and sections, showing outlets and other devices in casework, cabinetwork and built-in furniture.

1.4 PRODUCT DATA

- A. All product options specified shall be indicated on the product data submittal. All options listed on the standard product printed data not clearly identified as not part of the product data submitted shall become part of the Contract and shall be provided.
- B. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number.
- C. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.
- D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.
- E. Mark up a copy of the specifications for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect / Engineer / Owner (Does Not Comply, Explanation:)

1.5 MANUFACTURERS INSTRUCTIONS

- A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up and adjusting.

1.6 CONTRACTOR RESPONSIBILITIES

- A. Review submittals prior to transmittal.
- B. Determine and verify:
 - 1. Field measurements
 - 2. Field construction criteria
 - 3. Manufacturer's catalog numbers
 - 4. Conformance with requirements of Contract Documents
- C. Coordinate submittals with requirements of the work and of the Contract Documents.
- D. Notify the Architect / Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.
- E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect / Engineer's acceptance.
- F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect / Engineer reviews submittals or not.
- G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect / Engineer reviews submittals or not, unless Architect / Engineer gives written acceptance of the specific deviations on reviewed documents.
- H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
 - 1. Proper sizes and capacities
 - 2. That the item will fit in the available space in a manner that will allow proper service
 - 3. Construction methods, materials and finishes
- I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

1.7 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor.
- B. Number of submittals required:
 - 1. Shop Drawings and Coordination Drawings: Submit four opaque reproductions.
 - 2. Product Data: Submit the number of copies the contractor requires, plus those to be retained by the Architect / Engineer.
- C. Accompany submittals with transmittal letter, in duplicate, containing:
 - 1. Date
 - 2. Project title and number
 - 3. Contractor's name, address and telephone number
 - 4. The number of each Shop Drawing, Project Datum and Sample submitted
 - 5. Other pertinent data
- D. Submittals shall include:
 - 1. The date of submission
 - 2. The project title and number
 - 3. Contract Identification
 - 4. The names of:
 - a. Contractor
 - b. Subcontractor
 - c. Supplier
 - d. Manufacturer
 - 5. Identification of the product
 - 6. Field dimensions, clearly identified as such
 - 7. Relation to adjacent or critical features of the work or materials
 - 8. Applicable standards, such as ASTM or federal specifications numbers
 - 9. Identification of deviations from contract documents
 - 10. Suitable blank space for General Contractor and Architect / Engineer stamps
 - 11. Contractor's signed and dated Stamp of Approval
- E. Coordinate submittals into logical groupings to facilitate interrelation of the several items.
 - 1. Finishes which involve Architect / Engineer selection of colors, textures or patterns
 - 2. Associated items requiring correlation for efficient function or for installation

1.8 SUBMITTAL SPECIFICATION INFORMATION

- A. Every submittal document shall bear the following information as used in the project manual:
 - 1. The related specification section number
 - 2. The exact specification section title
- B. Submittals delivered to the Architect / Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.9 RESUBMISSION REQUIREMENTS

- A. Make resubmittals under procedures specified for initial submittals.
 - 1. Indicate that the document or sample is a resubmittal
 - 2. Identify changes made since previous submittals
- B. Indicate any changes which have been made other than those requested by the Architect /

Engineer.

1.10 CONTRACTOR'S STAMP OF APPROVAL

- A. Contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
- B. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect / Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.
- C. Do not deliver any submittals to the Architect / Engineer that do not bear the Contractor's stamp of approval and signature.
- D. Submittals delivered to the Architect / Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.11 ARCHITECT / ENGINEER REVIEW OF IDENTIFIED SUBMITTALS

- A. The Architect / Engineer will:
 - 1. Review identified submittals with reasonable promptness and in accordance with schedule. Specific equipment submittals that may be required to be expedited shall be submitted separately without other submittal items not requiring the same prompt attention.
 - 2. Affix stamp and initials or signature, and indicate requirements for resubmittal or approval of submittal
 - 3. Return submittals to Contractor for distribution or for resubmission
- B. Review of submittals will not extend to design data reflected in submittals that is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.
- C. Architect / Engineer's review is only for conformance with the design concept of the project and for compliance with the information given in the contract.
 - 1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
 - 2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes or coordination with the work of other trades.
- D. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.12 SUBSTITUTIONS

- A. Do not make requests for substitution employing the procedures of this Section.
- B. The procedure for making a formal request for substitution is specified in Division 1.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 SHOP DRAWINGS AND PRODUCT DATA

- A. Submittals shall not be combined or bound together with any other material submittal.
- B. Submit individually bound shop drawings and product data for the following when specified or provided:

1. Structural Cabling
2. Communications System
3. Sound Reinforcement System
4. CATV System

3.2 COORDINATION DRAWINGS

- A. Submit coordination drawings as specified.

END OF SECTION

SECTION 27 05 09
CONTRACT QUALITY CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Contract quality control including workmanship, manufacturer's instructions, mock-ups and demonstrations.

1.2 QUALITY CONTROL PROGRAM

- A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work in accordance with contract documents.

1.3 WORKMANSHIP

- A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform work by persons qualified to produce workmanship of specified quality.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.
- D. Provide finishes to match approved samples; all exposed finishes shall be approved by the Architect / Engineer. Submit color samples as required.

1.4 MANUFACTURER'S INSTRUCTIONS

- A. Comply with instructions in full detail, including each step in sequence.
- B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.5 MANUFACTURER'S CERTIFICATES

- A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.6 MANUFACTURER'S FIELD SERVICES

- A. When required in individual Specification Sections, manufacturer shall provide a manufacturer's qualified personnel to observe:
 - 1. Field conditions.
 - 2. Condition of installation.
 - 3. Quality of workmanship.
 - 4. Start-up of equipment.
 - 5. Testing and adjusting of equipment.
- B. Manufacturer's qualified personnel shall make written report of observations and recommendations to Architect/Engineer.

1.7 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 where possible.
- D. Perform tests and submit results as specified.

1.8 SCHEDULING OF 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. Demonstrations

PART 2 - PRODUCTS

2.1 REFERENCE APPLICABLE SPECIFICATION SECTIONS.

PART 3 - EXECUTION

3.1 ADJUSTMENTS AND MODIFICATIONS

- A. Contractor shall provide all adjustments and modifications as requested by the manufacturer's qualified personnel at no additional cost to Owner.

3.2 MOCK-UPS

- A. Mock-up a typical classroom, science lab of each type, and computer lab with all wiring devices, cover plates, rough-in boxes, conduits, etc. Provide all conductors from all wiring devices to above ceiling space to demonstrate conduit routing and conductor fill.

END OF SECTION

SECTION 270529
PATHWAYS FOR AV SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Conduits
- B. Pull Boxes
- C. Conduit Fittings
- D. Floor Boxes

1.02 DESCRIPTION OF WORK

- A. Furnish and install all items listed in AV0.01 required to support the AV systems cabling as indicated on the AV drawings, specified, or as otherwise required.

PART 2 PRODUCTS

2.01 General

- A. Refer to AV Drawings for pathway type required for each cable run. Substitution of pathway type requires Consultant's approval. Pathways shown without cable fill are for temporary or future cable use.

2.02 CONDUITS

- A. General
 - 1. Provide Pull String in all conduits for AV system.
 - 2. The sizes of conduits shall be as shown on the drawings, minimum size is 0.75". All conduits shall be reamed and furnished with insulation and/or grounded bushings as required.
- B. Flexible Steel Conduit
 - 1. Flexible steel conduits are not acceptable for AV systems installations
- C. Electrical Metallic Tubing (EMT)
 - 1. EMT shall be zinc galvanized both inside and out with a minimum thickness of .0008". It shall be round with uniform wall thickness and continuously welded seams. EMT shall be furnished in ten-foot standard lengths.
- D. PVC Conduit
 - 1. PVC conduit shall be rigid non-metallic Schedule 40 heavy wall.
 - 2. Use of PVC shall be limited to underground conduits only.
- E. Conduits carrying fiber cables shall have large labels indicating "Fiber Optic Cable." These labels should be placed every 10 feet where exposed.
- F. Buried conduits must have yellow "Caution Fiber Optic" tape laid 12 inches above duct bank.

2.03 PULL BOXES

- A. Pull boxes shall be constructed of code gauge steel, etched, primed and shall have rust resistant ANSI 61 gray finish and be NEMA 1 construction with screw covers unless noted otherwise. For conduits 1-1/4" and larger terminating in a pull box, the minimum length of pull box shall be 8 times the diameter of the largest conduit terminating in the pull box. Splice boxes shall be sized as per EIA/TIA-569A Table 5.2-3.

- B. Location and sizes of pull boxes and splice boxes shall meet the approval of the Architect and Consultant. Condulete type fittings (e.g. LB's, etc.) shall not be used in lieu of pull boxes or bends.
- C. Exposed pull boxes in public areas shall be provided with tamperproof screws.
- D. Boxes shall be free from unused openings, including knockouts.
- E. Pull boxes larger than 12" x 12" for which a custom panel has not been specified, shall have hinged covers.
- F. Gang, 4" square and 4-11/16" square boxes must be installed using open center brackets
- G. Pull boxes for indoor wet or damp locations shall be NEMA 3R Rated with stainless steel screws.
- H. Pull boxes for outdoor locations shall be NEMA 4X Rated stainless steel continuous hinges, door clamps and a hasp.
- I. Provide junction box, pull box, and hand-hole assemblies sized as required by the NEC. Pull boxes/hand-holes shall be located using the following table:
 - 1. Runs with total of all bends <90 degrees – 600ft.
 - 2. Runs with total of all bends >=90 degrees and <180 degrees – 400ft.
 - 3. Runs with total of all bends >= 180 degrees and <270 degrees – 200ft.
 - 4. Runs with total of all bends >= 270 degrees are not allowed.

2.04 CONDUIT FITTINGS

- A. All rigid, IMC and EMT fittings shall be galvanized malleable iron or steel. Connectors and couplings shall be threaded, setscrew, compression type, and concrete-tight.
- B. Conduit bodies shall be malleable iron, threaded type. Provide neoprene cover gaskets for conduit body covers exposed to the weather.
- C. Expansion fittings shall be O-Z/Gedney Type "AX" for rigid metal conduit and Type "TX" for electrical metallic tubing. For intermediate metal conduit applications, a 15-inch minimum length of rigid metal conduit shall be used with a Type "AX" expansion fitting. Provide O-Z/Gedney Type "BJ" bonding jumpers at all expansion fittings.
- D. Rigid and IMC conduit bushings shall be of the insulated type with phenolic thermosetting insulation molded to a hot dipped galvanized malleable iron body of the threaded type.
- E. EMT fittings shall be of the insulated throat type. Fittings larger than 2-1/2 inches shall have threaded bushings installed.
- F. PVC conduit fittings shall be slip joint type.
- G. All conduit sleeves will be fitted with "spillways" to maintain the bend radius of cables passing through the sleeve.

2.05 FLOOR BOXES

- A. Refer to AV drawings for manufacturer, model, quantity, and location information.
- B. Contractor to provide all parts and accessories required for a working floor box system including those required based on specific installation conditions unless otherwise noted.
- C. Boxes to have a voltage divider to allow for power receptacles and low-voltage AV connections to reside within the same box. Conduits for high and low voltages must enter box on appropriate side of voltage divider to maintain separation. High and low-voltage wires may not cross within the box.

- D. On-grade boxes to be cast-iron, and above grade, in-slab boxes to be steel.
- E. Boxes to be fully adjustable, before and after the concrete pour.
- F. Boxes shall have applicable approvals from a Nationally Recognized Testing Laboratory and meet all applicable local codes.
- G. Floor Boxes on elevated floors must maintain proper fire rating of slab.
- H. Provide equipment ground conductor as required by local code.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General
 - 1. Whenever possible, cable and raceway routing paths shall follow the logical structure of the building (e.g. follow hallways, aisles and corridors). Route all AV cables and raceways parallel to or perpendicular to the building structure. No diagonal runs will be permitted unless noted otherwise or pre-approved by the Architect and Consultant. Corridor crossovers shall be kept to a minimum.
 - 2. Coordinate layout of conduits including specific routing and mounting elevations with building structure and work of other trades.
 - 3. Provide a pull string in all raceways, cable trays and conduits.
 - 4. Transitions between cable trays and conduit, etc. shall not exceed 10" horizontally, 24" vertically. Provide "drop-out" supports spillways, and radius controls for changes in elevation as required.
 - 5. All power devices and power sources emit a given amount of radio frequency interference (RFI) and/or electro-magnetic interference (EMI). To reduce or eliminate the field effects of RFI/EMI on the signals residing on a given cable, runs shall be kept at the maximum possible distance from such sources. Running cables through the center of the building can reduce the external interference effects of RFI/EMI in the cable tray. Open wiring and non-metallic raceway shall be routed a minimum of twelve (12") inches away from fluorescent fixtures. Special attention shall be given to the routing of such pathways away from lighting ballasts and high intensity discharge devices. Reference AV0.01 for the required separation distances of signals of different types.
- B. Conduits
 - 1. Provide continuous conduits across open or inaccessible ceiling areas.
 - 2. Changes from home run conduits to stub up must be approved by The Consultant.
 - 3. Provide conduits from cable trays to accessible ceilings as required.
 - 4. Conduits attached to cable trays shall be secured with approved conduit clamps.
 - 5. Conduit buried in concrete slab pours shall be full weight rigid galvanized steel or Schedule 40 PVC. All elbows, stub ups and conduit above ground shall be rigid galvanized steel. All joints and terminations for PVC shall be made according to manufacturer's recommendations to ensure all joints are watertight.
 - 6. Conduit buried in or beneath building slabs or exterior below grade shall be full weight rigid galvanized steel or Schedule 40 PVC. The conduit shall be encased in 3" concrete envelope or as called for on the Plan Drawings. All elbows and stub ups shall be rigid galvanized steel. All joints and terminations for PVC shall be made according to manufacturer's recommendations to ensure all joints are watertight.
 - 7. Conduits and cables entering from outside the building shall be sealed water and moisture tight. Seal between conduit and sleeves, conduits and core drilled holes

and around conductors inside conduits. Provide cast iron pipe or Schedule 40 galvanized steel conduit sleeves in exterior walls below grade, with intermediate wall stop and anchor collar set in place before concrete pouring. Sleeve shall be a part of the sealing assembly. When the wall opening is core drilled, the wall sleeve may be omitted. A mechanically compressed rubber sealing assembly shall be placed in the annular space between conduit and the sleeve or the core drilling.

8. Conduits stubbed out into accessible ceiling to be located no more than 2'-6" above finished ceiling.
9. All conduit stub-outs and junction boxes in accessible ceilings to remain accessible by ladders from the finished floor below.
10. Layout the conduit system to avoid crossing building expansion joints. Where crossings are necessary, use expansion joints.

C. Boxes

1. Wall or ceiling boxes must be mounted flush with finished surface.
2. Final mounting height of all boxes on finished surfaces to be coordinated with Architect for alignment with adjacent boxes.
3. In stud walls, boxes on opposite sides of the wall must be separated by a minimum of 1 stud cavity.
4. In CMU or concrete walls, boxes on opposite sides of the wall must be separated by a minimum of 16".
5. Pull boxes shall be placed in straight sections of conduit runs and may not be used in lieu of a bend without approval of the Consultant. Pull boxes and/or splice boxes shall be installed in readily accessible locations. Where boxes are installed above suspended ceilings, they shall be located immediately above the suspended ceiling or the ceiling shall have a suitably marked and hinged panel to facilitate direct access to the pull box.
6. Boxes in accessible ceiling to be located no more than 2'-6" above finished ceiling.
7. All boxes mounted in accessible drop tile ceilings to remain accessible by ladders from the finished floor below.

D. Fire Stopping

1. Where pathways pierce walls, floors and/or ceilings, restore fire rating and smoke stoppage integrity as required by code.

E. Excavation:

1. It is the responsibility of the Contractor to obtain all permits and utility marking. Bids shall include landscaping restoration costs.

END OF SECTION

SECTION 27 10 00
STRUCTURED CABLING SYSTEM (SCS)

PART 1 - GENERAL

1.1 RELATED WORK

The following, in their entirety and as applicable, shall apply to this section. Including any associated drawings.

- A. Conditions of the Contract
- B. Division 1
- C. Division 26
- D. Division 27
- E. Division 28

1.2 DESCRIPTION

- A. Summary of Work:
 - 1. Reference Attachment 'A' of this specification for supplemental scope as it relates to the project and the Owner standards.
 - 2. Provide a complete and tested Structured Cabling System (SCS) for the interconnections of the Local Area Network (LAN). The SCS shall include fully terminated unshielded twisted pair cables, fiber optic cabling, raceways, conduit, back boxes, copper/fiber optic termination components, station mounting hardware, fiber optic enclosures, patch panels, copper/fiber optic patch cables, relay cabinets/cabinets, and other incidental and miscellaneous premises wiring system hardware as required for a complete, tested, and usable system that is in compliance with the latest NEC, ANSI/EIA/TIA, BICSI, and Authorities Having Jurisdiction codes and standards. The installation shall comply with all applicable requirements, design guidelines, and standards in effect at the job site and as indicated in the Drawings and Specifications.
 - 3. An IDF will be required when the distance between outlet terminations and MDF/IDF exceeds 280', including service loops. IDF's shall be selected and organized to be minimum in number while still reaching all locations to be wired.
 - 4. If there are any discrepancies between the drawings and specification or among themselves, the contractor shall request clarification prior to providing pricing for the scope of work. If a request is not issued and a response not provided via a posted addendum, the contractor shall provide pricing for the costliest scenario and obtain clarification during the project.
 - 5. These documents are conceptual in nature. It shall be the responsibility of the approved installer to furnish a complete and functional system, including the items shown on the drawings, in the specifications, and items not designated in either. The installer's shop drawings and product data submittals shall represent a complete system and documents accepted do not relieve the installer from being required to provide any materials, equipment, or labor to furnish a complete and functional system as recognized by the Project's Technology Consultant and the Owner.

1.3 QUALITY ASSURANCE

- A. Acceptable manufacturers:
 - 1. The equipment/products described herein and furnished per these specifications shall be the product of one manufacturer or must be able to obtain the full warranty of the combined solution. All references to model numbers and other detailed descriptive data is intended to establish standards of design performance, and

- quality, as required. The contractor shall not deviate from the part numbers listed. Any deviation from specified part numbers will result in the removal of non-specified materials and reinstallation of approved materials at no cost to the project.
2. The approved manufacturers shall provide a complete End-to-End solution with the maximum product and performance warranty offered by the specified manufacturer.
 3. Only products listed in Attachment 'B' or approved in compliance with the project manual's approval requirements will be accepted.
- B. Installer Qualifications:
1. The Data Cable System Installer shall be licensed and shall meet all applicable regulations of the State Department of Labor insofar as they apply to this type of system. The proposer shall be a firm normally employed in the low voltage and data cabling industry and shall provide a reference list of ten (10) large-scale projects and contact names confirming successful Structure Cabling System installations.
 2. The SCS Installer shall be a Certified, local area, integrator of the manufacturer's product and must be able to provide the manufacturer's maximum available warranty for the solution on the entire SCS. The contractor's certification must have been obtained and held within 75 miles of the project's location.
 3. The installing contractor must have a full-time employed RCDD (Registered Communications Distribution Designer) on staff. Current RCDD certification shall be provided in the product submittals.
 4. All individuals installing the SCS must be employees of the certified installer and at least 25% of the installing staff shall have undergone a training class given by the manufacturer. Current certification indicating the successful completion of the training course shall be available upon request at the project and submitted in the contractor's product submittals.
 5. The proposing contractor and the installing contractor must be the same company. No subcontractor to the proposing SCS contractor will be allowed for any portion of the SCS scope of work.
- C. Low Voltage Meeting Requirements:
1. The successful Contractor shall attend a mandatory pre-construction meeting with the project's consultant individuals deemed necessary by the Owner's representative prior to the start of the work. No SCS work shall begin prior to this meeting.
 2. The successful contractor shall attend a mandatory bi-weekly meeting to discuss the project progress to help aid coordination with the Owner and Other contractors.
 3. Prior to the installation of any items required for this scope of work the contractor must provide a purchase order with a detailed material list for all materials to be installed. The purchase order is not required to show cost, but part numbers must be provided. The purchase order will be reviewed during one of the regularly scheduled low voltage meetings.
- D. Acceptance: The Owner's representative reserves the right to reject all or a portion of the work performed, either on technical or aesthetic grounds.
- E. Warranty:
1. The selected system installer shall be a certified installing contractor of product and hold current certification. Contractor shall provide the specified manufacturer's maximum end-to-end performance warranty on all products installed. The proposer shall provide current certification documentation. The performance warranty shall be issued by the manufacturer and shall warrant that

ALL cable links have been tested bi-directionally (end to end) using a Level IIIe or better tester, per TSB-67, and that all test results conform to the most current ANSI/TIA-568.2-D.

2. The warranty will also cover multimode fiber optic cabling. Performance testing shall be conducted in accordance with ANSI/EIA/TIA-526-14 Standard, method B.
3. The warranty will stipulate that all products used in this installation meet the prescribed mechanical and transmission specifications for such products as described in ANSI/TIA/EIA-568.3-D. Quality and workmanship evaluation shall be solely by the Owner/Designer and designated representatives.

1.4 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. National Electrical Code, current version
- B. Other References:
 1. ANSI/TIA-568-C.0 – Generic Communications Cabling for Customer Premises...
 2. ANSI/TIA-568-C.1 – Commercial Building Communications Cabling Standard Part 1: General Requirements.
 3. ANSI/TIA 568-C.2 – Balanced Twisted-Pair Telecommunications Cabling and Components Standards
 4. ANSI/TIA 568-C.3 – Optical Fiber Cabling Components Standard
 5. ANSI/TIA-568-C.4, Coaxial Cabling Component Standard
 6. ANSI/TIA-569-C – Commercial Building Standard for Telecommunications Pathways and Spaces.
 7. ANSI/TIA-492.AAAC-B – Detail Specification for 850-nm Laser-Optimized, 50-um Core Diameter/125-um Cladding Diameter Class 1a Graded-index Multimode Optical Fibers (OM3/OM4). Current Edition
 8. ANSI/ICEA S-83-596, Fiber Optic Premises Distribution Cable.
 9. ANSI/TIA/EIA-598, Color Coding of Optical Fiber Cables
 10. ANSI/ICEA S-87-640, Fiber Optic Outside Plant Distribution Cable.
 11. ANSI/TIA/EIA-758: Customer-Owned Outside Plant Telecommunications Cabling Standard.
 12. ANSI/TIA/EIA-526-7, Optical Power Loss Measurements of Installed Single mode Fiber Plant: OFSTP-7.
 13. ANSI/TIA/EIA-526-14-A, Optical Power Loss Measurements of Installed Multimode Fiber Plant: OFSTP-14A
 14. ANSI/TIA/EIA-TSB-125, Guidelines for Maintaining Optical Fiber Polarity Through Reverse-Pair Positioning
 15. ANSI/TIA/EIA-TSB-140, Additional Guidelines for Field Testing Length, Loss, and Polarity of Optical Fiber Cabling Systems.
 16. ANSI/TIA-606-B – Administration Standard for the Commercial Telecommunications Infrastructure
 17. TIA/EIA-607-B - 2011 - Commercial Building Grounding and Bonding Requirements for Telecommunications
 18. Institute of Electrical and Electronic Engineers (IEEE 802.xLAN)
 19. TIA/EIA 942 Data Center Standards
 20. Current BICSI Telecommunications Distribution Methods Manual
 21. NFPA 70 – National Electrical Code (NEC).
 22. BICSI – TDMM, Building Industries Consulting Services International,

Telecommunications Distribution Methods Manual (TDMM).

- C. Governing Codes and Conflicts: 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, regulations, and manufacturer installation requirements.

1.5 ABBREVIATIONS

- A. The following abbreviations are used in this document:
- | | |
|------|---|
| IDF | Intermediate Distribution Frame |
| MDF | Main Distribution Frame |
| UTP | Unshielded Twisted Pair |
| SCS | Structured Cabling System |
| RCDD | Registered Communications Distribution Designer |

1.6 SUBMITTALS

- A. Project Initiation: Within fourteen (14) days of Notice to Proceed, the data network system installer shall furnish the following in a single consolidated submittal:
1. Permits: The Contractor shall obtain all required permits and provide copies to the Owner / Architect / Engineer.
 2. Product Literature: Complete manufacturer's product literature for all cable, patch panels, cross-connect blocks, 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 / Designer) and the manufacturer's supporting documentation demonstrating compatibility with other related products shall be included. The submittal shall have some type of distinguishing marker or pointer to indicated what specific product is to be provided
 3. Construction Schedule: A time-scaled Construction Schedule, using PERT/CPM, indicating general project deadlines and specific dates relating to the installation of the cable distribution system.
 4. Testing: Proposed Contractor UTP cable test result forms, fiber optic cable test result forms and a list of instrumentation to be used for systems testing.
 5. Specification Compliance: A letter shall be provided stating, by section and subsection, that the SCS 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 approved by the Owner.
 6. Each Submittal must have a detailed parts list with quantities.
 7. Certifications: The contractor shall submit all certifications for approved products and the certifications must contain dates which are valid from the date of proposal and not expire any sooner than 12 months after substantial completion of the project.
 - a. BICSI RCDD Certification: This certification must be held by an on-staff, full-time employee of the SCS installer. The holder must be staffed out of the office that is located within 75 miles of the project.
 - b. Certifications must be obtained by the SCS installer's office that is located within 75 miles of the project and shall be a company certification, not an individual certification.
 - c. Certifications must be held by at least 25% of the, on-site, staff and be

- made available at the site if requested by the owner, architect, and/or project's technology consultant.
- d. Fiber Optic Technician Certification: This certification must be held by the on-staff/on-site individual that is supervising the fiber optic installation and performing the fiber optic terminations and testing.
- B. Shop Drawings: Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed:
1. Proposed circuit routing and circuit grouping plan prepared by a BICSI certified RCDD (Registered Communications Distribution Designer). The RCDD certification must be current. Identifiable, separate routing shall be shown for both the station cabling and the MDF-to-IDF tie cabling.
 2. In addition to the cable routing, the submitted drawings shall indicate the following, even if the following is expected to be provided by the project's electrical or general contractor:
 - a. Location of wall penetrations (all penetrations shall be sleeved and contain protective bushings at both ends)
 - b. Location of sleeved wall pass-thru
 - c. Size of sleeve at each location installed
 - d. Quantity of cable passing through each sleeve
 - e. Location of drops in each room (quantity or labeling of drops are not required in the submittal plans. Labeling shall be provided in the closeout plans and quantities shall be as per the contract documents, addendums, and issued changes. Each drop shall be labeled for the type of outlet that it is)
 - f. Conduit routing, size, quantity, and stub-up locations for all floor mounted outlets.
 3. Drawing Compliance: A letter shall be provided stating that the SCS installer complies with the entire project drawing, including all general, keyed, and notes to contractor. 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 approved by the Owner.
 4. All subcontractors shall provide submittals to general contractor for normal distribution to Architects, Engineers and the Owner's project managers.
- C. At Substantial Completion: Provide drawings, to the Owner, to reflect installed cabling with correct labeling and cable routing.
- D. Close-out Procedures: Two (2) copies of the following documents shall be delivered to the building owner's representative at the time of system acceptance. Close out technology documents shall be separated from all other trade's documents. The close out finals shall include:
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. Provide complete test reports for all cabling and devices that comprise system as outlined in this document.
 3. Include the Name, address and telephone of the authorized factory representative with a 24-hour emergency service number.

4. The manual shall also include Manufacturer's data sheets and installation manuals/instructions for all equipment installed a list of recommended spare parts.
5. Generic or typical owner's instruction and operation manual shall not be acceptable to fulfill this requirement.
6. An up-to-date record ("as-built") set of approved shop drawing prints that have been revised to show each and every change made to the structure cabling system from the original approved shop drawings. Drawings shall consist of a scaled plan of each building showing the placement of each individual item of the technical cabling system equipment as well as raceway size and routing, junction boxes, and conductor size, quantity, and color in each raceway.
7. As-built Drawings shall include cable pathways, camera locations with correct labeling and MDF/IDF locations. A copy of the As-Built drawings reflecting the final locations of all cabling shall be given to the designated Owner's representative. The as-built drawings shall be prepared using AutoCAD 2012 or later. Provide the Owner with electronic versions of the as-builts on CD media.
8. All drawings must reflect final graphic numbering, point to point wiring, device address and programmed characteristics as verified in the presence of the engineer and/or the end user unless device addressing is electronically generated, and automatically graphically self-documented by the system.
9. A copy of the manufacturer's warranty on the installed system.
10. Any keys to cabinets and/or equipment and special maintenance tools required to repair, maintain, or service the system.
11. 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)
12. Upon completion of the work and at a time designated by the Architect or owner, provide formal training sessions for the Owner's operating personnel to include location, operation, and maintenance of all included systems and equipment. Minimum amount of training time shall be at least 4 hours.
13. One (1) 30" x 42" laminated floor plan sheets illustrating technology drops and cable designation with final graphic numbering. Contractor shall provide one complete floor plan sheet for each telecommunications room (MDF or IDF)

PART 2 - PRODUCTS

2.1 GENERAL

- A. Reference Attachment 'B' to this specification, which contains the minimum materials list for this specific project.
- B. Installation: The cabling shall be installed per requirements of the manufacturer and the Project Documents utilizing materials meeting all applicable TIA/EIA standards. The Contractor is responsible for providing all incidental and/or miscellaneous hardware not explicitly specified below as required for a complete and operational system.
- C. Materials shall be as listed or shall be approved equivalent products of other manufacturers meeting the intent and quality level of the TIA/EIA specifications.
- D. Testing: All installed cabling shall be tested 100% good after installation by the Contractor. All final test results shall be delivered to owner at completion of project. Refer to closeout requirements.
- E. Ratings: All products shall be new and brought to the job site in the original manufacturer's packaging. Electrical components (including innerduct) shall bear the Underwriter's Laboratories label. All communications cable shall bear flammability testing ratings as follows:

- CM Communications Cable
- CMP Plenum Rated Communications Cable
- CMR Riser-Rated Communications Cable
- F. Initial Cable Inspection: The Contractor shall inspect all cable prior to installation to verify that it is identified properly on the reel identification label, that it is of the proper gauge, containing the correct number of pairs, etc. Note any buckling of the jacket that would indicate possible problems. Damaged cable or any other components failing to meet specifications shall not be used in the installation.
- G. Cable Lubricants:
 - 1. Lubricants specifically designed for installing communications cable may be used to reduce pulling tension as necessary when pulling cable into conduit.
 - 2. Approved Products
 - a. Twisted-pair cable: Dyna-Blue
 - b. American Polywater
- H. Fire Wall Sealant:
 - 1. Any penetration through firewalls (including those in sleeves) will be resealed with an Underwriter Laboratories (UL) approved sealant.
 - 2. Approved Products
 - a. 3M or
 - b. Pre-approved equal

2.2 DATA CLOSET (MDF/IDF) HARDWARE

- A. Equipment Cabinets/Cabinets: Provide and install equipment cabinets and/or cabinets in locations indicated on the attached drawings for the following areas.
 - 1. For all MDF/IDF locations: Contractor shall provide and install a new floor mounted cabinet/rack system or a wall mounted cabinet where indicated on plans. Refer to floor plan and enlarged MDF/IDF room layouts for number of cabinets/racks to provide at each location. If an enlarged detail is not available, the contractor shall provide the required number of racks to accommodate 100% of all termination components and an equal amount of owner equipment; as well as (1) spare rack. If an MDF/IDF is located in shared space, the contractor shall provide a floor supported, wall mounted cabinet system with all required doors and side panels to secure the equipment and termination components.
- B. Distribution Cabinet/Cabinet Grounding: All Cabinets and/or Cabinets shall be grounded using stranded #6 AWG insulated copper conductor. Connect to service entrance grounding electrode. Provide all required bonding materials and hardware and bond to building grounding electrode subsystem at building electrical service entrance.
- C. Fiber Optic Patch Panels:
 - 1. The enclosures used shall provide termination panels for the specified type of connectors and be of sufficient size and capacity to terminate 110% of the fiber count of the inside of outside fiber optic cables. Patch panels must be 19" cabinet mountable. Provide all termination accessories, fiber patch cords, enclosures and test for a complete fiber optic distribution system.
 - 2. Provide closet connector housing panels, size for 110% of total fiber count to be terminated.
 - 3. ALL fiber strands must be terminated in fiber housing.
- D. Patch Panels:
 - 1. All patch cables shall be modular type patch panels to allow individual jacks to be inserted. All patch panels shall be fully populated with Jacks. Provide dust caps for all unused jacks. Furnish units that adhere to the performance requirements TIA/EIA-568A standards.

2. Provide cable support bars at the back of all patch panels to provide additional support at rear of panels. Provide one (1) support bar for each row of 24-ports. Support bars will not be required if the closet design consist of rear horizontal cable management above and below each patch panel.
- E. Rack Electrical:
1. A power strip shall be installed vertical at the back of each data relay rack.
 2. Project electrical contractor to provide and install one electrical receptacle for each UPS installed on the entire project. Coordinate receptacle type and location with the installed product requirements and the technology consultant prior to installation.
- F. Cable Management Panels:
1. Provide cable management panels as required for vertical cable management on ends and in between all racks on entire project.
 2. Provide Velcro straps for cable dressing in MDF/IDF rooms.
- G. MDF/IDF Patch Cables:
1. Cabling Contractor shall provide owner with one (1) patch cable for each data drop on entire project. These cables will provide connectivity from the front of the network patch panels to the network equipment. The patch cables are to be terminated properly with RJ-45 connections on each end with the proper pin-out assignments per project configuration.
 2. All patch cables shall be factory terminated. NO EXCEPTIONS.

2.3 CABLE ROUTING/PATHWAY

- A. Cable Tray:
1. Metal cable tray shall be provided to affix to the top of all floor mount cabinets. Cable tray shall be used to brace cabinets to walls and to route cable from walls to cabinets in communication closets.
 2. Contractor to provide and install all applicable installation accessories.
- B. Cable Support System:
1. All low voltage cabling shall be installed and supported using an approved cable support system installed at 48" intervals unless installed in conduit. Do not exceed manufacturer's recommendation for the quantity of cables supported in an individual support.
 2. Cable supports shall not connect to any ceiling grid wire or on any support attached to the ceiling grid.
 3. Cable supports shall not exceed a serviceable height of more than 5', but no closer than 2', above the finished ceiling.
 4. Cable supports can be attached to vertical walls or the building's structure.
 5. If attached to the building's structure, 3/8" threaded rod shall be utilized to extend down within the serviceable heights mentioned above. Grid wire hangers will not be accepted.
- C. All cable bundles shall be grouped together using plenum rated Velcro for the entire run above and below the ceilings.
- D. Conduit Bushings shall be installed prior to the installation of any cable. If cable is found to be installed without the bushing the cable will have to be removed and re-installed. No cut bushings will be accepted. If cable damage occurs during any portion of the installation, the cable will be removed and replaced at no cost to the project. This item will be strictly enforced and adhered too.
- E. The projects electrical contractor shall provide and install all metallic conduit and backboxes indicated to be installed on the drawings. It is the SCS installer's responsibility to coordinate all conduit requirements with the electrical contractor to ensure that all

conduit sizes and locations are correctly installed. If box locations and conduit sizes are found to vary from the project documents after installation the SCS installer will bare all financial responsibility to ensure these items are installed correctly. The RCDD for the SCS will be responsible for ensuring conduit sizes are sufficient for cable count while maintaining a 40% fill ratio. If there is not electrical contractor on the project, the SCS Installer shall bear responsibility for the provision and installation of all required raceways.

2.4 STATION WIRING

- A. Wire: The data and voice wire provided for all outlets shall be four-pair, solid copper conductor, meeting the intent and quality level of the TIA/EIA-568 Commercial Building Wiring Standard.
- B. Testing: The four-pair UTP cable must be UL Performance Level tested. Each 1000-foot spool must be individually tested with test results affixed to the spool. All cable must be provided on new 1000-foot spools. No shorts will be allowed.
- C. Rating: Cable installed in conduit shall be non-plenum rated. Cable not installed in conduit shall be plenum rated if installed in plenum ceiling space, non-plenum rated otherwise.
- D. All cable shall be routed to the center of the room in which it is serving and then route to the outlet location that it is intended for. Provide a 5' service loop in the center of the room and 5' service loop at each workstation outlet properly supported above ceiling. All workstation service loops shall be made in figure eight configurations, no exceptions.
- E. Provide minimum of 10' service loop at all headend locations properly supported above ceiling.
- F. Provide indoor/outdoor, plenum rated category cable at any outdoor data outlet or data outlets served by cabling that travels through subsurface conduit. This applies to station or horizontal cable runs only.

2.5 STATION HARDWARE

- A. Information Outlet / Jack Modules:
 - 1. Shall be high quality 8p/8c modular jacks with circuit board construction and IDC style or 110-style wire, T568B terminations. Jacks shall meet EIA/TIA TSB40 recommendations for connecting hardware
 - 2. Shall be standard 8-position, RJ-45 Style, FCC compliant
 - 3. Shall be designed for 4-pair, 100 Ohm balanced UTP Cable
 - 4. Shall terminate 26-22 AWG solid or stranded conductors
 - 5. Shall accept FCC compliant 6 position plugs.
 - 6. Shall have attached wiring instruction labels to permit either T568A or T568B wiring configurations.
 - 8. Shall meet or exceed transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA-568-C2, Transmission Performance Specifications for 4-Pair 100 Ohm.
 - 9. Shall be UL Listed and CSA certified.
 - 10. Each jack shall have category rating identified on the front face.
- B. Faceplates:
 - 1. Standard faceplates shall be a minimum of 4-port.
 - 2. Wall mounted telephone faceplates shall be 1-port.
 - 3. All faceplates shall be single gang.
 - 4. All blank inserts color shall be coordinated prior to procurement.
- C. Outlet Patch Cables: Cabling Contractor shall provide owner with patch cable for each data drop on entire project. Each cable will be terminated properly with RJ45 connections on each end with appropriate pin-out assignments per project configuration.
 - 1. Cabling Contractor shall provide owner with patch cable for each data drop on

entire project. Each cable will be terminated properly with RJ45 connections on each end with appropriate pin-out assignments per project configuration.

2. Patch cords shall be stranded copper, matching the category of the installed cable.
3. All patch cables shall be factory terminated. No exceptions

2.6 FIBER OPTIC PRODUCTS

- A. Multimode: 50/125um, OM4+, multimode fibers, each with a color-coded PVC tight buffer shall have a maximum attenuation of 3.5 dB/km at 850 nm and 1.5 dB/km at 1300 nm. Minimum bandwidth shall be 2000 MHz/km at 850 nm and 500 MHz/km at 1300 nm.
- B. Singlemode: Single mode fibers, each with a color-coded PVC tight buffer shall have a maximum attenuation of 1.0 dB/km at 1310 nm and 1.0 dB/km at 1550 nm.

PART 3 - EXECUTION

3.1 GENERAL

- A. Fire Wall Penetrations: The contractor shall avoid penetration of fire-rated walls and floors wherever possible. Where penetrations are necessary, they shall be sleeved with metallic conduit and resealed with an Underwriter Laboratories (UL) approved sealant. Contractor shall also seal all floor, ceiling and wall penetrations in fire or smoke barriers and in the wiring closet.
- B. Allowable Cable Bend Radius and Pull Tension: In general, communications cable cannot tolerate sharp bends or excessive pull tension during installation. Refer to the cable manufacturers allowable bend radius and pull tension data for the maximum allowable limits.
- C. Cable Lubricants: After installation, exposed cable and other surfaces must be cleaned free of lubricant residue.
- D. Pull Strings: Provide pull strings in all new conduits, including all conduits with cable installed as part of this contract. Pull test is not to exceed 200 pounds. Data and video cables can be pulled together with pull strings.
- E. Conduit fill shall not exceed 40%.
- F. Damage:
 1. The Contractor shall replace or rework cables showing evidence of improper handling including stretches, kinks, short radius bends, over-tightened bindings, loosely twisted and over-twisted pairs at terminals and cable sheath removed too far (over 1-1/2 inches).
 2. The Contractor shall replace any damaged ceiling tiles that are broken during cable installation.
- G. Clean Up: All clean up activity related to work performed will be the responsibility of the Contractor and must be completed daily before leaving the facility.
- H. Conduit and Back Boxes:
 1. The Contractor shall ensure that the appropriate back boxes and conduits, for the project, are provided as required.
 2. One (1) 1" conduit will be required each outlet that serves one to a maximum six (6) category 6 or a maximum of four (4) category 6A cables. Provide additional conduit for cable counts that exceed this number.
 3. One (1) double gang deep box will be required for each technology outlet. All boxes except Presentation outlets will be required to have a single gang reducer ring.

3.2 EQUIPMENT CABINET CONFIGURATION

- A. Equipment Cabinets: Equipment racks shall be assembled and mounted in locations shown on the Drawings and as detailed. Each rack shall be securely mounted to the floor and

- braced to the wall with cable tray in accordance with the manufacturer's instructions and recommendations. Racks shall be mounted such that the side rails are plumb with vertical cable management panels. Racks to be located such that future expansion can occur without relocating existing racks. Racks shall be grounded in accordance with NEC requirements.
- B. Wire Management Components: Horizontal cable management panels shall be installed directly above and below each patch panel. Vertical cable management panels shall be installed on each side of the cabinet.
 - C. 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 area 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.
 - D. Cable Routing: Cable shall be routed as close 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.
 - E. Installation: All incoming cables shall be routed on the cable tray and neatly dressed down to the patch panels. Cable bundles shall not exceed more than 48 cables to patch panel.
 - F. Hardware: Provide cabinet and jack panel hardware as required for all data station wiring.

3.3 STATION WIRING INSTALLATION

- A. General:
 - 1. Cabling between wiring closet and workstation locations shall be made as individual home runs. No intermediate punch down blocks or splices may be installed or utilized between the wiring closet and the communications outlet at the workstation location.
 - 2. All cable must be handled with care during installation so as not to change performance specifications. Factory twists of each individual pair must be maintained up to the connection points at both ends of the cable. There shall never be more than one and one-half inches of unsheathed UTP cable at either the wiring closet or the workstation termination locations.
 - 3. All cable shall be routed to the center of the room in which it serves before routing to the outlet location and a 5' service loop shall be provide. An addition 5' service loop shall be provided above ceiling at the outlet location. All service loops shall be figure 8 loops.
- B. Exposed Cable:
 - 1. All cabling shall be installed inside walls or ceiling spaces whenever possible. Exposed cables and/or cables routing through mechanical rooms, electrical rooms, or restrooms shall be installed inside conduits, unless noted otherwise on the project drawings.
 - 2. Additional exposed cable runs will require Owner approval and will only be allowed when no other options exist.
 - 3. All cable routing through conduits and sleeves shall maintain a 40% maximum conduit fill ratio.
- 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.
- D. Cable Routes:
 - 1. All cabling placed in ceiling areas must be in conduit, or Panduit Corp. J-MOD modular cable support with Velcro cable wrap at each location. 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. Do not route cable through webbing of structural steel. Cabling must be supported in dedicated supports intended to support cabling as described in this section. Contractor shall adhere to the manufacturer's suggested fill ratio for each size cable support installed. No support shall have more than 48 cables.

2. Attaching cable to pipes or other mechanical items is not permitted. Communications cable shall be rerouted so as to provide a minimum of 18 inches 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 routed down the corridors; parallel or perpendicular to building structure. Multiple cables to be bundled together at and between each cable support installed.
3. Contractor shall be responsible for coordinating with other trades on the project so that the installed cable pathway does not interfere with the installation of other systems to ensure that mechanical ducts, pipes, conduits, or any other above ceiling systems are not putting unnecessary stress on any portion of the install SCS.
4. All (48) cable bundles shall be routed directly to the MDF or IDF that serves the area. All bundles shall remain separated for the length of the cable run.
 - a. Provide data outlet for irrigation controllers. Coordinate location with landscape consultant.
 - b. Provide data outlet for time clock appliance in main custodian office.
 - c. Provide OSP or flooded/gel filled cat6 cable at any outdoor data outlet or data outlets served by cabling that travels through subsurface conduit. This applies to station or horizontal cable runs only.

3.4 STATION HARDWARE

- A. Flush Mount Jacks shall be mounted in a faceplate with back box.
- B. Placement:
 1. Where possible, the communications outlet shall be located so that its centerline is 18 inches above floor level or 12 inches above permanent bench surfaces. Outlets shall not be mounted on temporary, movable, or removable surfaces, doors, or access hatches.
 2. Outlets shall be installed within 3'-0" of power outlets
- C. RJ-45 Jack Pin Assignments:
 1. Pin connections for data station cable outlets and patch panels shall match EIA/TIA 568 modular jack wiring recommendation T568B.
 2. Pin connections at data jack panels shall match pin connections at outlets (straight through wiring)

3.5 CABLE TESTING REQUIREMENTS

- A. Notification: The Owner and Engineer shall be notified one week prior to any testing so that the testing may be witnessed.
- B. Inspection: Before requesting a final inspection, 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 timetable for all copper and fiber optic cabling.
- C. Procedures:
 1. 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 will be evaluated in the context of each of these factors.
2. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and submittal and approval of full documentation as described above. Tests with the "* PASS" (asterisk) will not be acceptable. These circuits must be repaired to meet "PASS".
- D. Errors: When errors are found, the source of each shall be determined, corrected and the cable retested. All defective components shall be replaced and retested. Re-test results must be provided on Owner approved forms and witnessed by Owner.
- E. Twisted Pair Cable Testing:
1. At a minimum, the Contractor shall test all station drop cable pairs from Data Closet termination patch panels to outlet device RJ45 jacks. Products shall be tested for compliance with ANSI/TIA/EIA 568A and ISO/IES 11801. Test equipment used shall meet TIA/EIA TSB-67, Level II accuracy. Further, the contractor shall have a copy of TSB-67 in their possession and be familiar with its contents.
 2. Each wire/pair shall be tested at both ends for the following:
 - a. Wire map (pin to pin connectivity)
 - b. Length (in feet)
 - c. Attenuation
 - d. Near end cross talk (NEXT)
 - e. Power Sum
 3. Test equipment shall provide an electronic and printed record of these tests.
 4. Test results for each four-pair UTP cable must be submitted with identification to match labels on all patch panel ports and RJ45 jacks and must match as-builts associated with that cable.
- F. Fiber Optic Cable Testing:
1. Testing device for fiber optic cables shall be a high quality OTDR (Optical Time-Domain Reflectometer) equipped with a printer. The printed data shall show, in addition to any summary information, the complete test t0.and all relevant scale settings. The OTDR must have the capability to take measurements from bare fiber strands as well as SC connector terminations.
 2. All fiber optic cable shall be tested on the reel before installation to ensure that it meets the specifications outlined herein.
 3. After installation the Contractor shall test each fiber strand in accordance the EIA 455-171 Method D procedures (bi-directional testing) at both 850nm and 1300nm for multimode or 1310nm and 1550nm for single mode. A form shall be completed for each cable showing data recorded for each strand including length, total segment (end-to-end) loss (dB) and connector losses (dB) at each end. In addition, the printed data strip for each strand shall be attached to the form. Patch cables shall also be tested.
 4. Acceptable fiber optic connector loss shall not exceed .75dB per mated pair. The Contractor is responsible for obtaining minimum loss in fiber connections and polishing per manufacturer specifications.
 5. Singlemode fibers shall have a maximum attenuation of 1.0 dB/km at 1310 nm and 1.0 dB/km at 1550 nm.
 6. Multimode: 50/125um micron multimode fibers shall have a maximum attenuation of 3.5 dB/km at 850 nm and 1.5 dB/km at 1300 nm. Minimum bandwidth shall be 2000 MHz/km at 850 nm and 500 MHz/km at 1300 nm.

3.6 INSPECTION

- A. Conformance to the installation practices covered above is to be verified when completed. In some cases, the Owner/Designer may inspect before acceptance.
 - 1. Written Test Report:
 - a. Complete test results, including actual values associated with tests.
 - b. Show all certifications for telecommunications wiring systems.
 - c. Include cable maps showing each cable route and keyed to cable labels. Provide owner with complete floor plans identifying outlet location and cable routing drawing in AutoCAD format. Provide electronic copy of drawings to owner in AutoCAD version 2012 or greater.
 - d. Documentation of outlet, cable and cabinet labeling system.
- B. After performing all tests, tabulate results and bind together in format acceptable to Owner. Installer shall provide written certification in the test report that telecommunications cable is properly installed, and test results certify system to all specified standards.

ATTACHMENT 'A'
PROJECT SPECIFIC SCOPE OF WORK AND INSTRUCTIONS

PART 1 – SUMMARY OF WORK

1.1 DESCRIPTION OF WORK

- A. This project consists of the provision and installation of a Structured Cabling System (SCS) as required to support network connectivity to workstations, telephones, video surveillance, access control, building automation, electrical lighting, and any other system requiring network connectivity. This project is a renovation and addition to Cy Lakes HS.
- B. The work includes provision and installation of a complete Cabling System (SCS) in compliance with these specifications and associated drawings, pre-proposal addenda, change orders, change directives and any other documents issued both pre-proposal and during the project.
- C. The SCS Installer shall comply with all conditions of the contract and “Division 1 – General Requirements” as they apply to the SCS Scope of Work. It shall be the responsibility of the SCS Contractor to make themselves familiar with all documents.
- D. It should not be assumed that any portions of a complete and functional system are to be furnished and/or provided by anyone, other than the SCS installer, unless specifically stated otherwise.
- E. Division of responsibilities:
 - OFOI = OWNER FURNISHED AND OWNER INSTALLED
 - CFCI = CONTRACTOR FURNISHED AND CONTRACTOR INSTALLED
 - 1. CATEGORY 6A CABLING – OFOI
 - 2. MDF/IDF NETWORK EQUIPMENT – OFOI
 - 3. VOIP TELEPHONES – OFOI
 - 4. WIRELESS ACCESS POINTS – OFOI
 - 5. UNINTERRUPTIBLE POWER SUPPLIES – OFOI
 - 6. RACEWAY: CONDUIT, BACK BOXES, SLEEVES, ETC – CFCI

1.2 STRUCTURED CABLING SYSTEM – ADDITIONAL INSTRUCTIONS

- A. Base Proposal:
 - 1. The SCS Installer shall provide and install a Commscope/Systimax End-to-End Structured Cabling System as per these specifications and associated drawings. The Base bid SCS shall consist of:
 - a. Category 6A cable and connectivity to each Video Surveillance Camera, Voice/Data Outlet, Access Controlled Door, and any other locations requiring Local Area Network Connectivity.
 - b. Category 6A cable and connectivity to each Wireless Access Points.
 - c. Each connectivity solution be a complete Channel Solution; consisting of jacks, patch panel, and patch cables.
 - d. Each channel solution shall be color coded to the system in which it serves.
 - 2. The products specified in Attachment 'B' are intended to establish quality, functionality, color, and standards. The following shall be considered preapproved equivalent for each specific portion of the SCS.
 - a. Category 6A copper cable
 - 1) Commscope/Systimax
 - b. Category 6A copper cabling, termination components, and patch cables
 - 1) Commscope/Systimax
 - c. Fiber Optic Cabling and Components:

- 1) Commscope
- d. Metals (racks, cable managers, and cable tray):
 - 1) Commscope
- e. Manufacturer approval request must be submitted in compliance with the Division 1 instructions and must be received no less than ten (10) business days prior to the posted proposal submission date. No substitutions will be allowed if not submitted per these instructions and approved via official pre-bid addendum.

1.3 COPPER PATCH PANELS

- A. The SCS Installer shall provide and install patch panels as per the instructions below.
 - 1. 24-port patch panels shall only be used for copper tie cables and demarcation extensions.
 - 2. Provide dedicated, 48-port patch panels for each of the following system (reference color code chart for designated insert and patch panel color coding per system):
 - a. LAN and IP Telephones
 - b. Wireless Access Points
 - c. IP Intercom
 - d. Video Surveillance Cameras

1.4 COPPER AND FIBER OPTIC PATCH CABLE LENGTHS

- A. The SCS Installer shall provide copper and fiber optic patch cables as per the instructions below. All patch cables shall be factory terminated and warranted for the copper and fiber solutions specified.
 - 1. MDF/IDF Copper Patch Cables:
 - a. Patch cables shall be category 6A
 - b. Provide one patch cable for each port on the entire project
 - c. Patch cables to be installed by network equipment installer/programmer
 - d. Patch cable lengths
 - 1) 95% shall be 5'
 - 2) 5% shall be 7'
 - 2. Work Area Outlet Copper Patch Cables:
 - a. Patch cables shall be category 6A
 - b. Provide one patch cable for each port on the entire project
 - c. Patch cables to be installed by the owner.
 - d. Patch cable lengths
 - 1) 90% shall be 10'
 - 2) 10% shall be 15'
 - 3. Wireless Access Point Copper Patch Cables:
 - a. Patch cables shall be category 6A
 - b. Provide one patch cable for each port on the entire project
 - c. Patch cables to be installed by wireless system installer.
 - d. Patch cable lengths
 - 1) Interior Ceiling Access Points: 100% shall be 1.5'
 - 2) Interior Wall Mounted Access Points: 100% 1'
 - 3) Exterior Access Points: 100% shall be 15'
 - 4. Video Surveillance Camera Copper Patch Cables:
 - a. Patch cables shall be category 6A
 - b. Provide one patch cable for each port on the entire project
 - c. Patch cables to be installed by the Video Surveillance System Installer.

- d. Patch cable lengths
 - 1) Interior Ceiling Cameras: 100% shall be 1.5'
 - 2) Interior Wall Mounted Cameras: 100% 3'
 - 3) Exterior Cameras: 100% shall be 15'
- 5. IP Intercom Copper Patch Cables:
 - a. Patch cables shall be category 6A
 - b. Provide one patch cable for each IP Intercom device on the entire project, plus an additional twenty (20) for future use.
 - c. Patch cables to be installed by the IP Intercom System Installer.
 - d. Patch cable lengths
 - 1) Interior Ceiling Speakers: 100% shall be 1.5'
 - 2) Interior Wall Mounted Speakers: 100% 1'
 - 3) Exterior Speakers: 100% shall be 15'
- 6. MDF/IDF Fiber Optic Patch Cables:
 - a. Patch cables shall be OS2 (Single-mode).
 - b. Patch cable shall be duplex, LC to LC
 - c. Provide quantity sufficient for connecting all network equipment plus 20% for growth.
 - d. Patch cables to be installed by network equipment installer/programmer
 - e. Patch cable lengths
 - 1) 100% shall be 3 meters
- 7. Prior to submittal and procurement of fiber optic and copper patch cables, the contractor shall coordinate with the project Consultant and Owner of final requirement for cable lengths on the specific project.

1.5 SYSTEM SPECIFIC COLOR REQUIREMENTS

- A. The following information shall apply to the complete SCS Channel. All cable, patch cables, outlet terminations, and closet terminations shall be provided in the colors designated below:

Item	Description	Horizontal Cable	Insert	Patch Cables
1	Data	Blue	Blue	Blue
2	VoIP Telephone	Blue	Blue	Blue
3	Wireless	Orange	Orange	Orange
4	Camera	Lilac	Lilac	Lilac
5	Access Control	Lilac	Lilac	Lilac
6	Intrusion Detection	Lilac	Lilac	Lilac
7	PA System	White	White	White

1.6 DOCUMENTATION

- A. Labels: The Contractor will label all outlets using permanent / legible typed or machine engraved labels approved by the Owner (no handwritten labels permitted). Label patch panels in the wiring closet to match those on the corresponding data outlets. 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.
 - 1. The following nomenclature shall be used when labeling data/voice jacks:
 - a. All cables being served by MDF closet shall begin with 'A' all IDF served cables shall begin with numerical digit 'B' thru 'Z') designating the specific IDF's identification.

- b. Next identification character shall be a numeric digit identifying the specific patch panel that is serving outlet (1, 2, 3...)
- c. Next identification shall note what # data port on patch panel (01 thru 48).

Example:

Label of an outlet from 23rd port of the third patch panel from top of rack located at IDF-2 shall read: C-3-23

Label of an outlet from the 5th port of the second patch panel from the top of rack located in the MDF shall read: A-2-05

- B. Floor Plan: A floor plan clearly labeled with all outlet jack numbers shall be included in the as-built plans.
- C. Cables: All cables shall be labeled at both ends. This includes but not limited to horizontal voice and data cabling, copper backbone tie cables, and fiber optic cables.
- D. Fiber Optics: Fiber optic strands shall be labeled at both ends on the fiber distribution panel.
- E. Equipment racks: Equipment racks shall bear at least one indicating label indicated MDF or IDF. If rack is installed in IDF, label shall include IDF #.
- F. Access Points: Label ceiling grid with digital label according to location installed and a bright orange $\frac{3}{4}$ " round dot sticker.

**ATTACHMENT 'B'
MANUFACTURER AND MATERIAL LIST**

The Communications Contractor shall perform no portion of the work requiring submittal and review of record drawings, shop drawings, product data, or samples until the respective documentation has been approved by project's Technology Consultant.

MATERIAL LIST

MANUFACTURER	DESCRIPTION	PRODUCT NUMBER	NOTES
Commscope	4-post Equipment Rack (45U) 12-24 Tapped Rails, Black	760082560 RK4P45-36A	Provide as shown on Drawing, minimum of one (1) in the Building's MDF.
Commscope	2-post Equipment Rack (45U) 12-24 Tapped Rails, Black	760082479 RK3-45A	Provide as shown on Drawing, minimum of one (1) in the Building's MDF and each IDF.
Chatsworth	12U-21U wall mount cabinet	11996-7**	CUBE-iT wall-mount cabinet. Replace ** with 24 for tempered glad door for Press box application. Replace ** with 36 for IDF application.
Commscope	Vertical Cable Management Kit, 8in W X 84in H Single Sided, Black	760244816	Provide and install between each rack and at both ends of all rack systems
Commscope / Systimax	GigaSPEED X10D® XL® M4800 1U Modular Panel, 48 port, for SYSTIMAX Category 6A and 6 Jacks	760105429 M4800-1U-GS	Provide in quantities as required to terminate 100% of all distribution structured cabling, plus 25% for future growth. Reference project drawings. Voice/Data, Security, and WLAN shall have dedicated panels per system.
Commscope / Systimax	GigaSPEED X10D® XL® M2400 1U Modular Panel, 24 port, for SYSTIMAX Category 6A and 6 Jacks	760118323 M2400-1U-GS	Provide in quantities as required to terminate 100% of all distribution structured cabling, plus 25% for future growth. Reference project drawings. Voice/Data, Security, and WLAN shall have dedicated panels per system.
Commscope	Copper Ground Buss Bar, 1/4 in x 4 in x 12 in	UGBKIT-0412	Provide one (1) in each MDF and IDF on the entire project
Commscope / Systimax	High Density 1U modular cassette sliding Panel, accepts (4) G2 modules or MPO panels, providing up to 48 duplex LC ports, or up to 32 MPO ports	760209940 HD-1U	Provide as per the project drawings. Or as required, to accommodate all fiber optics in the IDFs, if not shown on drawings

MANUFACTURER	DESCRIPTION	PRODUCT NUMBER	NOTES
Commscope / Systimax	High Density 2U modular cassette sliding Panel, accepts (8) G2 modules or MPO panels, providing up to 96 duplex LC ports or up to 64 MPO ports	760209957 HD-2U	Provide as per the project drawings. Or as required, to accommodate all fiber optics in the MDF/IDFs, if not shown on drawings
Commscope / Systimax	High Density 4U modular cassette sliding Panel, accepts (16) G2 modules or MPO panels, providing up to 192 duplex LC ports or up to 128 MPO ports	760209965 HD-4U	Provide as per the project drawings. Or as required, to accommodate all fiber optics in the MDF/IDFs, if not shown on drawings
CommScope	Rear cable management, rack moutnable	360-RCM-RM (760104737	
CommScope	Rear cable manager bar, 19in, 5in deep	NETCONNECT (557548-1)	
Commscope / Systimax	360 Distribution Adapter Pack, Singlemode, 12 LC with internal shutters	760109389 360DP-12LC-SM	Provide as required to accommodate 110% of all fiber terminated in each MDF/IDF
Commscope / Systimax	360 Distribution Adapter Pack, Singlemode, 24 LC with internal shutters	760115915 360DP-24LC-SM	Provide as required to accommodate 110% of all fiber terminated in each MDF/IDF
Commscope / Systimax	Category 5e PowerSUM 1100 U/UTP Patch Pane, 24-port	760182907 1100-U-PS-24	Provide in quantities as required to terminate 100% of all copper backbone cable. Reference project drawings.
Commscope / Systimax	GigaSPEED X10D® 360GS10E Solid Cordage Modular Patch Cord	CPCSSX2-0xFyyy	x' to be replaced with alpha or numeric character depicting the color of the patch cable. 'yyy' to be replaced with a numeric value depicting the patch cable length, in feet. Colors shall comply with designated color of the system each cable is provided for. Length to comply as stated in these specifications and coordinated with the Owner's Technology department
Commscope / Systimax	CommScope® Category 6A U/UTP Cord, Plenum , RJ45 to Ceiling connector, 1.5 ft, WHITE	CCA-CAT6A- PLENUM-WHITE- N018	Provide for all above ceiling terminations (IP Intercom Speakers, Wireless Access Points, Video Surveillance Cameras, etc.)

MANUFACTURER	DESCRIPTION	PRODUCT NUMBER	NOTES
Commscope	10 ft. x 12 in Ladder Rack Straight Section, Black	760085647 CR-SLR-10L12W	Provide as shown on drawings. Tray shall route to and between all racks, in each MDF/IDF, on the entire project.
Commscope	Ladder Rack, 90° radius, Horizontal E-Bend Section, 12", Black	760085530 CR90FCB-12W	
Commscope	Ladder Rack Inside Curved Section, 12", Black	760085688 CR90ICB-12W	
Commscope	Ladder Rack Outside Curved Section, 12", Black	760086082 CR90OCB-12W	
Commscope	Rack-to-Runway Mounting Kit, black in color	760084053 CRR2RRMK	Provide one (1) at the top of each rack and/or cabinet on the entire project.
Commscope	Ladder Rack wall angle support kit, 12", black	760084145 CR6-12WRSK	Provide one (1) at each location where the ladder tray system terminates at a wall
Commscope	Ladder Tray Triangle Support Bracket, 12", Black	760084095 CRTWSBK-12W	Provide every 5' of horizontal ladder tray section routing along the communication room walls.
Commscope	Vertical Wall Bracket	760084137 CRVWBK	Provide one kit every 5' of vertical wall ladder rack, minimum of two kits at top and bottom. Contractor to provide vertical wall cable tray section at locations where the service entrance and backbone thru-floor sleeves are located
Commscope	Ladder Rack protective end cap kit (2 caps), black	760084012 CRPECK	Provide one kit at each exposed end of ladder rack
Commscope	Ladder Tray, junction splice kit, black	760084046 CRTJSK	
Commscope	Ladder Rack, butt splice kit, black	760083899 CRBSK	
Commscope	Ladder Tray Radius Drop Kit, 12", Black	760083956 CRDK-12W	Provide one (1) at each location where cable drops to the rack associated rack.
Commscope	Ladder Rack Retaining Post Kit	760083980 CRRP-8H	Provide one (1) set at all ladder rack junctions and horizontal bends to prevent cable from dropping off thru ladder rack system.
Commscope / Systimax	GigaSPEED X10D® 2091B ETL Verified Category 6A U/UTP Cable, 4 pair count, 1000 ft length, WE TOTE® box	2091B ** 4/23 W1000	** to be replaced with numeric character depicting the color of the cable. Colors shall comply with designated color of the system each cable is provided for.

MANUFACTURER	DESCRIPTION	PRODUCT NUMBER	NOTES
			**=Blue for voice/data **=Purple for security cameras, door access **=Orange for wireless **=White for intercom
Commscope / Systimax	GigaSPEED X10D® MGS600 Series Information Outlet	MGS600-yyy	yyy' to be replaced with numeric character depicting the color of the Information Outlet (IO). Colors shall comply with designated color of the system each IO is provided for. Yyy=262 for white for intercom Yyy=318 for blue for data yyy=361 for violet for cameras, access control yyy=112 for orange for wireless
Commscope / Systimax	Single Gang, Stainless Steel, M-Series Faceplate	M1*SP	* to be replaced with a numeric character that depicts the port quantity of the faceplate. All faceplates shall be a minimum of 4-ports, with the exception of specialty outlets such as Wall Phones, Wireless Access Points, Video Surveillance Cameras, etc.
Commscope	TeraSPEED® Plenum Distribution Cable, interlocking aluminum armored with plenum jacket, 12 fiber	760127803 P-012-DZ-8W-FSUYL	
Commscope	48 Fiber, Single Jacker/Single Armor, Gel-Free, Outdoor stranded Loose Tube Cable, Single Mode	760053280 D-012-LA-8W-F12NS	
Commscope	12 Fiber, Riser Rated, Distribution cable, SM	760086371 R-012-LN-8W-F12BK/25D	
Commscope	Field Installable LC Connector, SM-UPC, Blue, for 250/900u	760117895 SFC-LCF-09-8X	1 per pack
Commscope	Field Installable LC Connector, SM-UPC, Blue, for 250/900u	760117895 SFC-LCF-09-8X-25	25 per pack
Commscope	Singlemode LC to LC, Fiber Patch Cord, 1.6 mm Duplex, Riser	FEWLCLC42-JXM***	*** to be replaced with a numeric value depicting the cable length in meters
Panduit	LD non-metallic series low voltage, one-piece hinged design, single channel surface raceway includes adhesive backing and is made of impact resistant material with a smooth finish that will not scratch, peel, or corrode. The raceway includes	Pan-Way LD surface raceway system.	Coordinate with architect and owner on color.

MANUFACTURER	DESCRIPTION	PRODUCT NUMBER	NOTES
	an assortment of bend radius and standard fittings that complement the offering to help route, protect, and conceal low voltage data, voice, and video cabling		
Commscope	25-Pair PowerSUM U/UTP 2061F Series Plenum Cables	2010B WH 25/24 R#####	Provide one (1) from the MDF to each IDF on the entire project. ##### to be replaced with numeric characters that depict the cable length
Dynacom	Unwired, 66-Style Termination Block with clear, hinged cover	66M1-50	Provide one (1) for each 25-pair demarcation extension cable
Dynacom	66 wiring block, metal backboard, blue in color	183C*M	* to be replaced with a numeric value depicting the board size. Provide at each demarcation point for the mounting of the 66 wiring blocks. Board size shall consist two (2) mounting brackets per 25-pair cable installed.
Ditek	10GbE, Single Channel, RJ45/RJ45, PoE Surge Protector, STP Category 6/6A	DTK-MRJPOES	Provide one for each copper network cable associated with an exterior device, up to two (2) cables. Bond to TGBB per manufacturer's instructions
Ditek	Rack Mount, 10GbE, 12-Channel, RJ45/RJ45, PoE Surge Protector, STP Category 6/6A	DTK-RM12NETS	Provide one for every four (4) to ten (12) copper network cables associated with an exterior device and originating at the same MDF/IDF. Bond to TGBB per manufacturer's instructions
Ditek	Rack Mount, 10GbE, 24-Channel, RJ45/RJ45, PoE Surge Protector, STP Category 6/6A	DTK-RM24NETS	Provide one for every Thirteen (13) to Twenty-Four (24) copper network cables associated with an exterior device and originating at the same MDF/IDF. Bond to TGBB per manufacturer's instructions

MANUFACTURER	DESCRIPTION	PRODUCT NUMBER	NOTES
Leviton	Decora Wall plate/Faceplate	804#-*	Provide one (1) at each USB charging wall plate. '#' to be replaced with numeric characters depicting the required port count. '*' to be replaced with alphabetic characters depicting the plates cover. Port count shall be determined by the quantity of charging wall plates installed at each location. Color to white, black, or stainless steel and shall be dictated by the electrical devices within the same area

END OF SECTION

SECTION 27 41 34 AV SYSTEMS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

- A. All requirements under Instructions to Bidders, General Conditions, Supplementary Conditions, Special Conditions, Division One, Technical Specifications, Referenced Documents or Practices and any Addenda of these Specifications will be a part of this section. The Contractor is responsible to be thoroughly familiar with all its contents as to requirements which affect this Division or Section.

1.02 RELATED DOCUMENTS

- A. AV Drawings.
- B. Specification Sections:
 - 1. 27 05 29, Pathways for AV Systems.
- C. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Divisions 00 and 01 Specification Sections, apply to this Section.

1.03 REFERENCES

- A. National Fire Protection Association (NFPA).
 - 1. NFPA 72 *National Fire Alarm and Signaling Code*, as adopted and/or amended by the Authority Having Jurisdiction (AHJ).
 - 2. NFPA 101 *Life Safety Code*, as adopted and/or amended by the Authority Having Jurisdiction (AHJ).
- B. Building Codes.
 - 1. International Building Code.
 - 2. State and Local Building codes as adopted and/or amended by the Authority Having Jurisdiction (AHJ).
 - 3. Americans with Disabilities Act (ADA) and/or State and Local equivalency standards as adopted by the AHJ.
- C. Owner Standards Documentation.
- D. Audio Video Integrated Experience Association (AVIXA).
 - 1. F501.01: 2015, Cable Labeling for Audiovisual Systems.
 - 2. F502.01: 2018, Rack Building for Audiovisual Systems.
- E. National Cable Television Association (NCTA).
- F. Society of Motion Picture and Television Engineers (SMPTE).
- G. International Telecommunications Union (ITU).
 - 1. BT.709-6: 2015, Parameter Values for the HDTV Standards for Production and International Programme Exchange.
 - 2. BT.2020: 2015, Parameter Values for Ultra-High-Definition Television Systems for Production and International Programme Exchange.

1.04 DEFINITION OF TERMS & ABBREVIATIONS

- A. Provide: to supply and install.
- B. Furnish: to supply to another contractor for installation.
- C. Supply: to supply but not install.
- D. Install: to install but not supply.

- E. OFOI: Owner Furnished Owner Installed.
- F. OFCI: Owner Furnished Contractor Installed.
- G. NIC: Not In Contract. Refers to items that are not included in the scope of work outlined in this section but may be shown for coordination purposes or reference.
- H. Future: Equipment that will be provided by owner later. Accommodations shall be provided for future equipment as shown on the drawings.

1.05 RESPONSIBILITY AND RELATED WORK

- A. The written specification and drawings AV-001 through AVC-401-G will be collectively referred to herein as the Contract Documents.
- B. The systems described in this section will be called the "AV Systems" and the installer will be named "The Contractor."
- C. The Contractor must provide all labor, materials, equipment, necessary tools, test equipment, hoisting, transportation, supervision and coordination necessary to complete the installation of the "AV Systems" as described in these specifications and illustrated on the Project drawings.
- D. Contractor shall provide, based on the Contract Documents, a complete, turnkey system, tested and ready for acceptance testing. The Contract Documents are developed to the extent required to properly convey design intent, signal flow, and system infrastructure. Contractor will supply any additional equipment required to provide a complete and working system.
- E. Contractor will supply any accessories, such as power supplies, adaptors, connectors and converters, required to provide a complete and working system.
- F. System features or devices which are mentioned in one part of the Contract Documents may not be shown in the other. In case of conflict between the written specifications and the drawings, Contractor must seek clarification from the Consultant. If the Contractor fails to obtain such clarification, the interpretation of the Consultant will prevail.
- G. Contractor shall obtain all licenses and permits necessary for the execution of any work pertaining to the installation within this scope of work.
- H. Contractor shall comply with all union jurisdiction and prevailing wage requirements.
- I. Refer to AV-001 for division of responsibilities related to the AV Systems.

1.06 SYSTEM DESCRIPTION

- A. Auditorium
 - 1. Projection System
 - a. A laser projector shall be mounted from the ceiling within the cafeteria. Projector to utilize a 16,000 ANSI lumen laser lamp & to feature full HD WUXGA and have support for 4K content.
 - b. A 226" diagonal 16:10 aspect ratio motorized projection screen shall be attached from above.
 - c. Primary equipment shall be housed in an AV equipment rack located in a nearby storage closet. (4) extended HDMI inputs shall be provided within the cafeteria will connect to a video matrix switcher. Extended connections to terminate to a video matrix processor located in the associated equipment rack & extend to the ceiling suspended projector.
 - 2. Sound System
 - a. Large, point source loudspeakers shall be oriented in a left | right | center stereo configuration on either side of the platform proscenium opening. (1) dual 15" subwoofer shall be mounted above the proscenium opening. Speakers &

- subwoofers shall be powered by networked amplifiers located in the associated equipment rack. Existing speaker locations will be reused.
3. Wireless Microphone System
 - a. All of the existing wireless microphones will be uninstalled from their existing location and be installed in the AV rack for reuse.
 - b. An antenna combining system will be provided to simplify RF signal reception.
 4. (2) wall boxes shall be located downstage, (2) wall boxes shall be located downstage, and (3) wall boxes shall be located at the front lip of the stage.
 5. Audio Mixing System
 - a. A new digital mixing console will be provided and used with the existing digital stage box (mounted in a portable rack) to be reused for events requiring a more in-depth audio setup. The console will connect to the audio network via the data connections on the wall plates throughout the space. A loose touch panel will be provided for use with the audio console.
 6. A Bluetooth input panel shall be located adjacent to the stage wall mounted touchscreen controller & connected to the associated audio DSP. A rack mounted CD player shall be provided for legacy audio playback.
 7. AV Network
 - a. An AV network switch shall be provided for local DSP, amplifier, touchscreens, Bluetooth, and matrix video switcher interconnectivity.
 8. Intercom System
 - a. A wireless intercom system will be provided for staff/operators; a master intercom station will be located in the AV equipment rack with an antenna in the ceiling for wireless transceivers.
 9. Assistive Listening System
 - a. A wireless transmission system with receivers will be provided for those hard of hearing.
 - b. Quantity of required devices dictated by local codes.
 10. Wall mounted touch panel controllers will control all AV devices within the space from the rear of the room and the stage.
- B. Blackbox
1. Sound System
 - a. Full-range speakers will be suspended from the pipe grid located in either of the four corners of the room.
 - 1) Speakers will be actively amplified by integrated amplifiers.
 - 2) Speakers will be suspended from the pipe gride with pipe mounting hardware and be portable for user definable relocation of speakers.
 - b. Local DSP will be provided.
 - c. Emergency paging for campus wide announcements to override content playback.
 2. Audio Mixing System
 - a. Mixing of local I/O will be from a digital mixing console located in the control room.
 - b. Remote I/O will be located in the associated AVL equipment room and connect to I/O from the local in room wall and pipe mounted boxes.
 - 1) Remote I/O will consist of Dante connectivity.
 3. Bluetooth input panel will be located in the room.
 4. Wireless Microphone System
 - a. (4) Channels of digital wireless microphones will be provided.
 - 1) Receiver(s) will be located in the associated AVL equipment room.

- 2) Antennas will extend from the associated AVL equipment and utilize wall mounted antenna.
- 3) Transmitter will consist of (2) body packs with headset microphones and (2) handheld microphones.
- 4) A rechargeable battery system will accompany the transmitters.
- 5) Chargers mounted to sliding shelves located in the AVL equipment room.
5. Assistive Listening System
 - a. A wireless transmission system with receivers will be provided for those hard of hearing.
 - b. Quantity of required devices dictated by local codes.
6. Projection System
 - a. Projection screen will consist of (1) 159" diagonal, 16:9 aspect ratio, motorized projection screen.
 - 1) Projector screen will be controlled via IP connectivity.
 - 2) Projector screen will be suspended from the pipe gride with pipe mounting hardware and be portable for user definable relocation of projection screen.
 - b. Projector will consist of (1) 13,000 ANSI lumen Full HD WUXGA laser light source projector.
 - 1) Projector will be controlled via IP connectivity.
 - 2) Projector will be suspended from the pipe gride with pipe mounting hardware and be portable for user definable relocation of projection.
 - c. The projection systems primary inputs will be driven by the provided video over IP distribution system and have associated HDMI inputs on input panels. Inputs will include the following and be encoded into the IP distribution system:
 - 1) (6) extended HDMI inputs will be provided.
 - 2) (1) rack mounted wireless presentation gateway will be provided
 - d. Video system will be automated with preset recalls available from the AV control system. Automation will include projection screen controls and routing of all associated video input to the projector and other distributed displays.
7. Camera System
 - a. A point-of-view (POV) static camera package will consist of four fixed cameras.
 - 1) Cameras will feed a multi-viewer.
 - 2) The output of the multi-viewer will feed the video IP distribution.
 - 3) Compact monitors will be provided at the operators positions and connect to the video IP distribution.
8. Intercom System
 - a. A wireless intercom system will be provided for staff/operators; a master intercom station will be located in the AV equipment rack with an antenna in the ceiling for wireless transceivers.
9. Wall mounted equipment rack will be provided in the control room for AV equipment.
10. Local control of the AV system will utilize the local touchscreens and OFE provided wireless tablets with provided control system applications.

1.07 PRE-BID SUBMITTALS

- A. Bid Clarifications. Contractor is responsible for reading and understanding all information presented in these specifications and related documents outlined in Section 1.02. Discrepancies between drawings and specifications or other errors or omissions should be brought to the Consultant's attention a minimum of 5 days prior to bid date. Failure to do so does not relieve the Contractor from the requirement to provide a fully operational and turnkey system as

outlined above. In this event, the Contractor agrees to abide by the decision of the Consultant for resolution.

- B. Contractor Qualifications. Contractors will be considered by the Owner and Consultant upon receipt of the following information:
1. Company profile including history, number of employees, facility size and completed projects.
 2. Resume of key personnel to be used on this project, including but not limited to: Project Manager; Lead Engineer; Job-Site Superintendent.
 3. Contractor shall have previously installed at least three jobs of similar magnitude, completed within the last five years. A resume shall be provided for these projects including project name, scope of services, year completed, and contact information for a reference. Provide at least one such completed job for inspection by the Architect and/or Consultant.
 4. Contractor shall have five years of experience with equipment and systems of the types specified, shall maintain a fully staffed and equipped service facility, and shall be a franchised dealer and authorized service facility for the major brands specified, and shall be properly licensed to work I at the project location.
 5. A description of the Contractor's abilities for in-shop assembly, fabrication, and testing.
 6. A sample set of shop drawings or as-built documents that confirm the Contractor's capabilities to provide engineering and documentation for the project.
 7. A line sheet listing all manufacturers the Contractor is a dealer and/or authorized service center for.

1.08 BID SUBMITTAL

- A. Submit according to conditions of the Construction Contract and Project Manual.
- B. The Bidder shall disclose in the bid whether any portions of the project work will be subcontracted out. All terms of this contract, including bidding and qualification statements, shall apply to the subcontractor. Provide the following information for each subcontractor to be used:
1. Name of the proposed subcontractor.
 2. A statement of qualifications for each subcontractor.
 3. A scope of work outlining what portions of the project for which the subcontractor will be responsible.
- C. Include the following information with the bid submittal:
1. The total contract price.
 2. The price for any add or deduct alternates.
 3. An itemized equipment list which includes unit pricing for all equipment.
 - a. List to be presented in the same sequential order as in Part 2 below.
 4. A breakdown of the cost and number of labor hours for each of the following:
 - a. Engineering and documentation.
 - b. On site coordination meetings and supervision.
 - c. In shop fabrication and assembly.
 - d. On site fabrication, assembly, and installation.
 - e. On site verification and testing.
 - f. Contractor tests and adjustments as outlined in Section 3.07.
 - g. Manufacturer training, inclusive of travel expenses.
- D. Substitutions. Contractor shall note all substitutions at the time of bid. Comply with General Conditions. Any proposed substitutions must meet all specifications of the specified equipment. No product substitution will be accepted without the written approval of the Consultant or Owner. Consultant and Owner retain the right to reject any proposed substitution.

1.09 PROJECT SUBMITTALS

- A. Submit according to conditions of the Construction Contract and Project Manual.
- B. Each submittal shall be as a coordinated package complete with all required information. Uncoordinated sets will be returned without review.
- C. Product Data.
 - 1. Submit manufacturer's product data sheets for each item of equipment that will be provided as part of this contract for approval prior to purchase of equipment.
 - 2. Submit electronically as a single PDF. All equipment cut sheets will be arranged per specification section number. Provide a table of contents and a bookmark at the start of every product sheet.
 - 3. Failure to submit without time for evaluation shall not entitle the Contractor to purchase, substitute product or delay the project's delivery product without approval.
- D. Color Submittal.
 - 1. Submit according to conditions of the Construction Contract and Project Manual.
 - 2. Organize according to location, device, and color option.
 - 3. Where custom colors have been specified, include the appropriate reference (RAL, Pantone, etc.).
 - 4. This shall include but not be limited to: floorbox lids, wall mounted devices and panels, ceiling mounted devices and panels, and loudspeakers.
- E. Millwork Colors and Samples. Submit according to conditions of the Construction Contract and Project Manual.
- F. Shop Drawings.
 - 1. Review of shop drawings is for general conformance with the design intent and general compliance with the contract documents of the project. Corrections, comments, or markings made do not relieve the Contractor from compliance with the Contract Documents nor allow departure therefrom. Contractor remains responsible for detailing and accuracy, confirming and correlating quantities and dimensions, selecting fabrication processing and techniques of construction, coordinating work with that of other trades, and performing work in a safe a satisfactory manner.
 - 2. Failure to submit shop drawings without time for evaluation shall not entitle the Contractor to an extension of contract time.
 - 3. There will be no work authorized on site without the prior submittal and subsequent approval of a complete set of shop drawings. Any exceptions to this must be in writing and approved by the Consultant.
 - 4. Submit as a multi-sheet searchable PDF document with:
 - a. 42" X 30" sheets.
 - b. Table of Contents.
 - c. Bookmarks for every sheet with Sheet Name and Number.
 - 5. Drawings shall be a standalone package containing all information required for system installation. The package shall include:
 - a. A legend of all symbols and abbreviations used in the drawing package.
 - b. Plan View Drawings showing:
 - 1) Locations of all equipment and devices.
 - 2) Locations of junction boxes, with associated conduits and cable fill.
 - 3) Coordinated layouts of:
 - a) Equipment Rooms.
 - b) Control Booths.
 - c) Production Suites.

- c. Section and Elevation Drawings including but not limited to:
 - 1) Speakers.
 - 2) Large Displays.
 - 3) Projection Screens.
 - 4) Projectors.
 - 5) LED Display Boards.
 - 6) Monitor Walls.
- d. Equipment Rack Elevations including:
 - 1) Location of all equipment within the rack.
 - 2) Heat loads for each equipment rack and calculations showing how numbers were derived.
- e. Custom Furniture and Millwork Details.
 - 1) Show all dimensions and finishes for custom furniture and millwork including equipment locations and mounting methods, coordinate with Division 6.
- f. AC Power Requirements.
 - 1) For each equipment rack show:
 - a) Power requirements and calculations showing how numbers were derived.
 - b) Power distribution details within each rack.
- g. Rigging Details.
 - 1) Submit for LED Displays and Speakers.
 - 2) Details will be submitted with licensed engineer stamp licensed to practice at the project location.
 - 3) Drawings will include:
 - a) Structural attachment details.
 - b) Welding calculations.
 - c) Types of hardware to be used.
 - d) Speaker aiming angles.
 - 4) Provide structural calculations along with the stamped drawings. Refer to all requirements of Division 5 – Metals.
- h. Wiring Schematics.
 - 1) Provide complete and detailed wiring schematic for all systems including:
 - a) Cable types.
 - b) Cable identification by number and color codes.
 - c) Detailed wiring of connections to equipment and between equipment racks.
 - d) Equipment identifier matching that used in the Contract Documents.
- i. Schematic drawings of any custom circuitry or equipment modifications, including connector pin-outs and component lists.
- j. Schedules showing:
 - 1) Cable Types.
 - a) Type identifier matching that used in the Contract Documents.
 - b) Manufacturer.
 - c) Part Number.
 - d) Signal Group.
 - e) Nominal Outside Diameter.
 - 2) Junction Boxes.
 - a) Box Name matching that used in the Contract Documents.
 - b) Drawing Reference.

- c) Location.
 - d) Dimensions.
 - e) Mounting Height.
 - 3) Pull Schedule.
 - a) Pull Length.
 - b) Source and Destination.
 - c) Wire Number.
 - 4) Custom Color and Finishes for:
 - a) Speakers.
 - b) Custom Panels.
 - c) Exposed Cabling.
 - d) Custom Furniture.
 - k. Conduit riser diagram showing interconnect of all systems.
 - l. Terminal strip layouts for all terminal strips to be used in junction boxes or equipment racks.
 - m. Connector wiring details including connector model numbers and labeling methodology.
 - n. Network schematic showing:
 - 1) Logical Connections of all devices.
 - 2) IP address scheme.
 - 3) VLAN Scheme.
 - o. Custom Panel Details including:
 - 1) Materials.
 - 2) Finishes.
 - 3) Dimensions.
 - 4) Connector Layout.
 - 5) Connector Labeling.
 - p. Audio, Video and Data patch bay layouts and labeling scheme.
 - q. Mounting and orientation details for:
 - 1) Flat Panel Displays.
 - 2) Surface Mount Speakers.
 - 3) Wireless antennas.
- G. Custom Software Programming including Graphical User Interface (GUI).
- 1. Provide for approval at least 6 weeks prior to system commissioning electronic copies of all custom software. It is the Contractor's responsibility to provide all custom software programming. Coordination with the Consultant is required for the development of this software.
- H. Wireless Frequency Analysis.
- 1. It is the responsibility of the contractor to coordinate all wireless frequencies. The contractor shall perform a spectral sweep from 140 MHz through 3 GHz in the facility and then present a written report of proposed new frequencies.
 - 2. The Contractor must arrange and perform this sweep at a time of day that reflects the time of facility use.
 - 3. The contractor should also include in the report additional frequencies for future expansion.
 - 4. The Contractor will incorporate any existing and other new frequencies in the determination of the new frequencies to be used, including but not limited to wireless intercom, wireless cameras and wireless radios.
- I. Assistive Listening System Analysis.

1. Contractor is responsible for providing documentation showing the Assistive Listen system meets accessibility requirements of the project location.
 2. Contractor is to provide a quantity of receivers per prevailing code.
- J. Final Inspection Notification Report.
1. Two copies of a computer-generated checkout report for the entire system must be prepared and submitted 2 weeks prior to system commissioning. It will include:
 - a. A complete listing of every piece of equipment including serial number, the date it was tested and by whom, the results and (if failure occurred during any previous tests) the date retested.
 - b. The final report will indicate that every device tested successfully.
 - c. A performance test report indicating that the system meets all the Contractor testing requirements in Section 3.07.
 - d. A copy of the Final Inspection Report must be included in the Project Manual.

1.10 CONTRACT CLOSEOUT SUBMITTALS

- A. Submit according to conditions of the Construction Contract and Project Manual.
- B. Submit all contract closeout documentation within 30 days after substantial completion, unless otherwise noted.
- C. Contractor shall work off approved shop drawings only. Note changes made during installation on a single set of drawings. This set of marked up drawings will not leave the jobsite until after the final system commissioning. Submit 4 corrected sets of reproducible drawings showing work as installed. All “as-built” drawings to be provided both in electronic form (ACAD 2010 or later) and in hard copy (same size as architectural drawings).
- D. Contractor to provide a Project Manual prior to acceptance testing. Provide a minimum of one hard copy and one electronic copy. This manual shall contain the following information:
 1. Table of Contents.
 2. Contractor’s contact information for warranty and/or service.
 3. A complete list of equipment, both installed and loose gear. Include manufacturer, model number, and serial number for all devices. Include settings (software or hardware) for any devices that required modification or adjustment during the acceptance testing.
 4. Operating manuals for each device.
 5. Documentation of all testing results as outlined in Section 3.07.
 6. Wireless microphone frequency coordination report.
 7. A USB drive containing all As-Built drawings in PDF & DWG format.
 8. Replacement parts lists of major items of equipment.
 9. Provide a suggested schedule of routine maintenance. Schedule should include dates of replacement of all batteries, cleaning of air filters and procedures for verifying system functionality.
- E. Create a quick start guide to provide information specific to each room/system, such as procedures for system power on/off, patching, different modes of operation, etc.
 1. The guide should convey information specific to each room/system. It is not intended to be a guide on generic system operation.
 2. Anticipated length of each guide is less than 2 pages front and back.
- F. Software Licensing and Manuals. Provide a copy of all software installed on computers or equipment in the system, including all device configuration files, on a USB disk drive.
- G. Produce compact system flow diagrams showing all components, cables, and wire numbers that will be mounted on the wall of each equipment room. Provide photographically reproducible as-built wiring diagrams at a reduced scale that are easy to handle and fully legible.

- H. Provide a complete list of spares inventory that includes quantity, manufacturer, model number, and serial number.
- I. System Remote Controls. All remotes for displays, projectors, etc. to be collected and turned over to Owner.

1.11 PROJECT CONDITIONS

- A. Verify conditions on the job site applicable to this work. Notify the Consultant and General Contractor in writing of discrepancies, conflicts, or omissions promptly upon discovery.
- B. The drawings diagrammatically show cabling, conduit, wiring, and arrangements of equipment fitting the space available without interference. If conditions exist which make it impossible to install work as shown, recommend solutions and/or submit drawings to the Consultant for approval, showing how the work may be installed.

1.12 WARRANTY

- A. Contractor shall warrant equipment to be free of defects in materials and workmanship for not less than one year after date of Substantial Completion. Defects occurring in labor or materials within the one-year warranty shall be rectified by replacement or repair. Owner furnished equipment is excluded from the warranty, but terminations and wire leading to or from Owner furnished equipment is included. Within the warranty period, provide answer to service calls and requests for information within a 48-hour period, and repair or replace any faulty item within a 72-hour period without charge, including parts and labor.
- B. This warranty shall not void specific warranties issued by manufacturers for greater periods of time. Nor shall it void any rights guaranteed to the Owner by law.
- C. Contractor to provide Owner with exact beginning and ending dates of the warranty period. Include the name and telephone number of the person to call for service. This information is to be part of Project Record Drawings.
- D. Contractor to conduct a final site visit and verify that the system is operational, and all items are functioning correctly at the end of the warranty period. Contractor shall not be responsible for correcting items that have been changed by the Owner or end user.

PART 2 PRODUCTS

2.01 GENERAL

- A. Model numbers and manufacturers included in this specification are listed as a standard of quality. Equipment and materials will be new, meet the latest published specifications of that product.
- B. All devices will have applicable approvals from a Nationally Recognized Testing Laboratory and meet all applicable local codes and requirements. Should any equipment lack proper approval the Contractor will arrange for onsite inspections and certification at no additional expense to the Owner.
- C. Product Substitutions.
 - 1. Consultant will consider other qualified manufacturers subject to review. Submit according to conditions of the Construction Contract and Project Manual.
 - 2. Proposed substitutions must meet all specifications of the specified equipment. The Contractor will supply complete technical data specifications at the time of proposed substitution.
 - 3. The Contractor will arrange for product demo at the request of the Consultant or Owner Representative and will pay ground freight shipping to and from site, or to and from Consultant's office.

4. No product substitution will be accepted without the written approval of the Consultant and Owner. The Owner, General Contractor, and the Consultant reserve the right to accept or refuse any substitution without condition.
 5. Upon acceptance of a substitution, Contractor assumes all responsibility for verification and coordination of all heat, power, rack space and architectural requirements.
- D. If product is discontinued and/or no longer publicly advertised as a part of a manufacturer's current product line-up at time of installation, the project team reserves the right to request a substitution of product for new and currently offered product of like function fulfilling the design intent. Substitution value will be based on fair market value of original product at time of bid.

2.02 EQUIPMENT LIST

- A. In addition to the equipment below, include all product specified in Attachment A.
- B. Color selection shown in the equipment list does not designate a selected color. All colors must be coordinated with Architect and Consultant.

2.03 AV SYSTEMS COMPONENTS

- A. AV Equipment Racks:
 1. Rack color: coordinate with Architect.
 2. Verify exact rack space required.
 3. Provide service lamp in the top of each rack.
 - a. Middle Atlantic LT-CABUTL Series
 4. Modular power raceway system. Include as required:
 - a. Middle Atlantic MPR-8A.
 - b. Middle Atlantic MPR-JB###A (Provide size as required).
 - c. Middle Atlantic M-2X20A.
 - d. Middle Atlantic M-30TL-HWA.
 - e. Middle Atlantic power cabling as required.
 5. Provide & install rubber mat under all floor standing racks.
- B. Rackmount UPS Backup.
 1. UPS must have contact closure for remote shut down of load circuits.
 2. UPS to have a minimum 15 min run time under load.
 3. Use fanless UPS in noise control booths and control rooms.
- C. Digital Signal Processor.
 1. See Section 3.02 for Programming Requirements.
 2. Interface DSP logic with fire mute in each rack location.
- D. Network Switches.
 1. Contractor to configure switches as required.
 2. Work with related DIV 27 contractors, Owner's IT Provider and other contractors to allocate IP addresses and configure network VLANs to support AV system needs.
 3. All network capable equipment shall be connected to the AV network, including but not limited to Amplifiers, wireless microphones, DSP, playback devices, etc.
- E. Power Amplifiers.
 1. Each amplifier to have a 2-ply phenolic label on the front and rear, stating amplifier number and which speakers it is feeding.
- F. Loudspeakers.
 1. Coordinate all colors with Architect.
 2. All rigging to allow for +/- 10deg of horizontal and vertical adjustment.
 3. Provide a support structure for speaker systems sized to safely handle the system weight.

- G. FM transmitter with headset receivers for Assistive Listening System.
1. Contractor is responsible for verification of receiver quantities per project code requirements.
 2. Install antenna system in accordance with manufacturer's recommendations.
- H. Wireless Microphone Systems
1. Select wireless frequency bands based upon frequency analysis performed in Section 1.6.J.
 2. Ensure all modules necessary for a complete system are included.
 3. Ensure all cabling required for remote antenna locations is included.
 4. Contractor shall perform calculations to determine cable and connector loss based on install conditions. Install antenna boosters as required per calculations. Include this report with shop drawing submittals.
- I. Projection Screens
1. Unless otherwise noted on drawings, set limits so the bottom of projected images are 48" above finished floor in classrooms, conference rooms, and meeting rooms and 60" above finished floor in auditoriums and ballrooms. Include additional black drop as needed to meet projected images specified heights. Ensure deployed screens clear all wall protrusions and allow for future installation of wall mounted whiteboard or chalkboard.
- J. Televisions and Mounts
1. TVs must meet the following specifications:
 - a. TV viewable diagonal sizes may be +/- 3" from that specified
 - b. Internal ATSC & QAM tuner
 - c. Internal speakers.
 - 1) TVs will have digital audio output following the selected input.
 - 2) TVs will have an analog audio output following the selected input with variable volume.
 - d. Wall mounted TVs are to be compliant with ADA clearance requirements.
 - 1) If the bottom of the TV is below 6'-8" AFF the following applies:
 - a) Displays 2.5" or less in total thickness to use mounts with a depth of 1.5" or less with micro adjust, tilt & swing arm capabilities.
 - b) Displays 2.5" or greater in total thickness to use ultra-thin mounts with a depth of 1" or less with micro adjust & tilt capabilities.
 - c) Display & mounting solution total overall protrusion from the wall not to exceed 4".
 - 2) The total depth of the display & mounting solution not to exceed 4" protrusion from the wall to the front face of the display.
 - 3) The contractor will provide ultra-low-profile mounts per each display to meet all relevant ADA clearance requirements.
 - e. Controllable by 3rd party control system via hardwired RS-232 / serial port.
 - f. LED backlit LCD technology only.
 - g. VESA mount compatible
 - h. Acceptable Manufacturers
 - 1) Sony
 - 2) Samsung
 - 3) LG
 - 4) Panasonic
 - 5) Planar
 - 6) NEC
- K. Audio Patchbays:

1. Label each patch point with unique wire label to match label on panel or equipment. Provide functional labels over groups of patch point to label destination hardware or location.
 2. Front programmable patchbay
 - a. Bittree B96DC-FNAIT/E3 M2OU12B. (Qty. per design)
 3. Patch Cords:
 - a. Coordinate color with owner.
 - b. Bittree BPC1800-110 (Qty. 24 per patchbay provided)
 - c. Bittree BPC2402-110 (Qty. 12 per patchbay provided)
- L. Data Patchbays:
1. Data patch point to match specification for cable terminating to patch point. Shielded cabling will require a shielded connector.
 2. Label each patch point with unique label to match label on panel or equipment. Provide functional labels over groups of patch point to label destination hardware or location.
 3. Modular Patch Panel:
 - a. Install with printed labeling strip.
 - b. Belden AX103114 24-Port 1RU (Qty. per design)
 - c. Belden AX103115 48-Port 2RU (Qty. per design)
 4. Cat6 UTP Connector
 - a. Black Keystone
 - b. Belden AX101321 (Qty. per design)
 5. Cat6 STP Connector
 - a. Shielded Keystone
 - b. Belden AX104596 (Qty. per design)
 6. Provide all patch cables required for use, per system schematics, plus additional 8 matching patch cables per patch bay.
- M. Fiber Patchbays:
1. Label each patch point with unique wire label to match label on panel or equipment. Provide functional labels over groups of patch point to label destination hardware or location.
 2. Modular Enclosure:
 - a. Belden ECX-01U 1RU LAN Housing (Qty. per design)
 - b. Belden ECX-02U 2RU LAN Housing (Qty. per design)
 - c. Belden ECX-04U 4RU LAN Housing (Qty. per design)
 3. Splice Cassettes
 - a. Provide Dual LC Connectors.
 - b. Belden FC3X06LDFS OM3 Aqua Adaptor (Qty. per design)
 - c. Belden FCSX06LDFS SM Blue Adaptor (Qty. per design)
 - d. Belden FCSX06LAFS SM/APC Green Adaptor (Qty. per design)
 4. Patch Cables:
 - a. Provide all patch cables required for use, per system schematics, plus additional 4 matching patch cables per splice cassette.
 - b. Belden FP3LDLD002M, OM3 2m
 - c. Belden FPSLDLD002M, OS2 2m
 - d. Belden FPSLALA002M, OS2/APC 2m
- N. Video Patchbays:
1. Label each patch point with unique wire label to match label on panel or equipment. Provide functional labels over groups of patch point to label destination hardware or location.

2. Normalled patchbay:
 - a. Bittree B64T-2MWNHD (Quantity Per Design)
 - b. Bittree VPCM 24 02-75 Patch Cords (Qty. 8 per patchbay provided)
 - c. Bittree VPCM 24 05-75 Patch Cords (Qty. 8 per patchbay provided)
 - d. Bittree VPCM 24 06-75 Patch Cords (Qty. 8 per patchbay provided)
 - e. Bittree ADMW48 BNC to Mini-WECO (Qty. 4 per patchbay provided)

2.04 CUSTOM PANELS

- A. Panels to be fabricated by Contractor, engraved and loaded with connectors with information shown on Drawings.
- B. Unless otherwise specified, all wall and ceiling panels will be 1/8-inch-thick, anodized aluminum. (Brush in direction of aluminum grain only.) Engraving will be 1/8-inch block sans serif characters.
 1. Coordinate all panel colors/finishes with Architect.
 2. All custom panels will have beveled edges.
 3. Text color will be white for all black/dark colored panels and black for all white/light colored panels.
 4. Connector color will be silver for all white/light colored panels and black for all black/dark colored panels.
 5. Plastic plates will not be accepted.
 6. Where Extron, Crestron, or other manufacturer's transmission equipment will be mounted on a wall or ceiling plate visible to the public, uses Decora style plates, coordinate color of equipment and wall plate with Architect.
 7. Wall panels sizes to be coordinated with J-boxes dimensions and mounting conditions.
 - a. Panels mounted on surface mount boxes will not protrude beyond the edge of the box thereby creating a sharp edge condition.
 - b. Panels mounted on flush mount boxes will extend beyond the edge of the J-box by 1/4" on all sides.
- C. Unless otherwise specified, all rack panels and floor box panels will be 1/8-inch-thick, black anodized aluminum. (Brush in direction of aluminum grain only.) Engraving will be 1/8-inch block sans serif characters. Lettering will be white.
 1. Coordinate all panel finishes with Architect.
 2. Connector color will be silver for all white/light colored panels and black for all black panels.
 3. Rack panels will be standard EIA sizes.
 4. Plastic plates will not be accepted.
- D. Floor Boxes will be flush mounted.
- E. Panels in outdoor or harsh environmental conditions will be stainless steel and contain connectors fit for their environment.
- F. Contractor will submit panel engraving schedule and fabrication drawings for approval
- G. Panels to be manufactured by one of the following manufacturers:
 1. Panel Authority
 2. Proco
 3. RCI
 4. Whirlwind
- H. Panel Connectors.
 1. Panels to contain components listed below:
 - a. Female XLR: Neutrik NC3FD-L-B-1.
 - b. Male XLR: Neutrik NC3MD-L-B-1.

- c. Locking 1/4": Neutrik NJ3FP6C-B.
- d. Female XLR-1/4" TRS Combo: Neutrik NCJ6FI-S
- e. Rugged RJ45: Neutrik NE8FDX-P6-B or NE8FDX-Y6-B
- f. BNC (75 Ohm): Neutrik NBB75DFIB-P
- g. BNC (50 Ohm): Canare BJ-JRUD
- h. 4-Pole Speaker: Neutrik NL4MP
- i. 8-Pole Speaker: Neutrik NL8MPR-BAG
- j. Mass Connectors: Whirlwind W-series
- k. Triax: ADC ProAx Plugs and Jacks w/45 Degree Mount Kit.

2.05 CABLE, CONTROL WIRING & TERMINATIONS

- A. Electrical conductors installed under this contract, except where otherwise specified, will be soft drawn annealed stranded copper having a conductivity of not less than 98% of pure copper.
- B. Refer to drawing AV-001 for scope of work related to supply, installation, and termination of cable.
- C. Refer to drawing AV-001 for cables to be used.
 - 1. Use plenum and underground cables as required by code.
 - 2. It is assumed all underground cables, where they transition to cable tray or free air, will not pass through plenum spaces outside of conduit.
- D. Refer to drawing AV-001 for minimum cable lengths required outside of boxes.
- E. The Contractor will verify all connector details required for installation of equipment, including make, model, connector sex, attachment configuration, pinouts, and cable clamp accessories.
- F. Video Connectors: All primary video equipment will use crimp-on style BNC connectors. If consumer grade equipment is furnished with RCA connectors, the cable will be terminated in a crimp-on style RCA connector. It will not be acceptable to use BNC to RCA adapters for consumer grade connections.
- G. Video Terminators: Video terminations will be comprised of commercially available 75-ohm 0.1% tolerance units with integral BNC connectors, which are applied as required, plus a 20-count spare.
- H. Speaker Level Rail Mounted Terminal Blocks:
 - 1. To be used in speaker cluster and Equipment Room junction boxes where shown on schematic drawings or as required by field conditions
 - a. Rail-Mounted Terminal Blocks
 - 1) Positive Terminal (+): Orange Part #2010-1302
 - 2) Negative Terminal (-): Gray Part #2010-1301
 - b. Mount on non-corrosive DIN rail
 - 1) Wago 210-112
 - c. Use insulated Ferrules on all terminations
 - 1) 8 AWG: Wago 216-289
 - 2) 10 AWG: Wago 216-288
 - 3) 12 AGW: Wago 216-287
 - 4) 14 AWG: Wago 216-286
 - d. Crimp with
 - 1) 6-10 AWG: Wago 206-216
 - 2) 12-24 AWG: Wago 206-204
 - e. Use end and intermediate plates
 - 1) Orange: Wago 2010-1392
 - 2) Grey: Wago 2010-1391

- f. Use push-in jumpers as required
 - 1) Wago 2010-4xx
- g. Use marking strip system
 - 1) Wago WFB Continuous Marking Strip
- I. Microphone and Line Rail Mounted Terminal Blocks
 - 1. To be used in Equipment Room junction boxes where shown on schematic drawings or as required by field conditions
 - a. Rail-Mounted Terminal Blocks
 - 1) Wago 280-550
 - b. Mount on non-corrosive DIN rail
 - 1) Wago 210-112
 - c. Use insulated Ferrules on all terminations
 - 1) 20 AWG: Wago 216-222
 - 2) 22 AWG: Wago 216-221
 - 3) 24 AGW: Wago 216-321
 - d. Crimp with
 - 1) Wago 206-204
 - e. Use end and intermediate plates
 - 1) Wago 280-305
 - f. Use push-in jumpers as required
 - 1) Wago 280-4xx
- J. Cable Mount Connectors.
 - 1. Cables to use components listed below, unless otherwise noted:
 - a. Female XLR: Whirlwind WI3F-BK
 - b. Male XLR: Whirlwind WI3M-BK
 - c. Male XLR Numbered: Whirlwind WI3M -BK-#
 - d. To be used on all audio console and stage box inputs.
 - e. 1/4" TS: Switchcraft 280
 - f. 1/4" TRS: Switchcraft 297
 - g. Rugged CAT6 RJ45: Neutrik NE8MX-B-1
 - h. RCA: Canare 75 Ohm
 - i. BNC (75 Ohm): Canare 75 Ohm
 - j. BNC (50 Ohm) Type F Cables: Amphenol Connex 112563
 - k. BNC (50 Ohm) Type G Cables: Amphenol Connex 112120
 - l. 4-Pole Speaker smaller than 12AWG: Neutrik NL4FC
 - m. 4-Pole Speaker greater than 12AWG: Neutrik NLT4FX-BAG
 - n. 8-Pole Speaker smaller than 12AWG: Neutrik NL8FC
 - o. 8-Pole Speaker greater than 12AWG: Neutrik NLT8FX-BAG
 - p. Mass Connectors: Whirlwind W-series
 - q. Triax: ADC ProAx Plugs and Jacks.
 - r. SM Fiber Optic: Amp Metallic ST style (Flat Finish)
- K. Use the following chart for color coding cables for use in the AV systems. Please see the drawing package for specific cable part numbers

Signal Type	Letter	Color
HD Video	H	Violet
SDI Video	H	Blue, Light
Composite Video	H	Green

Bi-Level Sync/Reference	H	Red
Tri-Level Sync/Reference	H	Orange
V-TIE (multi-use)	H	Grey
Triax Camera Cable	T	Black
Multicore Camera Cable	M	Black
Analog Line Level Audio	D	Green
Analog Mic Level Audio	E	Orange
Digital Audio (AES)	X	Yellow
Time Code	E	White
RF (Distributed)	K	White
RF (Trunk Line)	L	Black
RF Antenna	F/G	Black
Tally	E	Chrome
RS-232/422/485 Control	R	Chrome
Network 10/100/1000	U	Yellow
Network Facility LAN	U	Blue
KVM	U	Green, Dark
Intercom	E	Brown
Speaker	A	Grey

2.06 J-HOOKS, CABLE HANGER AND TIES

- A. Non-metallic cable support systems such as J-hooks, ties, etc. must be CMP, plenum rated or CMR, riser rated, where applicable. Panduit J-Pro J-hooks Caddy brand “Cable-Cat” hangers or owner and engineer approved equal.
- B. Metallic cable support systems such as J-hooks or Caddy brand “Cable-Cat” hangers must be CMP, plenum rated.
- C. J-hooks will provide a fully radiused support structure with no tight corners to pinch or bind cables, must provide a minimum 1" wide load bearing surface with a minimum 1/4" radius edge.
- D. Cable support system devices will be provided complete with cable retainer.
- E. Cable installation accessories (e.g. pulleys for J-hooks) may be provided and utilized as applicable in compliance with TIA/EIA standards.
- F. "Velcro" type cable wraps will be utilized for cable management only, in the horizontal plane and the vertical plane in MDF, BDF, TR and data cabinets. “Velcro” may not be used in other locations requiring vertical support.
- G. Cable ties of a minimum 0.190" width, installed in a figure 8 pattern around the support member and crossing over the cable/cables will be utilized for cable management and support in a vertical plane.

PART 3 EXECUTION

3.01 GENERAL

- A. Coordinate work with other trades to avoid causing delays in construction schedule.
- B. Delivery, Storage and Handling.
 - 1. All products and materials to be handled and shipped in accordance with manufacturer's recommendation.

2. Provide protective covering on equipment and furniture during construction to prevent damaging or entrance of foreign matter.
 3. Replace at no expense to Owner, product damaged during delivery, storage, handling or construction.
- C. Mount equipment and enclosures plumb and square. Permanently installed equipment to be firmly and safely held in place.
- D. Cover edges of cable pass-through holes in chassis, racks, boxes, etc., with rubber grommets or Brady GRNY nylon grommetting. Adhesive-backed electrical tape and friction tape is not acceptable for insulating or protective purposes.
- E. Turn over any existing equipment that is not required for the renovation to be salvaged by the AV Contractor and turned over to the Owner.
- F. Mount equipment in racks and consoles and fully wire and test before delivery to job site. If field conditions prevent prior assembly of racks, notify Consultant in writing that racks will be fabricated on site and the reasons for the change.
- G. Provide and install equipment racks as specified under this section in a manner in keeping with local seismic codes. Racks located on concrete floors in equipment rooms or non-finished spaces are to be mount on a 4 inch di-electrically isolated riser such as a 4-inch concrete riser, provided by Division 3. Ensure that all equipment racks are electrically decoupled from flooring to prevent coming into contact with any safety grounded items during operation by providing rubber mat-style isolation between racks and riser.
1. Inspect all racks, consoles, and enclosures prior to installation. All rough or sharp edges that may cause injury to personnel must be deburred or a permanent protective coating applied.
 2. Design and provide ventilation adequate to keep temperature within the rack below 85 degrees Fahrenheit. This ventilation system must be temperature actuated.
 3. Provide blank rack-mount panels installed in all rack openings not occupied by equipment. Blank filler panels will not exceed five rack units in size. Install rack mounted equipment with black 10-32 Phillips head machine screws.
 4. Looking at the rack from the rear, locate AC power, digital control, DC control, and speaker wiring on the left; microphone, line level audio, and video wiring on the right. Panels or equipment mounted on the rear rack rails will not block access to any front mounted components.
 5. Provide security covers on non-user operated equipment having front panel controls. Install covers at the conclusion of Acceptance Testing.
 6. Install rack mounted equipment with black 10-32 button head machine screws.
 7. Panels or equipment mounted on the rear rack rails must not block access to any front mounted components. Front mounted equipment will be given ample space to allow for access to rear connection.
 8. Provide security covers on non-user operated equipment having front panel controls. Install covers at the conclusion of Acceptance Testing.
- H. The process of acceptance testing the System may necessitate moving and adjusting certain component parts - e.g., video monitors.
- I. AC Power and Grounding
1. The Contractor will be responsible for the supply and installation of AC power connections and circuits within the equipment racks that are to be provided under this section. The Contractor is to provide a 6"x6" J-Box at the top of each rack with power circuit cabling terminating in 24" pig tails. The Electrical Contractor will provide all AC

- power and conduit to the equipment racks and will terminate AC power circuits within J-Boxes at bottom/top of racks.
2. Install 3-conductor, 120 VAC outlets in each rack. Provide a minimum of two spare outlets in each rack. Label each outlet as to which AC circuit is feeding it and provide the same information in the circuit breaker panel.
 3. The A/V system technical ground will be bonded to the metal frame of all equipment racks by use of an uninsulated ground buss lug or bar mounted in each rack. When more than one rack exists, all equipment buss lugs will be bonded to one central equipment rack buss lug. This central equipment rack buss lug will be the only connection to the A/V system technical ground conductor. The ganging of racks together with mechanical fasteners is not an acceptable method of bonding the video system technical ground between racks.

3.02 DSP AND CONTROL SYSTEMS PROGRAMMING

A. General.

1. Programmers will have current manufacturer's certifications for all Control and DSP software.
2. The contractor will develop signal flows and user interfaces for each system. Several levels of user access are expected.
3. All programming is the property of the Owner and will be given to the Owner via flash drive at the end of the system warranty period.
4. All passwords for devices and software will be provided to the Consultant.
5. The Contractor will coordinate with the Owner's IT staff as necessary to interface with the facility LAN and Wi-Fi.
6. Completed programming will be tested and operational prior to system calibration and verification.
7. Three major owners requested revisions to functionality and user interface layouts will be incorporated during the first year of building operation.
8. The lead programmer(s) will be present for 4 Owner designated events to provide event support and functionality verification.

B. Control Systems Programming.

1. Provide control of all AV equipment. Control utilizing a listed method or manufactures documented control process, plugin, or driver utilizing the following protocols:
 - a. TCP/IP
 - b. UDP/IP
 - c. HTTP
 - d. Serial
2. All controlled devices will provide real-time feedback for status and monitoring.
3. Where a listed method of control is not present for an AV component, Contractor will provide a method of control.
4. Custom control programming and scripting is required to control AV equipment.
5. Spaces with user interfaces but without a dedicated processor will use resources from an available processor on the network.

C. DSP Programming.

1. The audio for the systems described above will be processed by a combination of a standalone DSP and onboard amplifier processing. This will provide all equalization, cross-over settings, level control, muting, routing, level monitoring, etc.
2. The audio signal flow through the DSP will be designed so that:
 - a. All processing, from input to output, for a space is on a single tab.

- b. Multiple spaces may share a tab where each space is bordered by a clearly labeled frame.
 - c. A label, meter and mute control for each active input and output are provided on the schematic page.
 - d. Processing signals along a common signal path (input or output processing) is via n-input or multichannel processing blocks. Channel groups should not be used.
 - e. Controls for simple processing blocks, such as delays or high-pass filters, are copied to the schematic page.
 - f. Manufacturer's custom voicing profiles are loaded.
 - g. All controls addressed by scripts, user interfaces, or external control:
 - 1) Are notated by color and naming convention.
 - 2) Have text adjacent to the control noting the associated script or external device. For example:
 - a) "Fire Mute: controlled by GPI 1".
3. When available, the Programmer will utilize the manufacturer's plugins for direct control of equipment, such as amplifiers.
 - a. Parameter status in devices will follow status in DSP and vice versa. For example, muting a group of speakers in the amplifier controller software will show the group as muted in DSP. Partial group muting will indicate a partial muting of that group in DSP.
- D. Graphical User Interface Programming.
1. Provide control and monitoring of display devices, playback devices, DSP, and other AV equipment as described below.
 2. User interfaces will be formatted and sized appropriately for display resolutions of the control screen displays. Multiple versions of the same GUI may be required for compatibility with different display resolutions.
 3. Control screen workflow will be activity/preset based and follow these guidelines:
 - a. Activities for each space will be coordinated with the Consultant and Owner.
 - b. User will select an activity, the technical system will configure for the selected activity, and only necessary control elements are available on the user interface.
 - c. Within each activity the control screen will be built around a single page layout with popups displaying control elements as needed.
 - d. When additional control elements are needed, the user will select the advanced operator control page.
 - e. The interface layout will be consistent across all activities with commonly used control items always shown such as source volume with mute.
 4. User interfaces will control technical systems in each space. Each user interface will be tailored for the specific control needs based on the intended user and installed location:
 - a. User control interface will have the following minimum functionality:
 - 1) Control screens:
 - a) Welcome Screen/Login Screen – Coordinate passwords and access levels with Owner.
 - b) Activity Preset Selection Screen – Allows selection of system presets and/or mode of operation and advances to the control screen corresponding to the activity selected.
 - c) Control Screens – For each activity, allow for real-time modification and feedback of routing, source selections, on/off status, muting, monitoring, and level adjustment.
 - 2) Advanced Operator Control Screens:

- a) Overall Status Screen – System power on/off (with off confirmation), signal failover status and reset controls, overall equipment status, fire mute status.
- b) Support Spaces – Allows source select, monitoring, level adjustment and muting of front and back of house spaces.
- c) See below for additional advanced functionality.
- 3) The following control buttons will be present on each screen except for the Welcome/Login screen.
 - a) Navigation to the activity preset selection screen.
 - b) Power Off (with confirmation) – Turns off all equipment associated with the space and returns to the Welcome/Login screen.
 - c) Logoff – Returns the panel to the Welcome/Login screen without affecting the activity currently in progress. Upon login, the panel should return to the activity’s control screen.
 - d) Navigation to the Advanced Operator Control.
- b. Additional Advanced Functionality. Advanced functions or activities will be tailored for the specific control needs based on the intended user and installed location:
 - 1) Rooms with Front of House Control Location.
 - a) Metering Screen – Shows primary inputs to the system from mixing console and primary outputs to the space.
 - b) Mute Screen – Allows muting of individual speakers and zones overlaid on a venue map.
 - 2) Rooms with Audio/Video Conferencing.
 - a) Conferencing Screen – Shows feedback of all associated conferencing AV equipment.
 - b) Real-time modification and preview of camera equipment, PTZ controls, VOIP softphone integration, and single button push-to-start meeting automation for conferencing platforms.
 - 3) Rooms with operable partitions.
 - a) Room Combining – Allows multiple rooms to operate as a single room and controls the combining state where routing, source selections, on/off status, muting, monitoring, and level adjustments are made across all combined rooms.
 - b) Logical preset room layouts will be available for selection to place the room into a combined state.
 - 4) Rooms with video walls or LED screens.
 - a) Control and creation of preset video windowing layouts for automation of video display.
 - b) Source selection of each window within each preset video windowing layout.
 - c) Provide pop-up full screen live preview of input sources before adding them to the video display system or associated window.
 - d) Selection of audio source from windowed layout.
 - 5) Rooms that require lighting and window shade controls.
 - a) Provide individual level, color, and zone control of lights and window shade systems.
 - b) Provide control and creation of presets for automation of lights and window shade systems.
- c. Facility wide moments of exclusivity.

- 1) Moments of exclusivity will be coordinated with Consultant and Owner.
- 2) Automate facility wide global control of associated AV equipment to execute specifically defined tasks related to modification of routing, source selections, on/off status, muting, monitoring, and level adjustments.
- 3) Moments of exclusivity will be one of the following:
 - a) Momentary - Automation will be time defined and return the systems to the previous operational state after time has expired.
 - b) Latching – Automation will be deployed as latest takes precedence priority, allowing local controls to override the event after execution.
 - c) Lock-Out – Automation will be deployed as highest takes precedence priority, not allowing local controls to override event.

3.03 CUSTOM CONSOLE AND WORK SURFACE DESIGN

- A. All consoles and casework items will be rigidly constructed and will allow for a minimum temporary additional load of 200 pounds on any horizontal surface without permanent deformation.
- B. Consoles will be steel frame construction using extruded hollow square and angle sections welded together to form the sub-frame. This sub-frame will form the structural support for all equipment loads, work surfaces and writing surfaces.
- C. The steel frame will be electrically arc welded or similar. Remove all spatter and grind off excess weld and burrs. Prepare for shop priming by power wire brushing to remove rust. Degrease, shop prime, and finish with paint finish as specified. Protect for transport and shop/site and apply touch up paint as necessary. All arc weld hardware will be degaussed after the completion of all welding to be done on the piece.
- D. All dimensions and profiles will be checked with all right-angles true and uniform. Use blank rack mount panels to confirm accuracy of mountings.
- E. All attachments to viewable surfaces will be concealed. Attachments through the finish face of painted sections will be countersunk 1/4" below the surface. A resilient packing 1/16" thick will be placed over the screw before the hole is filled with a 2-part epoxy and finish sanded. When fitting panels allow clearances for paint finished. All laminate will be accurately scribed and fitted to the profiles required. Joints will be glued and screwed using frets or glue blocks where possible to ensure rigidity of the panels independently of the steel frame.
- F. Perforated metalwork will be folded accurately to match adjacent profiles with 3/4" returns lapped and spot welded to form a rigid unit. Hinges and accessories will be chrome or brass, including screws.
- G. All consoles will have removable rear panels for rear access to installed equipment. Removable front "kick panel" doors will also be required. All panels will remove completely during installation and service to facilitate installation work. The panels when installed will present a neat and finished appearance and will have a secure mechanical latch mechanism to avoid any rattles or buzzes.
- H. Provide a suitable method of cable access through the bottom and between sections of consoles.
- I. Control interfaces and panels mounted in custom fitted cutouts will provide a non-gaping interface to the surrounding surface to within a 1/32" tolerance.
- J. Clearances: There will be a minimum of 1 inch clearance inside all consoles between the top equipment mounting space and the console top. This is to allow airflow above equipment mounted in the top mounting position. Provide adequate ventilation grilles to allow continuous cooling in consoles containing equipment. This should include both supply and exhaust grilles. Provide ventilation adequate to keep temperature within the rack below 85 degrees Fahrenheit.

Provide whisper type ventilation fan in each rack if temperature in rack rises above 85 degrees. This ventilation system must be temperature actuated.

- K. All consoles and racks will have front and rear rack rails separated by at least 24 inches. The rails will be parallel and square and will conform to EIA RS-310C for 19-inch racks.
- L. Console work surfaces will be finished with a material and color selected by the Architect and Owner. Painted and metal panels will be finished with sprayed polyester lacquer, satin finish, and color as selected by the Architect and Owner. Steel frame finish will be black enamel.
- M. Painting:
 - 1. Surface Preparation: Preparation for painting will involve fine paper sanding and dusting to ensure a perfectly smooth substrate.
 - 2. Primer: Sealer undercoat will be spray applied and sanded back using 250 grit. Touch up as needed and re-sand.
 - 3. Finish coats will be spray finished in an appropriate spray booth with approved ventilation, humidity control, dust extraction, and lighting. Finished paint thickness will be 1 mil minimum and will be free from runs, orange peeling, blooming or other blemishes. Metal panels will have a similar finish using appropriate metal primer.

3.04 CABLING

- A. Execute wiring in strict adherence to "standard broadcast practices," as excerpted from "Recommended Wiring Practices," Broadcast Audio Equipment for AM, FM, Television (5th Edition), Radio Corporation of America (RCA), Camden, N.J. 1962, and Appendix II, "Recommended Wiring Practices", Sound System Engineering, (2nd Edition), D. Davis, and performed in accordance with standard professional practice.
- B. Take precautions to prevent and guard against electromagnetic and electrostatic hum. For line level audio signals, float cable shields at the output of source device. Shields not connected to be folded back over cable jacket and covered with heat-shrink tubing. Do not cut off unused shields.
- C. Exercise care in wiring; damaged cables or equipment will not be accepted. Isolate cables of different signals or different levels; and separate, organize, and route to restrict channel crosstalk or feedback oscillation. Keep wiring separated into groups for microphone level circuits, line level circuits, loudspeaker circuits, power circuits, video circuits and control/data circuits.
- D. Route unbroken microphone, audio line, and control wiring from receptacle plate/chassis to patch panel/rack. Remove spliced cables and replace without additional charge to the Owner.
- E. Wiring entering equipment racks will be run directly to equipment. Use of splices or connectors to extend cabling to equipment will not be accepted. All signal wiring will be continuous and unbroken from connector plate/chassis to chassis/patch panel. Use of intermediate connections for inter rack cables is not acceptable. Use of splices or connectors to extend cabling to equipment is not acceptable.
- F. Make joints and connections with rosin-core solder or with mechanical connectors approved by the Owner. Where spade lugs and BNC terminations are used, trim cable using manufacturer recommendations and crimp properly with ratchet type tools. Spade lugs mounted on 22 gauge or smaller cable to be soldered after crimping.
- G. Connect audio cable to active components through screw terminal connections and spade lugs whenever available. Make connections to speaker transformers with properly sized closed end connectors crimped with factory approved ratchet type tool. Wire nut or "Scotchlock" connectors are not acceptable. Do not wrap audio cable splices or connections with adhesive backed tape.

- H. Connect loudspeakers electrically in phase, using the same wire color code for speaker wiring throughout the project.
- I. Wiring and connections will be completely visible and labeled in rack.
- J. All power cables will run on the left side of the equipment rack, as viewed from the rear. All other cables will be run on the right side on the equipment rack, as viewed from the rear. Where signal cabling and any cabling types carrying power must cross, they will do so at right angles. Vertical wiring will be run with a bundling and support system, to maintain a clear and organized appearance.
- K. Horizontally routed wiring to equipment will be neatly tied in manageable bundles with cable lengths cut to minimize excess but still allow ready access for service and testing. Provide horizontal support bars if cable bundles sag
- L. For equipment mounted on slides, additional service loops will be provided to accommodate the full range of travel of the slides. This includes all power, ground, control and signal cables.
- M. Neatly bundle excess AC power cables from rack-mounted equipment with plastic cable ties. Rack wiring to be bundled with plastic cable ties or lacing twine. Electrical tape and adhesive backed cable tie anchors are not acceptable. Cable tie and lacing installation will be accomplished using hand tools specifically designed to apply proper tension to the cable tie, and to cut it off flush with no protruding sharp edges. Cable ties will not be applied with excessive force, which may damage or deform sensitive and fragile cables.
- N. All cables in cable trays will be neatly installed with maintaining separation of the different cable types.
- O. Required production room cable paths and lengths must be predetermined especially in instances where timing is a factor. The information that is essential for the implementation of this task is as follows:
 - 1. Site Survey
 - 2. Floor and Ceiling Plans
 - 3. Elevation Design
 - 4. Equipment List
 - 5. Video and Audio Schematics
 - 6. Cable Trays and Conduits
- P. Multiconductor Cables: Follow a uniform application of color codes for multiconductor cables throughout the Facility. Where there are unused conductors or pairs in a cable assembly, they can be insulated as a group, left long enough for future termination, and folded into the connector hood. Where this is impractical, they may be folded back along the outer jacket of the cable and covered with heat-shrinkable tubing.
- Q. Multipin Connectors: Where jumpers are indicated between pins of the same connector, they will be installed internal to the connector shell and will not have any cable number designations applied to the jumper.

3.05 CABLE HOOKS

- A. Whenever possible, cable and raceway routing paths will follow the logical structure of the building (e.g. follow hallways, aisles and corridors). Route all AV cables and raceways parallel to or perpendicular to the building structure. No diagonal runs will be permitted unless noted otherwise or pre-approved by the Architect and Consultant. Corridor crossovers will be kept to a minimum.
- B. The suspended ceiling and/or lighting fixture support wire or rod will not be utilized to support AV cables. Do not support cables from ductwork, plumbing lines, fire suppression or

mechanical systems, etc. Do not lay AV cables on ductwork, piping, plumbing systems or on top of lay-in ceiling tile and lighting fixtures.

- C. Support spacing will not exceed 48". For spans longer than 48", the Contractor shall provide cable tray, channel, ladder, conduit, or other Consultant approved cable support.
- D. A maximum of 17 cables will be supported in a single hanger, no exceptions.
- E. An open ceiling distribution system will not be installed above inaccessible ceiling areas, such as "lock-in" type ceiling tiles, drywall or plaster. Adequate and suitable space will be available in the ceiling area for the distribution system. A minimum of 6" of clear space will be provided on all sides of the distribution system to accommodate installation and servicing.

3.06 LABELING

A. General

- 1. The attachment method for equipment identification plates will be designed for permanency unless otherwise described. All labels will be protected prior to installation and will not be installed if damaged or scratched. Follow manufacturer's recommended procedure for surface preparation, which must be free of any dust, dirt or film. Wiping with a manufacturer-approved solvent is required. If a label is in a place that might be susceptible to damage, it will be protected with a layer of clear plastic, 1/16" or thicker, taped down. Internal labels will be replaced only if they become illegible. External labels will be replaced if they become scratched or marred.
- 2. On black lamicoid panels or pushbuttons, letters will be white; on stainless steel or brushed natural aluminum plates, or light-colored pushbuttons, letters will be black.
- 3. Embossed labels are not acceptable.
- 4. Mount labels in a neat, plumb and permanent manner except where indicated.
- 5. Text heights will be as follows:
 - a. Rack designation labels will have 1" high block sans serif text.
 - b. Equipment labels will be 3/4" high block sans serif text.
 - c. Operator Control labels will be 1/4" high block sans serif text, this may be adjusted to fit available space.
 - d. Panel labels will be 1/8" high block sans serif text.
 - e. Patchbay, Cable and Connector labeling will be 10-point block sans serif text, this may be adjusted to fit available space.

B. Equipment Labels

- 1. Provide engraved lamicoid labels on the front and rear of active equipment mounted in racks. Front mounted equipment labels for the Production Suite video monitor wall monitors are to be mounted with Velcro. Equipment labels to have one line of engraving, giving the schematic reference of the device, and/or its production function, i.e. "VTR #4", "PA-29A".
- 2. Amplifier labels to include the schematic reference of the device as well as the loudspeaker being fed. Provide color coded labels for the different levels and types of speakers.
- 3. Unless equipment manufacturer has clearly labeled functions, provide an engraved label over each user-operated control that describes the function or purpose of the control.
- 4. If the manufacturer provides a protected labeling strip such as those used for switcher control panels and patch bays, then patch/routing point labels may be typed clearly on 80 pound paper stock.

C. Cable Labels

- 1. Cables and wiring to be logically, legibly and permanently labeled for easy identification. Labels on cables to be adhesive strip type covered with clear heat-shrink tubing. Factory

- stamped heat shrink tubing may be used in lieu of the adhesive strip style label. Hand-written or self-laminating type labels are not acceptable.
2. Wiring designations to be an alphanumeric code that is unique for each cable. Locate the cable designation at the start and end of each cable run and within 2 inches of the point of termination or connection. For cable runs that have intermediate splice points, the cable will have the same designation throughout with an additional suffix to indicate each segment of the run. Actual cable designation assignments to be determined by Contractor. Add cable designation codes to system schematic drawings included with Project Record Drawings.
 3. Provide adhesive labels on the rear of equipment where cables attach to indicate the designation of the cable connected at that point.

3.07 ACCEPTANCE

- A. Provide a pre-commissioning system report to the Consultant two weeks prior to the scheduled systems commissioning proving all systems to be in full compliance. Report will include test results, date of each test, pertinent conditions such as control settings, etc., and test equipment employed. In addition, submit written notification that the installation has been completed in accordance with the requirements of the Contract Documents, and is ready for acceptance testing.
- B. Acceptance testing will include operation of each major system and any other components deemed necessary by the Consultant. Contractor will assist in this testing and provide required test equipment. Contractor will provide at least three technicians familiar with installation, available for the entire testing period (day and night), to assist in tests, adjustments, and final modifications. Tools and material required to make any necessary repairs, corrections, or adjustments will be furnished by the Contractor. The Contractor will keep a running list of all acceptance tests performed and submit a final copy of the results with the closeout submittals as listed in Part 1.6. Testing process is estimated to take 3 days up to 10 hours per day and may require multiple crews / shifts.
- C. During all consultant walkthroughs, the project manager will be present.
- D. If during acceptance testing it becomes evident that further adjustment or work may be required to bring the system into compliance, the Contractor will continue to work until the system is acceptable at no additional charge to the contract price. If approval is delayed because of defective equipment, poor installation, or failure of equipment to meet the requirements of these specifications, the Contractor will pay for additional time and expenses of the Consultant at the Consultant's standard rate in effect at that time, during any extension of the acceptance testing period. The Contractor will provide rental or loaner equipment to make the system operational in critical cases of equipment failure prior to contract completion.
- E. Verify the following before beginning actual tests and adjustments on the system:
 1. Electronic devices are properly grounded.
 2. Powered devices have AC power from the proper circuit and hot, neutral, and ground conductors are connected correctly.
 3. Insulation and shrink tubing are present where required.
 4. Dust, debris, solder, splatter, etc. is removed.
 5. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
 6. Clean all control spaces, equipment rooms, production rooms, and equipment racks so they are free from dust, debris, solder, boxes, etc.
 7. Clean air filter for all devices with operable fans (amplifiers, power, supplies, etc.)
- F. Cabling Tests.

1. Submit printed test reports proving the systems to be in full compliance to the consultant as part of the pre-commissioning systems report.
2. After installation, and before termination, all wiring and cabling will be checked and tested with a megohmmeter to ensure there are no grounds, opens, or shorts on any conductor or shields.
3. Verify all audio lines are wired to maintain proper continuity and polarity.
4. Perform TDR measurements on all triax and coax video cables.
5. Perform sweep tests on all triax and coax cables with a spectrum analyzer. When documenting the results of these tests, include the calculated loss based on length of the video cable measured with the TDR. Correct cabling for any field readings that differ more than 20% from the calculated loss.
6. Test all CAT5E and CAT6 cables to verify they meet full specifications. Tests will use a certified tester that will confirm bandwidth, cable distance, and error and bit rate detection.
7. Optical Fiber Cable Testing
 - a. Test all fiber optic cable strands for continuity and performance before and after the cables are pulled and terminated.
 - b. Test link attenuation of all installed multimode fiber optic strands after splicing and termination in accordance with ANSI/TIA/EIA-568-C.1, Section 11.3.
 - 1) One direction with an optical light source and an optical power meter.
 - 2) Test at two wavelengths to account for attenuation differences due to wavelength:
 - 3) 850 nm and 1300 nm for multimode strands.
 - 4) 1310 nm and 1550 nm for singlemode strands.
 - 5) Test multimode strands in accordance with ANSI/EIA/TIA-526-14A, Method B, One Reference Jumper.
 - 6) For multimode strands, wrap reference jumper around mandrel to remove high-order mode transient losses as specified in ANSI/TIA/EIA-568-C.1, Section 11.3.3, Table 11-15.
 - 7) Test Singlemode strands in accordance with ANSI/EIA/TIA-526-7, Method A.1, One Reference Jumper.
 - a) The total attenuation budget for each fiber cable length (end-to-end) will equal the allowed attenuation for the fiber (0.2 dB per km times the length in km) plus the attenuation for each splice and connector. For example, a cable length of 3 km with 1 splice and 2 connectors would have an attenuation budget of $(3 \text{ km} \times 0.2 \text{ dB/km}) + (2 \times 0.2 \text{ dB}) = 1.2 \text{ dB}$.
 - c. Test all installed fiber optic strands after splicing and termination with an OTDR (Optical Time-Domain Reflectometer) per TIA/EIA-455-61:
 - 1) End-to-end bi-directional signature trace with fault finding, connection point reflection, fiber bend, pressure point location, etc.
 - 2) One wavelength, 1300 nm for multimode strands.
 - 3) One wavelength, 1550 nm for singlemode strands.
 - 4) Multimode fiber connector losses $\leq 0.5 \text{ dB}$ at 850 nm
 - 5) Singlemode fiber connector losses $\leq 0.2 \text{ dB}$ at 1310 nm
 - 6) Multimode fiber splice losses $\leq 0.3 \text{ dB}$ at 850 nm
 - 7) Singlemode fiber splice losses $\leq 0.2 \text{ dB}$ at 1310 nm
 - 8) Localized attenuation will not exceed 0.5 dB at any point
 - d. Fibers that are broken or damaged will be replaced at no cost to the owner and replaced fiber optic cables will be re-tested.

- e. Provide test results in both PDF and in the native file format of the OTDR.
8. Loudspeaker System Tests. Perform the following tests and adjustments. Make corrections necessary to bring system(s) into compliance with the specifications.
 - a. Measure and record the impedance of each loudspeaker at the equipment rack with the amplifier disconnected. Measurements will be documented in a table that lists the impedance for each 1/3 octave band over the loudspeakers operating frequency. Measurements will be accurate to within one-tenth of an ohm. As an alternative, contractor may perform, and document full impedance sweeps over each individual device. Sweep to be performed over loudspeakers specified operating range.
 - b. Check polarity of loudspeakers with an electronic polarity checker and by applying music program or constant power per octave (pink noise) signal to system while walking through the transition areas of coverage from one loudspeaker to the next. Transition should be smooth with no apparent shift in source from one speaker to the next.
 - c. Apply sine wave sweep signal to each loudspeaker system, sweeping from 50 Hz to 5k Hz and at a level 10 dB below full amplifier output, and listen for rattles or noise. Correct if apparent.
9. Microphone, line level, and Tie Lines Systems. Confirm the following. Make corrections necessary to bring system(s) into compliance with the specifications.
 - a. Proper circuits appearing at each termination location.
 - b. Continuity of all conductors.
 - c. Proper polarity is maintained.
 - d. Absence of shorts between conductors.
 - e. Absence of shorts between conductors and conduit.
- G. System Tests.
 1. The following procedures will be performed by the Contractor:
 2. Audio fidelity Verification: Driving an input of the audio system with pink noise and measuring the loudspeaker response from 40 Hz to 16k Hz. Digital Signal Processing will be used to adjust the response of the system (s) to fit the requirements of the space.
 3. Video Signal Verification: From all source inputs (for cameras, character generators, video tape units, etc.) through all VDAs, A/D and D/A converters, processors, switchers, etc., to all signal destinations. Verification of correct signal timing for each source via each path will be made using standard test patterns. Each processing device will be checked; the signal will pass through the device in the no processing mode such that unity luminance, chrominance, and signal timing and phasing conditions are achieved.
 - a. Video.
 - 1) Volt (peak to peak) throughout video signal path
 - 2) S/N (peak to RMS), unweighted, DC to 4.2 MHz: 55 dB minimum
 - 3) Crosstalk, unweighted, DC to 4.2 MHz: 45 dB minimum
 - 4) Frequency Response: + 0.5 dB to 4.2 MHz
 - 5) Line and Field Tilt: 2% maximum
 - 6) Differential Gain: 2% maximum
 - 7) Differential Phase: 2 degrees maximum
 - 8) Signal level: within plus or minus 0.5 dB
 - 9) System timing: Sync coincidence within 20 nanoseconds
 - 10) Color timing: Within 1/2 degree at 3.58 MHz
 - b. Digital Video.
 - 1) Verify strength of data signal throughout video signal path.
 - 2) Verify validity of data timing signals.

- 3) Verify receiving device clock recovery
- 4) Report input data errors
- 5) Report transport layer errors
4. Control functions will be checked for proper operation, from controlling devices to controlled devices.
5. Adjust, balance, and align equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for each level control, and record these settings, in the "System Operation and Maintenance Manual".
6. Installed and loose equipment will be inventoried for correct Qty.
7. Any other test on any piece of equipment or system deemed appropriate by Consultant.
8. The omission of a description of a device, function, signal path, or test in this document will not exempt the Contractor from responsibility for checking all devices and signal paths for appropriate compliance with Industry Performance Standards and making corrections necessary to bring system(s) into compliance with the applicable standards.
9. The process of acceptance testing the System may necessitate moving and adjusting loudspeaker aiming. Contractor to adjust loudspeaker aiming within parameters set in Part 2. Contractor to make changes without claim for additional payment, this includes the use of lifts, scaffold, etc. If the construction timeline or architecture interferes with the ability to make changes during acceptance testing, notify consultant in writing prior to loudspeakers becoming inaccessible so that final on-site aiming may be accomplished.

3.08 TEST EQUIPMENT

- A. Provide the following equipment on site for final acceptance testing. Test equipment to be available for the entire period through final system acceptance. Prior to start of testing, provide a list to the Consultant of test equipment make and model numbers that will be used.
 1. Multimeter: Measurement range, DC to 20,000 Hz, 100 mV to 300 V, 10 ma to 10A. Acceptable: Fluke 75.
 2. Sound Level Meter: ANSI S1.4-1971 Type S1A with digital or analog display. Meter to provide ranges of 40 to 120 dBA.
 3. Impedance Meter: Capable of testing audio lines at three frequencies, minimum, between 250 Hz and 4k Hz. Measurement Range: 1 ohm to 100k ohms.
 4. Audio Oscillator: bandwidth 20 Hz to 20k Hz +1 dB at 0 dBm output. Output to be balanced. Oscillator to include adjustable output level.
 5. Polarity checker for mic and line level signals.
 6. Polarity checker for loudspeakers.
 7. (2) full height weighted base mic stands
 8. Time Domain Reflectometer.
 9. Optical Time Domain Reflectometer: Fluke Optifiber, Corning OV1000, or equal.
 10. SDI Generator: Acceptable: Tektronix SDA601
 11. SDI Analyzer: Acceptable: Tektronix TSG601
 12. Digital Field Strength Meter: Acceptable: Blonder Tongue DFSM-10 or Tektronix RFM90
 13. CAT6 cable tester: Acceptable: Microtest Omniscanner 2.
 14. Acterna (Formerly Wavetek) SDA-5000 Sweep System
 15. Digital Field Strength Meter : Acceptable: Blonder Tongue DFSM-10 or Tektronix RFM90

3.09 INSTRUCTION OF OWNER PERSONNEL

- A. Upon completion of the installation of the specified AV systems, and prior to any facility events, provide designated operating personnel training on the equipment operation. This training will be performed at the site by the Contractor's and the manufacturer's education staff.

- B. The as-built documents and product data submittals must be complete and on-site prior to the time of the first instruction.
- C. For all conference or meeting spaces, provide a single page instruction sheet for setting up a basic presentation and web conference (Team, Zoom, etc.).
- D. First Use. Provide trained personnel (one person) to be present at first three events where the specified systems are in use.
- E. Coordinate schedule of instruction with the Owner subject to availability of Owner's personnel. This may require scheduling instruction during weekends or evenings.
 - 1. Training will be provided in a series of classes to operations personnel to review all aspects of operation and maintenance of the system.
 - 2. Follow-up sessions to better enhance the operator's ability to expand or maximize the system will be made available.
- F. The system training will include 5 days or 40 hours of technical training covering the explanation of the system, including documentation, configuration, interfacing and diagnostics. Provide training of the system operators and maintenance personnel as follows:
 - 1. System Overview: Explanation of system includes documentation, configuration, interfacing and basic diagnosis.
 - 2. Operator Training General: Basic training in the use of system devices including powering, timing and general operation of overall system.
 - 3. Operator Training Specific: Advanced training in use of system devices including video on demand and ad insertion equipment.
- G. Where specified, training will be by manufacturer representatives.
 - 1. Manufacturer training and commissioning is specified in this document.
 - 2. The Contractor will cover expenses such as flight, hotel, rental car, and meals and include them as part of the bid pricing.

END OF SECTION

SECTION 274134
ATTACHMENT A

Qty	MFGR	Model Number	Description
Auditorium			
A01 - Infrastructure			
1	Chief Middle	RPMAUS	UNIVERSAL RPMA
1	Atlantic Middle	SRSR-4-16	4 SLIDE SRSR,16 SPACE
2	Atlantic	WL-60	MAGNETIC WORK LIGHT
1	Cisco	CON-SW-C9300XM8	CISCO BASE C9300-48UXM-EDU
1	Aruba	IAP-315-CI	Access Point
A02 - Loudspeaker System			
1	Misc	Part	Rigging for Sub
3	QSC	CX-Q 4K8	8-Channel 500W/CH Q-SYS Network Amplifier
1	QSC	CORE 110f-v2	Unified Core with 24 local audio I/O channels, 128x128 total network I/O channels with 8x8 Software-based Dante license included, USB AV bridging, dual LAN ports, POTS and VoIP telephony, no GPIO, 16 next-generation AEC processors, 1RU.
2	QSC	TSC-70-G3	Q-SYS 7-inch• PoE Touch Screen Controller for In-Wall Mounting. Color - Black only
1	QSC	QIO-GP8x8	Q-SYS peripheral providing control expansion with 8 logic inputs and 8 logic outputs. Up to 4 devices daisy-chainable. 1U-1/4W, powered over Ethernet or +24 VDC. Surface mountable, rack kit sold separately.
1	QSC	QIO-S4	Q-SYS peripheral providing control expansion with 4 serial communication I/O. Up to 4 devices daisy-chainable. 1U-1/4W, powered over Ethernet or +24 VDC. Surface mountable, rack kit sold separately.
6	JBL Professional	CONTROL 47HC	PREMIUM HIGH-CEILING COAX w/ 6.5"
1	QSC	SLDAN-32-P	Q-SYS Software-based Dante 32x32 Channel License, Perpetual
1	QSC	SLQUD-110-P	Q-SYS Core 110 UCI Deployment Software License, Perpetual.
1	QSC	SLQSE-110-P	Q-SYS Scripting Engine License
2	Fulcrum Acoustic	Sub215L	Dual 15 inch Direct-Radiating Subwoofer
6	Fulcrum Acoustic	GX1595	15 inch Coaxial Loudspeaker 90° x 45°
6	Fulcrum Acoustic	YK-GX15	GX15 Series Yoke Bracket
4	Fulcrum Acoustic	RX599	5.25 inch Coaxial Loudspeaker
1	Electro-Voice	EVID-S8.2TB	Quick install Speaker 8-inch• cabinet 70/100V black. IP54. Sold only in pairs.

1	Denon Professional	DN-500CB	CD/USB/1/8" Aux/Bluetooth/Balanced/RS232/Pitch Control Audio Player
1	Denon Professional	DN300RMKII XU S	SOLID-STATE SD/USB AUDIO RECORDER
9	Audix	M1255B	MIC, COND, MICRO, 12MM CARD, HIGH OUTPUT
2	AKG	C451 B	Studio Condenser Microphone
A03 - FOH Equipment			
1	HSA Rolltop	INSEXT-II	Inspire Extended Rolltop Desk. Include PLUS4 and INSRKWIDE for additional height and width. Reference drawing #23078 when contacting the manufacturer.
1	Yamaha Commercial Audio	DM7	28 Motorized faders (12 x 12 x 4); 120 mixable channels; 2 x 12" high-res + 1 high-res 7" multi-touch screens; 48 mono mixes + 12 matrixes + 2 ST bus + 2 cue; 32 x 16 analog I/O; 2 x AES digital I/O; 64 x 64
A04 - Wireless Mics			
2	Shure	UA864US	Wall-Mounted Wideband Antenna
1	RF Venue	DISTRO9HDR	DISTRO9 HDR Nine (9) Channel Multi-Zone Antenna Distribution System
A05 - Monitor System			
4	Community Professional Loudspeakers	MX10-B	Monitor 2-Way 10-Inch Coax Black
2	Whirlwind	SK510G12	Cable - Speaker, NL4 Speakon to NL4 Speakon, 10', 12 AWG, wired 1+ / 1-
6	JBL Professional	PRX412M	12" Two-Way Stage Monitor
6	Whirlwind	NL4-050	Cable - Speaker, NL4 Speakon to NL4 Speakon, 50', 12 AWG, 4 conductor
A06 - Assistive Listening			
32	Williams AV	BAT 026-2	Two (2) 1.2-volt AA rechargeable NiMH batteries.
1	Williams AV	FM T55	FM Plus - Large-area Dual FM and Wi-Fi base transmitter with network control, OLED display, DSP audio processing, analog XLR input and line output. Includes: (1) ANT 025 antenna, (1) TFP 048 power supply, (1) WCA 013 audio cable, (1) WLC 004 line cord. FM operates in the 72-76 MHz band. Replaces PPA T45 / PPA T45 NET
1	Williams AV	RPK 005	Rack panel kit. For one transmitter or modulator in one IEC rack space.
32	Williams AV	FM R38	Multi-channel FM receiver with OLED display. (1) EAR 022 surround earphone, and (1) BAT 001-2 AA alkaline battery.
32	Williams AV	HED 024	Stereo folding headphones. Stereo 3.5 mm plug
8	Williams AV	NKL 001-S	Neckloop. 18" cord. 3.5mm stereo plug. For use only with WaveCAST receiver (WF R1).
1	Williams AV	CHG 3512 PRO	Multi-bay, drop-in charger with case for 12 FM or infrared body-pack transmitters and/or receivers. Power Supply Included.
1	Williams AV	IDP 008	ADA wall plaque.

1	Williams AV	ANT 024	Dipole wall-mount antenna with F-connector for use with large-area FM transmitters. 75 Ohm.
A07 - Loose Inventory			
	Middle		
1	Atlantic	UPS-S2200R	UPS STD 2200VA
	Middle		
1	Atlantic	PD-915RC-20	PD-915R W/20' POWER CORD
	Middle		
1	Atlantic	D3LK	3SP ANOD DRAWER W/LOCK
	Middle		
10	Atlantic	BL1	1SP FLANGED ALUM ANOD BLA
	Middle		
2	Atlantic	BR1	1SP PANEL W/BRUSH GROMMET
	Middle		
1	Atlantic	U1V	1SP VENTED UTILITY SHELF
	Middle		
3	Atlantic	VT1	1SP PERFORATED VENT PANEL
	Middle		
1	SKB	1SKB-R3U	3U Roto Molded Rack
	Middle		
4	Shure	SM58-CN BTS	SM58 + CABLE + STAND BUNDLE
AV02 - Video			
	Miscellaneous		
1	us	Part	Draper 101782
1	Epson	V12H004L08	EPSON ELPLL08 Long Throw Lens
2	Visionary Solutions	DuetE5-WP-BT-BLACK	A/V Encoder (Wall Plate), 4K60 4:4:4 UHD over IP cinema quality ultra-low latency visually lossless switch matrix routable, with built-in video wall functionality; POE; AES67/Dante, with Bluetooth Audio
2	Visionary Solutions	DuetE5-WP-BLACK	A/V Encoder (Wall Plate), 4K60 4:4:4 UHD over IP cinema quality ultra-low latency visually lossless switch matrix routable, with built-in video wall functionality; POE; AES67/Dante
1	Lumens	VC-A61PNB	(TAA) NDI, 30x Optical Zoom 4K, IP PTZ Video Camera; Black Color
2	Samsung	QM55C	55-inch Commercial 4K UHD Display, 500 NIT
1	Samsung	QM65C	65-inch Commercial 4K UHD Display, 500 NIT
2	Visionary Solutions	D5100	A/V Decoder, 4K60 4:4:4 UHD over IP cinema quality ultra-low latency visually lossless switch matrix routable, with built-in video wall functionality; POE
1	Visionary Solutions	DuetE-5	4K60 4:4:4 UHD over IP Ultra-Low latency , with built-in video wall functionality, Expansion Ethernet Port; POE+; Single Port AES67/Dante
1	Marshall Electronics	CV568	Miniature Global Camera (4.4mm) with Genlock
1	Epson	V11HA67820	EPSON High Brightness EB-PU2216B Projector, 16,000 Lumens, WUXGA, Black
1	Visionary Solutions	E5200	A/V Encoder, 4K60 4:4:4 UHD over IP cinema quality ultra-low latency visually lossless switch matrix routable, with built-in video wall functionality, Expansion Ethernet Port; POE+; Upgradeable to AES67/Dante

2	Visionary Solutions	DuetD-5	A/V Decoder, 4K60 4:4:4 UHD over IP cinema quality ultra-low latency visually lossless switch matrix routable, with built-in video wall functionality; Expansion Ethernet Port; POE+; Single Port AES67/Dante
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Blackbox

A01 - Infrastructure

4	Global Truss	QUICK RIG CLAMP BLK	BLK LOW PROFILE QR HOOK CLAMP DT5005B
1	Middle Atlantic	DWR-35-26	35SP/26D WALLRACK BLACK
1	Middle Atlantic	DWRSR-ZL	DWR/SR ZERO CLEAR LATCH
1	Middle Atlantic	UPS-2200R	2200VA/1650W UPS
1	Middle Atlantic	DWR-FK6-32	6" FAN32"D DWR FAN KIT
1	Middle Atlantic	WL-60	MAGNETIC WORK LIGHT
1	Middle Atlantic	DWR-18-26	18SP/26D WALLRACK BLACK
1	Middle Atlantic	FD-18	18SP SOLID FRONTDR, UNIV.
1	Bittree	B64T-2MWNHD	2 rows of 32 patch points, 2 RU, fully normalled, non-terminating, 3G SDI
3	Belden	Data Patchbay - 24 Port	24 port data patchbay with modular connectors per specfications
1	Bittree	B96DC-FNSST/E3 M2OU12B	2 RU, 2x48, Full Normal, Switched Grounds (Sleeve Normalling), E3 Rear Interface, 12" Deep Chassis
4	Custom	Medium Wall Panel	Custom Wall Panel mounted to pipe boxes with audio, video, & data connectors and cabling to local AV Equipment Rack
1	Cisco	CON-SW-C9300XM8	CISCO BASE C9300-48UXM-EDU
1	Aruba	IAP-315-CI	Access Point
1	Grundorf	T8-TLR1224	Tour 8 Series - Top-Load Rack - 12 Space Top Slant - 12 Space Bottom
1	Grundorf	TLR8-24-LC2B	Large Caster (4") Two Brakes Dolly Plate
1	Grundorf	TLR8-24-QL	Yamaha QL1 Mixer Top-Load Modification
1	Grundorf	T8-AR1616	Tour 8 Series - Amp Rack - 16 Space - 15.56" Rackable Depth
1	Grundorf	AR8-16-LC2B	Large Caster (4") Two Brakes Dolly Plate

A02 - Loudspeaker System

1	Radial Engineering	USB-Pro	Digital USB DI for laptops, 24/96 with heapdhone amp & isolated outs
1	QSC	CORE 8 FLEX	Unified Core with 8 local audio I/O channels, 64x64 network I/O channels with 8x8 Software-based Dante license included, USB AV bridging, dual LAN ports, VoIP telephony, 8x8 GPIO, 8 AEC processors, Half-size 1RU.

1	QSC	SLQSE-8N-P	Q-SYS Core 8 Flex, Core Nano, NV-32-H (Core Capable). Scripting Engine Software License, Perpetual.
1	QSC	SLQUD-8N-P	Q-SYS Core 8 Flex, Core Nano, NV-32-H (Core Capable). UCI Deployment Software License, Perpetual.
1	Attero Tech	unD6IO-BT	4x2 Channel 2 Gang US, Dante/AES67 Wall Plate w/Bluetooth, RCA, 3.5mm I/O, PoE (white and black faceplates included)
1	QSC	CX-Q 2K4	4-Channel 500W/CH Q-SYS Network Amplifier
4	Fulcrum Acoustic	CCX896	8 inch Coaxial Loudspeaker
4	Fulcrum Acoustic	YK-CX8	CX8 Series Yoke Bracket
1	Denon Professional	DN-500CB	CD/USB/1/8" Aux/Bluetooth/Balanced/RS232/Pitch Control Audio Player
1	Denon Professional	DN300RMKII XU S	SOLID-STATE SD/USB AUDIO RECORDER

A03 - FOH Equipment

1	BenQ	PD2700U	Professional, GREY, 27", IPS, 3840x2160, HDMI/DP/mDP, HD R, Edge to Edge Display,, KVM, Daisy Chain DP Out(MST), Brightness Intelligence, DualView, DarkRoom, Height Adjustable, CAD/CAM Mode, Animation Mode, ZeroFlicker, Low Blue Light
1	Apple	Mac mini	Owner Furnished Mac Mini or Equivalent. Provide all pertinent software to interface with the system: Dante Controller, Wireless Workbench, Q-SYS Designer, SQ Director, Vision Lite, Mosaic, CCM for HelixNet. Q-Lab licence.
1	Logitech	Craft Keyboard and Mouse	Owner Furnished Logitech Wireless Keyboard & Mouse or Equivalent.
1	ProX Direct	T- 16MRSS13ULT	Universal 19" rackmount mixer 13U Top / 16U Front (3 removable doors) 2 long doors could be use as side tables
1	Yamaha Commercial Audio	DM7C	16 Motorized faders (12 x 4); 72 mixable channels; high-res multi-touch 12" + 1 x high-res 7" screens; 48 mono mixes + 12 matrixes + 2 ST bus + 2 cue; 16 x 16 analog I/O; 1 AES digital out; 64 x 64 PY slot I/O; built-in Dante I/O (144 x 144); 18x18 USB-C audio interface; ships with one free license for the following software applications: VST Rack Elements and Nuendo Live.

A04 - Wireless Mics

1	Shure	ULXD4Q--G50	Quad Digital Wireless Receiver with internal power supply, 1/2 Wave Antenna and Rack Mounting Hardware
2	Shure	UA860SWB	1/2 Wave Omni Antenna, 2' BNC/BNC Cable, 25' BNC/BNC Cable, WA371 Mounting Clip (470-1100 MHz)
2	Shure	ULXD2/SM86-- G50	Handheld Transmitter with SM86 Microphone
2	Shure	ULXD1--G50	Digital Wireless Bodypack Transmitter with Miniature 4-Pin Connector
2	Point Source Audio	CR-8D-XSH-BL	SERIES8 CARDIOID Headset Microphone for Shure. Color: Black
2	Shure	WL184	Microflex Supercardioid Lavalier Microphone

4	Shure	SB900B	RECHARGEABLE BATTERY
2	Shure	SBC200-US	Dual Docking Charger with PS45US Power Supply

A06 - Assistive Listening

1	Williams AV	FM T55	FM Plus - Large-area Dual FM and Wi-Fi base transmitter with network control, OLED display, DSP audio processing, analog XLR input and line output. Includes: (1) ANT 025 antenna, (1) TFP 048 power supply, (1) WCA 013 audio cable, (1) WLC 004 line cord. FM operates in the 72-76 MHz band. Replaces PPA T45 / PPA T45 NET
1	Williams AV	ANT 024	Dipole wall-mount antenna with F-connector for use with large-area FM transmitters. 75 Ohm.

A07 - Loose Inventory

4	Renkus-Heinz	CA121-RD	Powered, RHAON & Dante Redundant, SA1250-RD Amp Module
1	QSC	TSC-710t-G3	Table top mounting accessory for TSC-70W-G3 and TSC-101W-G3.
1	Middle Atlantic	PD-915RC-20	PD-915R W/20' POWER CORD

AV03 - Control

2	QSC	TSC-70-G3	Q-SYS 7-inch PoE Touch Screen Controller for In-Wall Mounting. Color - Black only
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Intercom

A09 - Intercom

8	Clear-Com	KB-701	Single-Channel flush-mount PTT speaker station: Encore single-channel half-duplex flush-mount push-to-talk speaker/microphone station. Mounts in a four-gang box, console, or accessory enclosure 21.6cm/8.25" x 11.4cm/4.5".
1	Clear-Com	FSII-BASE-II	FS II Digital wireless base station: FreeSpeak II Digital license-free wireless base station. Supports up to 25 Beltpacks and 10 antennas. (Two antennas can connect to the base station directly or up to 10 antennas can be connected by using two x FSII-SPL splitters) The base station has connections for four party-lines and four 4-wires plus a dedicated SA output and dedicated program audio input. XLR-4 pin male headset connection. To use the fiber connections to the FSII-SPL Splitter please choose suitable SFP transceivers from either HLI-MMFO or HLI-SMFO. Please note: SFP modules can vary in electrical capabilities despite being mechanically compatible. Clear-Com can only support Clear-Com supplied SFP transceivers which have been tested with Clear-Com products.
4	Clear-Com	FSII-BP24-X4	FreeSpeak II Beltpack: 2.4GHz
4	Clear-Com	CC-28-X4	Headset: Single ear, Light weight, XLR (F) 4 Pin
1	Clear-Com	FSII-TCVR-24	FreeSpeak II Transceiver: 2.4GHz

6	Clear-Com	HXII-BP-X4	HelixNet digital 2 Ch. dual listen monaural beltpack: HelixNet digital and IP two-channel dual listen monaural beltpack with a high-contrast OLED display and four-pin male headset connector. It has a three-pin female XLR for Digital PL and an RJ-45 EtherCON PoE intercom line connector.
6	Clear-Com	CC-110-X4	LW Single-ear standard HS XLR-4F: Premium lightweight single on ear headset with superior audio quality and on/ off switch in gooseneck microphone boom, includes leatherette (fitted) and foam (option) ear pads and headset bag - field removable four-pin female XLR for standard Clear-Com connection.
1	Clear-Com	HMS-24-UG	HelixNet Main Station Upgrade: 24Ch
1	Clear-Com	HLI-ET2	HelixNet Ethernet module: Ethernet interface module. Dual channel Ethernet for LAN connectivity. With the Ethernet Module, Main Stations share partyline channels and program audio and make them available to any station and beltpack on the linked system. This module is required for LAN connected remote stations, wall stations, PoE beltpacks and LQ for port expansion and extended capabilities. Up to 64 IP enabled devices can be connected to the Main Station over the LAN. HLI-ET2 Modules can be mixed with Fiber Modules in the same network.
1	Clear-Com	MS-702	2 Ch. headset/speaker main station: Encore two-channel headset/speaker main station. Built-in 1-amp (2-amp peak) power supply, 1RU rack mount. Three XLR-3 Male connectors for each partyline A and B, one XLR-3 female for Program Audio in and one XLR-3 Male for Stage Announce out on the rear panel. Jack for hot mic out.
1	Clear-Com	PS-702	Encore Power Supply: 2Ch, 1.2 Amp, 1RU with Program Audio

Paging

A02 - Loudspeaker System

1	Telex	NC450D	Dynamic, Normally open, Low Z, handheld paging mic
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A09 - Intercom

10	AtlasIED	AT35D	Deluxe Decora Plate Mounted 35W Attenuator, 3dB Steps
11	Sonance	45131	PS-C63RT WHITE

END OF ATTACHMENT

SECTION 27 50 00
SCHOOL COMMUNICATION SYSTEM

PART 1 - GENERAL

1.1 RELATED WORK

The following, in their entirety and as applicable, shall apply to this section. Including any associated drawings.

- A. Conditions of the Contract
- B. Division 1
- C. Division 26
- D. Division 27
- E. Division 28

1.2 SUMMARY

- A. This section includes a fully operational IP platform for a district-wide internal and school Critical Communications Solution, incorporating school safety notifications and general communications including but not limited to the following:
 - 1. The platform shall provide complete internal communications and employ state of the art IP Technology including the minimum functions listed.
 - a. Two-way internal intercommunications between staff locations and classrooms.
 - b. Scheduled bell events.
 - c. Integration of campus Lockdown buttons.
 - c. Emergency announcements that will override any pre-programmed audio, assuring that all Emergency/Lockdown etc., are heard at each and every speaker location.
 - d. Capability of prerecording emergency announcements that can be activated by a Soft Key on an administrative console, panic button, dial string, or web browser.
 - e. Atomic Time Synchronization with Class Change Tones utilizing multiple, programmable schedules for each zone.
 - f. District-wide, Emergency, Group, All School and Zone live voice paging.
 - g. District-wide, Emergency, Group, All School and Zone paging for pre-recorded audio – tones, music, and voice.
 - h. Web-based user interface.
 - 2. The system shall support a minimum of 1000 level priorities which shall be user-definable, allowing each end point to place a minimum of 5 different priority calls at the same time.
 - 3. Any authorized administrator shall be able to call from outside the school into any classroom, zone, or entire school directly via the School District supplied SIP enabled Telephone Network. This shall allow remote monitoring, call-in annunciation, and two-way conversation from outside the facility as well as paging into the system. (Compliance with NEMA Standard SB-40 for emergency communications in K-12 Schools).
 - 4. Authorized system users shall be able to create a minimum of 100 automated sequences with voice instructions, tones, emails, program distribution, and relay activations and replay them.
 - 5. Automated message strings shall be manually initiated from a single-button access on the console, on a SIP connected telephone, a panic button, from the

6. web-based user interface or via interface with third party systems. Paging and two-way intercom features shall be accessible from any system console or SIP connected telephone for each campus.
 7. The platform shall synchronize its system time to the network timeserver or a web-based time server.
 8. Each single campus installation shall be locally survivable for intercom, paging, bells, and emergencies such as lockdown, even when the district connection is unavailable.
 9. This specification establishes a minimum level of quality, features, and performance for individual components as well as the integrated system.
 10. Systems that do not comply with the feature-sets highlighted in this Specification will not be considered.
 11. Network switches shall be provided by owner. Contractor to provide written statement to A/E, GC, and owner within 90-days of contract date with switch requirements.
- B. Locate equipment to accommodate millwork, fixtures, marker boards and other room equipment at no additional cost to the Owner.
 - C. Integrate the communications system with the following systems:
 1. Clock and Bell System
 2. Local sound reinforcement sound systems
 - D. Return air plenum cable shall be used. Wherever cabling is run exposed, conduit shall be used to cover and protect wiring.
 - E. The drawings and specifications are to be considered conceptual in nature and are intended to establish system standards insofar as manufacturer type and system configuration. The contractor shall provide pricing of a complete engineered system based on the issued conceptual documentation. The engineered system is to be submitted to the project's consultant for review prior to installation.
 - F. If there are any discrepancies between the drawings and specification or among themselves, the contractor shall request clarification prior to providing pricing for the scope of work. If a request is not issued and a response not provided via a posted addendum, the contractor shall provide pricing for the costliest scenario and obtain clarification during the project.
 - G. Contractor shall remove existing Telecenter 5 controller and expand existing Telecenter U controller with gateways as necessary to connect existing devices and expand into renovated and addition areas. Provide and install new administrative consoles.

1.3 DEFINITION OF TERMS

- A. Installer(s): Shall refer to the person, persons, or company who or which actually contracts to perform the work specified herein.

1.4 SUBMITTALS

- A. Product data for each component.
- B. Shop Drawings: Prior to proceeding with the work: Provide detailed equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, location of each field connection, and a complete schedule of all equipment and materials with associated manufacturer's cuts sheets which are to be used.
 1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring. Identify terminals to facilitate installation, operation, and maintenance. Include a single-line diagram showing cabling interconnection of components and levels throughout system and impedances.

2. Artwork drawings and lists indicating proposed nameplate nomenclature and arrangements for control panels and plug panels prior to fabrication reflecting equipment used.
 3. Each drawing shall have a descriptive title and all sub-parts of each drawing shall be labeled. All drawings shall have the name and locations of the project, Systems Contractor's name in the title block.
 4. Details and descriptions of any other aspect of the system, which must differ from the contract documents due to field conditions or equipment, furnished.
- C. FCC Approval: The system shall be approved for direct interconnection to the telephone utility under Part 68 of FCC rules and regulations. Systems, which are not FCC approved or utilize an intermediary device for connection, will not be considered. Provide the FCC registration number of the system being proposed as part of the submittal process.
- D. Product Certificates: Signed by manufacturers certifying that products furnished comply with specified requirements.
- E. Installer Certificates: Signed by manufacturers certifying that Installers comply with specified requirements.
- F. Manufacturer Certificates: Signed by manufacturers certifying that they comply with specified requirements.
- G. Field Test Reports: Indicate and interpret test results for compliance with performance requirements. Include record of final matching transformer-tap settings, and signal ground-resistance measurement certified by Installer.
- H. Maintenance Data: For equipment to be included in maintenance manuals specified in Division 1.
1. Record of Owners equipment-programming option decisions.
 2. All instructions necessary for proper operation and manufacturer's instructions.
 3. "Proof of Performance" information.
 4. Manufacturer's maintenance information.
 5. Copies of non-proprietary computer programs and system set up disks documenting all programmable features of the installed system.
- I. Record Drawings: Prior to final acceptance, provide three (3) complete sets of drawings indicating all cable numbers and construction details in accordance with the actual system installation. Revise all shop drawings to represent actual installation conditions. These Record Drawings will be used during "Final Acceptance Testing".
- J. System Training: Submit the following information describing the training programs and system trainers as outlined in paragraph 1.6 of this specification and in accordance with Division 1 specifications.
1. Include with the submittal a preliminary staff development training program in outline form for review and approval by the owner's representative.
 2. Include with the submittal a current copy of the trainer's certification from the manufacturer that certifies and identifies the trainer(s) who are eligible to provide training and support for the project.
 3. Include with the submittal a current copy of trainer's needs assessment form which will be reviewed with the owner's designated representative for the system's preliminary system programming and configuration.
 4. Include with the submittal copies of all documentation used to identify for the owner those participants attending and completing the training programs.
- K. A copy of the manufacturer's standard statement of warranty proving all equipment provided for the school communications network is covered with the required five-year warranty shall be included with the project submittal. This statement of warranty shall be provided on the manufacturer's stationary.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced Installer who is an authorized representative of equipment manufacturer for both installation and maintenance of equipment required for this Section. Provide the following within thirty (30) days after notification to proceed:
 - 1. Provide a list of installations that the Installer has specifically installed for verification by the Owner. Random installations from other vendors and/or Installers shall not be accepted. The Installer, not its employees, must meet these qualifications.
 - 2. The Installer shall be bondable.
 - 3. The Installer shall demonstrate to the satisfaction of the Owner or his representative that he has:
 - a. Adequate plant and equipment to pursue the work properly and expeditiously.
 - b. Adequate staff and technical experience to implement the work.
 - c. Suitable financial status to meet the obligations of the work.
 - d. Technically capable and factory trained service personnel at a local service facility to provide routine and emergency service for all products used in this project.
- B. Because the life expectancy of this type of communications structure normally exceeds 10 years, the owner expects continuity from the service provider. If the installing/servicing company has not been an authorized provider of the manufacturer's product for it least seven (7) years, the following is required:
 - 1. A list of two (2) systems manufacturers of which they currently are authorized service providers where the relationship exceeds seven (7) years.
 - 2. A letter from the manufacturer outlining the details of changes in service providers over the last seven (7) years and what actions they will take to ensure continuity of service to the customer.
- C. Each major component of equipment shall have the manufacturers name, address and model number on a plate securely affixed in a conspicuous place. NEMA code ratings, UL Label, or other data that is die-stamped into the surface of the equipment shall be easily visible.
- D. Equipment and installation shall be provided by one communications contractor.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- F. Comply with NFPA 70
- G. Comply with NEMA Standard SB-40 for Emergency Communications in K-12 schools.
- H. Comply with UL 60950.

1.6 SUBMITTALS

- A. Project Initiation:
 - 1. Within fourteen (14) days of Notice to Proceed, the projection system installer shall furnish the following in a single consolidated submittal:
 - a. Product Literature: Complete manufacturer's product literature for all, speakers, amplifiers, cable, cross-connect blocks, 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/Designer) and the manufacturer's supporting documentation demonstrating compatibility with other related products shall be included.
 - b. Construction Schedule: A time-scaled Construction Schedule indicating

- general project deadlines and specific dates relating to the installation of the cable distribution system.
- c. The contractor shall provide a letter from the manufacturer stating that the dealer is an authorized service center.
 - d. The resume and contact information of the full-time service personnel responsible for the installed projection system.
 - e. Specification Compliance: A letter shall be provided stating, by section and subsection, that the 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.
 - f. Certifications: The contractor shall submit all of the following certifications, and the certifications must contain dates which are valid from the date of proposal and not expire any sooner than 12 months after substantial completion of the project.
 - 1) State Licenses as applicable to this system
 - 2) Manufacturer's Authorized Dealer Certification
 - 3) Manufacture Installer Training Certificate (required for at least 25% of all installers on site.)
 - g. Provide specification with line-by-line acknowledgement of compliance.
- B. Shop Drawings:
- 1. Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed:
 - a. Proposed wiring and connectivity diagram of the proposed projection system including all faceplates and sound reinforcing equipment
 - b. In addition to the wiring/connectivity diagram, the submitted drawings shall indicate the following, even if the following is expected to be provided by the project's electrical or general contractor:
 - 1) Location of wall penetrations (all penetrations shall be sleeved and contain protective bushings at both ends)
 - 2) Location of sleeved wall pass-thru
 - 3) Size of sleeve at each location installed
 - 4) Quantity of cable passing through each sleeve
 - 5) Location of drops in each room (quantity or labeling of drops are not required in the submittal plans. Labeling shall be provided in the closeout plans and quantities shall be as per the contract documents, addendums, and issued changes. Each drop shall be labeled for the type of outlet that it is)
 - 6) Conduit routing, size, quantity, and stub-up locations for all floor mounted outlets.
 - c. Drawing Compliance: A letter shall be provided stating that the installer complies with the ENTIRE project drawing, including all general, keyed, and notes to contractor. 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.

1.7 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 the staff and faculty members who attended, received, and completed the training program.

1.8 WARRANTY

- A. Provide a manufacturer's five-year warranty of the school communications network equipment against defects in material and workmanship. This warranty will cover all electronic system components. Additional warranties cover clocks, speakers, and call-in switches. If any defects are found within the warranty period, the defective equipment shall be replaced at no cost (equipment only); a one-year warranty shall be provided for labor.
- B. A copy of the manufacturer's standard statement of warranty proving all equipment provided for the school communications network is covered with the required five-year warranty shall be included with the project submittal. This statement of warranty shall be provided on the manufacturer's stationary. The standard five-year warranty is an important element in establishing a standard in quality. Manufacturers who circumvent the five-year warranty by offering special "extended warranties" that are not part of their normal published warranty will not be accepted.
- C. Contractor shall respond, excluding weekends and holidays, within 24 hours to any warranty service calls. If equipment cannot be repaired within 24 hours of service visit, the contractor shall provide "loaner" equipment to the facility at no charge.
- D. Make available a service contract offering continuing factory authorized service of the system after the initial warranty period.

1.9 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide the following system:
 - 1. Telecenter U as manufactured by Rauland and installed by a Rauland authorized dealer

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

- A. The New Campus Communications System will connect to the Existing District Server for District Wide announcements and all Management Functions. Server Currently Runs the Rauland Telecenter Campus Enterprise Software.
- B. The platform shall utilize state of the art IP Technology for Call-in Notification, School Safety Paging and Evacuation tones, Atomic Time Synchronization, Class Change Tones utilizing multiple, programmable schedules for each zone, Two-way hands-free Internal Communications and Paging, and Program Distribution. The system shall be easy to learn and operate. All standard programming shall be web-based and user friendly to allow the system administrator the ability to easily program system features.
- C. Provide complete and satisfactorily operating district/school communications and district/school safety as described herein, using materials and equipment of types, sizes, ratings, and performances as indicated. Use materials and equipment that comply with referenced standards and manufacturers' standard design and construction, in accordance

- with published product information. Coordinate the features of all materials and equipment so they form an integrated system, with components and interconnections matched for optimum performance of specified functions.
- D. The platform shall be a single electronic system consisting of a minimum of 10 audio channels for each campus, (classroom) IP Speaker Modules and call switches, IP Zone Modules connecting corridor speakers, inside and outside horns, IP Administrative Consoles, SIP enabled PBX integration and district-wide integration for paging, emergency notifications, calendar scheduling and configuration.
 - E. Each Classroom shall be provided with a Speaker Module interface and a minimum of 5 different call switches, each with their own annunciation path and priority.
 - F. Call-ins may automatically annunciate (display of priority and location) to administrative consoles, SIP enabled phones, and outside phones.
 - G. Call-ins shall be programmed to automatically change priority and annunciation route based on age of call-in and original priority.
 - H. Call-ins may have priority (and annunciation route) changed by user action from a console or SIP enabled phone.
 - I. Call-in annunciation route shall include playing pre-recorded audio over speakers, sending a pre-configured email, and activating relays.
 - J. The platform shall lend itself to expansion by simple addition of hardware modules.
 - K. The platform shall connect directly to an existing, standard protocol WAN/LAN network, without the need for a separate server at each school location. Configuration, including bell schedules, calendars, and emergency sequences can be remotely created, changed, stored, and downloaded to the system by an authorized user from a web-based user interface.
 - L. The platform shall provide the ability to initiate school safety paging announcements, evacuation tones and take cover tones from any telephone or connected web browser within the facility or outside the facility to any other location within the facility or district.
 - M. The platform shall provide the ability to selectively communicate or monitor individual classrooms in emergency situations from any telephone within the facility or outside the facility to any other location within the facility; all communication within the classroom shall be hands-free and will not require any interaction by the classroom user.
 - N. The platform shall provide classroom users the ability to confirm that they have safely secured their classrooms during an emergency with a single button press. The front office administrator will receive confirmation that the classroom is safely secured via an administrative console and web-based user interface. The front office administrator can view classrooms that are not safely secured via the administrative console. The front office administrator can view classrooms that are not safely secured via the web-based user interface. The front office administrator shall be able to initiate two-way communication, without a pre-announcement tone, to the classroom during an emergency via the administrative console. Web-based user interface will still identify that a school is in an emergency, even if all classrooms are safely secured. Individual classroom check-in and school emergency status shall be viewed from the web-based user interface, both on-site and remotely.
 - O. IP Addressable and POE powered Speaker Modules for individual rooms shall be system programmable and may be assigned any two, three, four, five- or six-digit number as well as name and description. Any extension may be reassigned at any time.
 - P. IP-enabled two-way voice communication shall be available from any provided telephone or administrative console through any speaker in a campus. This shall allow hands-free communication to any classroom or any individual loudspeaker unit. A programmable pre-announce tone shall sound immediately before the intercom path is opened and a

supervisory tone shall continue to sound at regular intervals when speaker monitoring is active, complying fully with all privacy legislation. Preannounce tone and supervisory tones shall be disabled during designated emergencies automatically.

- Q. The platform shall allow users to configure multiple schedules per school, with a minimum of 500 unique events per schedule, and automatic Daylight Savings time correction. Schedules can be programmed to occur once, daily, weekly, monthly, or in any combination of the preceding recurrences. Each school may have a minimum of 20 unique bell schedules, with a minimum of 5 active schedules on any given day for each campus. User shall be able to select from 25 standard included tones as well additional user created and uploaded audio files for class change signaling and messaging. In addition, scheduled events shall include relay actions, email notifications, and paging exclusions as system configuration changes. The platform shall allow control of the bell schedules via the district WAN/LAN without the need for a separate server at each school location. Bell schedules can be remotely created, changed, stored, and assigned to calendar days for the local school by an authorized user from a web-based user interface.
- R. The platform shall be able to integrate with an existing PA system or operate as a fully independent IP solution. The platform shall be able to function in combination of said configurations and allow for seamless communication within a school or district-wide, regardless of the type of configuration used. The platform shall be scalable, with the ability to easily add, install, and configure additional equipment to a system.
- S. The platform allows for customization of preprogrammed sequences, used for emergencies, events, and everyday communications. Preprogrammed sequences can be activated from the push of a relay button, soft key of an administrative console, a dial string of a SIP phone, or a web browser configured to the district network. Sequences can be initiated automatically as part of a schedule or on the fly. Preprogrammed sequences can be customized to utilize any combination of audio tones, emails, relays, tone exclusions, swings, delays, duples, SIP phone notifications, and program distribution. Audio tones can include customized audio files and voice messages, recorded in any language. Uploaded audio tones and messages can be preprogrammed to announce repeatedly or individually, as part of a scheduled sequence or on the fly. Each school in a district can have its own customized sequences, and can be activated individually, in groups, or districtwide.
- T. Reference attachment 'A' for more information.

2.2 EQUIPMENT AND MATERIAL

- A. Server Software
 1. Provides district-wide paging, bell event scheduling, emergency notification and configuration for entire district.
 2. Ability to configure system and initiate system features, per school and district-wide via web-based user interface.
 3. The software has the ability to sync system time to the Atomic Clock Signal or to the school's or district's network time server.
 4. The software will provide a web browser to deliver district-wide emergency paging, pre-recorded messages, and tones from any authorized computer in the facility or the district. The software must be capable of automatically notifying district personnel via the WAN/LAN of an alarm condition.
 5. The software can automatically broadcast emergency instructions via associated system hardware throughout an entire district when an alarm (e.g., lockdown, lockout, security, fire) is initiated via the web-based user interface. The emergency instructions are preprogrammed and require no user intervention. Bell

- tones can be halted during an emergency. The system provides redundant alarm annunciation over intercom/paging speakers and is not meant to replace primary fire alarm or security systems.
6. The software allows for user-uploaded pre-recorded messages and tones. Software supports the upload of MP3 and WAV file types. User-uploaded pre-recorded messages and tones can be part of emergencies, sequences, and bell schedules.
 7. The software can be installed in cloud, virtual or physical server environments.
 8. The web-based user interface supports secure HTTP browsing.
 9. The software supports encryption to ensure secure access.
 10. The system shall monitor itself if devices go offline and system actions are not received. Specified users shall receive email notifications when devices go offline. The software shall be able to keep a log and report on system activity within a school or all schools district-wide for a minimum of one year. These reports can be exported to excel spreadsheets.
 11. The software will support a minimum of 20 bell schedules per school, with 5 schedules assignable to a specific school day. Bell schedules can be programmed to annunciate tones, activate relays, send emails, activate program distribution, and notify SIP phones.
 12. The system allows programmable end points to be automatically included or excluded for live paging, bell tones, or prerecorded audio, depending on the time or day or day of the week. These inclusions/exclusions can be applied manually or automatically depending on their schedule.
 13. The software can automatically send an email, as part of a programmed sequence of events, to district administrators alerting them of an emergency within the district.
 14. The software provides the ability to view schools that are in an emergency status, using any web browser on the district's network. The software shall identify the name of the school in an emergency as well the type of emergency that school is in.
 15. The software provides the ability to view individual classrooms that are not checked-in during an emergency, using any web browser on the district's network. The software shall identify the name, extension, and description of the classroom that is not checked-in during the emergency.
 16. The system has a minimum of 5 customizable emergencies, one of them being an All-Clear – with the ability to return the system from an emergency to normal status. Each emergency shall have a minimum of 500 unique events.
 17. As a district-wide communications solution, the system shall be able to provide simultaneous communications to all schools or groups of schools within a district. The system shall allow a user to initiate district-wide communications to individual schools, all schools, or groups of schools, from a web-based user interface. The system shall allow a user to initiate prerecorded audio, live paging, or programmed sequences to individual schools, all schools, or groups of schools, from the web-based user interface. Programmed sequences shall be customizable per school, and the system shall be able to activate them simultaneously to individual schools, all schools, or groups of schools, from the web-based user interface.
 18. The communications software must allow upgrade from an individual school system to multiple schools, or an entire school district, using the same web-based user interface. The communications software from an individual school system must be identical in typical user operation to the multiple schools or entire school

- district communications system software.
- B. Campus Controller
1. Provides call routing for paging and intercom for a single facility.
 2. System shall connect to the district provided Telephone Network via a SIP connection.
 3. Support a flexible numbering plan allowing two, three, four, five, or six-digit extensions.
 4. SIP interface to a district provided Telephone Network shall be capable of allowing connected phones to display classroom call-ins, answer internal intercom call-ins, make pages, and change priorities of call-ins in progress.
 5. Direct dialing, two-way amplified voice intercom between any provided telephone or admin console and speaker without the use of a press-to-talk or talk-listen switch.
 6. Ability to upgrade priority level from individual call switch.
 7. The ability to answer intercom call-ins registered at administrative consoles and pre-selected telephones.
 8. The ability to automatically escalate incoming call-ins to an alternate telephone or group of telephones if they remain unanswered for a predetermined amount of time.
 9. The ability to manually upgrade an intercom call-in to an alternate telephone or group of telephones.
 10. The ability for classrooms to “check-in” via push button when they have successfully secured their location during emergency.
 11. Administrative console shall display locations that have not checked in to confirm their secured location and provide hands-free audio monitoring and communication to unsecured locations.
 12. The controller shall not need direct connection to any classroom via home run or distributed wiring. It shall communicate solely through the IP network.
 13. Single button access from any console on the system to distribute emergency announcements within the facility to all or select locations equipped with speakers. Emergency announcements originating from any assigned administrative console shall have priority over all regular system functions.
 14. Ability for administrative consoles and connected phones to selectively monitor audio at any two-way speaker during an emergency.
 15. Stores a minimum of 48 hours’ worth of Bell Event Schedules, all emergency notification sequences as well as facility wide configuration.
 16. System has the ability to sync system time to the Atomic Clock Signal or to the school’s or districts network time server.
 17. System’s SIP Interface shall provide:
 - a. Audio paging access from any telephone to any single intercom speaker, zone (group) of intercom/paging speakers, or all speakers/paging horns throughout the entire facility.
 - b. Ability to answer a call-in directed to that SIP extension.
 - c. Ability to upgrade a call-in directed to that SIP extension.
 - d. Single button access from any telephone on the system to initiate alarm signals within the facility to all or select locations equipped with speakers. A minimum of 25 separate distinct alarm signals shall be provided. Alarm signals originating from any assigned administrative telephone shall have priority over all regular system functions.
 - e. Ability to initiate a school-wide emergency including lockdown and evacuate sequences.

- f. SIP device shall display call-in information from call in switch. Information will include a minimum of Classroom Name, Number, and Priority Level.
 18. The system will have the ability to utilize a web browser and a USB microphone connected to the PC to deliver district-wide live emergency paging, pre-recorded messages, and tones from any authorized computer in the facility or the district. The system must be capable of automatically notifying district personnel via the WAN of an alarm condition.
 19. The system can automatically broadcast emergency instructions throughout an entire campus when an alarm (e.g., lockdown, lockout, security, fire) is tripped or manually activated. The emergency instructions are preprogrammed and require no user intervention. Bell tones can be halted during an emergency. The system provides redundant alarm annunciation over intercom/paging speakers and is not meant to replace primary fire alarm or security systems.
- C. IP Addressable Modules:
 1. System shall provide multiple IP Addressable Modules for intercom, paging and relay activation.
 - a. All Modules are POE 802.3af compliant
 - b. All Modules support DHCP.
 - c. All Modules connect to network with a single RJ45 connector
 2. IP Addressable Speaker Module
 - a. Shall interface to school's data network, a classroom speaker, and multiple call switches.
 - b. A minimum of 5 levels of call-in can be placed from an IP Speaker Module. The call-ins are routed to administrative consoles and select SIP connected telephones and can only be cleared from the system once answered. If a call-in is not answered within a preprogrammed time the call-in may reroute to other telephones, consoles, and speakers.
 - c. An option for Privacy call in switches is supported. When the Privacy switch is activated, it prevents administrative or classroom telephones from monitoring the specific classroom/location intercom speaker.
 - d. The ability to belong to one or more of a minimum of 100 independent zones for zone paging, program/music distribution zones and class change tone zones; this assignment is a programmable function, changeable by time of day. Each IP Speaker Module's location shall be programmed in software to belong to any combination of software zones. IP Speaker Modules shall be designed to mount near ceiling and wall speakers and in the plenum space.
 - e. Intercom and paging volume adjustable from Software interface.
 3. IP Addressable Zone Paging Module
 - a. Zone Paging Module shall connect multiple speakers for district all page, all page, zone paging, bells, audio events and, emergency notification.
 - b. Zone Paging Modules shall be rack and wall mountable.
 - c. Zone Paging Modules shall be able to belong to one or more of 100 independent zones for live paging, bells, pre-recorded audio, and emergency notification.
 4. IP Addressable Aux I/O Module
 - a. Aux I/O Module shall have two input contacts and two output contacts.
 - b. Input and output contacts are individually addressable.
 - c. Aux I/O Module shall be wall and rack mountable.
 - d. User can program relays to be activated manually, through an event/bell

- schedule, or during emergency notification.
 - e. Aux I/O Module can perform school lockdown from a single press of a panic button.
 - 5. IP Addressable Program Line Input Module
 - a. Program Line Input Module shall provide line level audio program distribution into system.
 - b. Program Line Input Module shall have a 3.5mm cable jack.
 - c. Program Line Input Module shall be configured via web-based user interface.
 - d. User can configure program distribution to be activated manually or automatically through an event/bell schedule.
 - e. Program Line Input Module will have a system priority level such that emergency communications override program distribution.
- D. IP Addressable Analog Gateway
 - 1. IP Addressable Gateway provides integration with existing analog wiring infrastructure – consisting of shielded two-pair classroom field wiring. The Gateway provides the ability to reuse speaker wiring, speakers, and punch blocks to integrate analog infrastructure with IP platform.
 - 2. Each Gateway will have 5 watts of power per port and 25 watts total per device.
 - 3. Supports 24 classrooms that utilize 25 Volt speakers and all current Telecenter call switches for front office notification.
 - 4. Supports minimum of 5 call switch priorities per classroom, capable of lockdown check-in functionality, while reusing existing shielded two-pair classroom field wiring.
 - 5. Classroom intercom volume adjustable from Software interface.
 - 6. Classroom paging volume adjustable from Software interface.
 - 7. Configured to the school network and can be used in conjunction with IP Addressable Modules.
- E. IP Addressable Administrative Console
 - 1. A full color screen with 64 soft keys, 3 line select, volume control, push to talk, speakerphone mode and left/right and up/down scrolling.
 - 2. Audio paging access from any Console to any single intercom speaker, zone (group) of intercom/paging speakers, or all speakers/paging horns throughout the entire school.
 - 3. Programmable soft key access from any console on the system to initiate alarm signals within the school to all or select locations equipped with speakers. A minimum of 25 separate distinct alarm signals shall be provided. Alarm signals originating from any assigned administrative console shall have priority over all regular system functions.
 - 4. Programmable soft key access from any console to automatically broadcast page emergency instructions throughout an entire school when an alarm (e.g., lockdown, lockout, security, fire) is tripped or manually activated. The emergency instructions are preprogrammed and require no user intervention. The system provides redundant alarm annunciation over intercom/paging speakers and is not meant to replace primary fire alarm or security systems.
 - 5. Ability to perform intercom to any single IP Addressable Speaker Module.
 - 6. Ability to display 3 call-ins at a time on the screen while other call-ins are annunciating and the ability to scroll to view all call-ins.
 - 7. Ability to upgrade a call-in via soft key.
 - 8. Programmable soft key access from any console for activating relays, campus wide.

9. Ability to maintain, along with controller and other IP Modules system functions, including intercom, bells and paging for the local campus in the event of district-wide connection loss.
 10. Classrooms that have not 'checked-in' during an emergency are listed on the Administrative Console's screen.
 11. The time duration of an emergency is shown on the screen of the administrative console. The check-in timer is shown on the screen of the administrative console.
- F. Audio Paging/Program Amplifiers – Ashly NE 8250
1. Power amplifier(s) shall be provided to provide a minimum of 2 watts of power to all paging speakers, and 15 watts of power to all paging horns.
 2. The maximum load on the paging/program amplifiers shall be 80% of the rated maximum output of the amplifiers.
- G. Normal/Emergency Call Switch – Rauland Dual Level Call-In Switch
1. Normal/Emergency Call Switches indicated on the drawings shall provide the following functions and features:
 - a. One (1) "Normal" call switch that shall activate a distinctive "NORMAL" level call from single button activation. The button shall be clearly marked "NORMAL" and will route the call-in to any one or more Administrative Consoles and/or Marquee Displays for quick and easy response from an Administrative Console.
 - b. One (1) "Emergency" call switch that shall activate a distinctive "EMERGENCY" level call from single button activation. The button shall be red in color and shall be clearly marked "EMERGENCY" and will route the call-in to any one or more Administrative Consoles and/or Displays for quick and easy response from an Administrative Consoles.
- H. Emergency/Check-In Call Switch – Rauland Check-In Call-In Switch
1. Emergency/Check-In Call Switched indicated on the drawings shall provide the following functions and features:
 - a. One (1) "Emergency" call switch that shall activate a distinctive "EMERGENCY" level call from single button activation. The button shall be red in color and shall be clearly marked "EMERGENCY" and will route the call-in to any one or more Administrative Consoles and/or Displays for quick and easy response from an Administrative Consoles.
 - b. One (1) "CHECK-IN" call switch that shall activate a distinctive "CHECK-IN" level call from single button activation. The button shall be blue in color and shall be clearly marked "CHECK-IN" and will route the call-in to any one or more Administrative Consoles. This button will be used for emergency check-ins during school emergencies, notifying the front office of the classroom occupants' safety during an emergency.
- I. Equipment Racks
1. All equipment racks shall provide 44 spaces (77") minimum for mounted system equipment.
 2. All equipment racks shall be multi-rack format ("gangable") style, bolted together, and open cavity.
 3. All equipment racks will be provided with lockable rear doors.
 4. Equipment rack(s) shall be located in climate-controlled areas/rooms as shown on drawings.
 5. All head-end, distribution, and source equipment, including data and power, shall be located in racks configured as approved by the Engineer.
 6. Rack mounted equipment shall be accessible from front and rear.
 7. All unused rack spaces will be covered with appropriate blank/vent panels.

- J. Interior Ceiling Speakers
 - 1. Provide Ceiling Speaker Assembly consisting of 8 Ohm, 8" speaker mounted in a 2 foot by 2 foot, lay-in baffle, with an integrated back box that covers the full area of the baffle.
 - 2. The speaker shall be connected by inserting an 8-pin RJ45 terminated CAT 5e or Cat 6 cable.
 - 3. The speaker shall include provisions to allow attachment of a safety cable if required.
- K. Wall Mounted Horns
 - 1. Provide double re-entrant type horn loudspeakers with integral driver. The horn loudspeaker shall be impervious to weather and vandalism. Horn shall be constructed of heavy-duty ABS plastic. Horn loudspeaker drivers shall be rated at 15 watts with a frequency response of 480 Hz to 14 KHz. Sensitivity shall be 106 dB 1 watt, 1 meter. Transformer assembly shall be dual voltage multi-tap type suitable for 25 or 70-volt installations. Dispersion pattern shall be 180 degrees conical. The horn loudspeaker shall be constructed of treated heavy gauge aluminum, with all exposed parts potted and a sealed driver. Wiring terminal shall be fully enclosed. The speaker flange and mounting surface shall have a cork-rubber gasket. The horn loudspeakers finish shall be gray baked on enamel.
 - 2. The recessed back box shall be of heavy gauge cold-rolled steel, spot welded for stability with a rust-retardant gray primer finish. Acoustically treat the interior to eliminate mechanical resonance. The back box shall be 10-3/4"x10-3/4"x6" deep.
 - 3. The baffle shall be vandal proof, the faceplate constructed of 14-gauge carbon steel with a minimum tensile strength of 55,000 PSI. A lattice grid sub-plate shall deny access to the horn but be acoustically transparent for sound projection. Provide tamper-proof, stainless steel mounting hardware. The baffle shall have a mar/scratch baked epoxy rust inhibitive finish.
- L. Uninterruptible Power Supplies (UPS)
 - 1. UPS equipment provided for this system will include Power Conditioning to smooth current and voltage fluctuations.
 - 2. UPS equipment will be sized in accordance with the system manufacturer's recommendations.
 - 3. Provide an individual UPS for EACH remote gateway outside of the MDF (Gateway) furnished with the system.
 - 4. Provide additional UPS(s) for protection of all other equipment furnished with the system and housed in the equipment racks.
 - 5. All UPS equipment shall be rack mounted.
- M. Wall Mounted Volume Control
 - 1. Provide as shown on floor plans. Provide Atlas AT-10PA or approved equal recessed autotransformer volume control. Routine paging shall not override the volume control.
- N. Wall Mounted Emergency Lockdown Button
 - 1. Provide Safety Technology International Stopper Station Push, Turn-to-Reset w/shield w/sound, or pre-approved equal in locations as shown on floor plans.
 - 2. Labeled "EMERGENCY"
 - 3. Lockdown shall be Blue
- O. Program Source Equipment
 - 1. Provide Qty 1 cd player with blue tooth Interface
 - 2. Provide 1 Program Source Module to interface with the IP Communications system

3. Provide a Mixer Preamp for use in adjusting Sound levels
 4. Provide an Interface panel for additional sources and 1 paging Microphone
 5. Provide 1 desk top paging Microphone
 6. Provide Desktop enclosure to house all program source equipment
- P. Additional Equipment:
1. Contractor shall include in their pricing, the cost to furnish and install the following additional equipment. These devices shall be used to fulfill any changes request issued until the list is depleted. Upon the completion of the project, all remaining material shall be delivered to the project for owner stock. No devices shall be used without documentation and written authorization from the project's technology consultant. Contractor shall obtain a signed transmittal of additional equipment to the owner at the end of the project. The signed transmittal shall be included in the contractor's closeout documents.
 2. Additional Equipment List:
 - a. Five (5) Ceiling Mounted Speakers with tile bridges
 - b. Two (2) Wall Mounted Volume Controls
 - c. One (1) Exterior Speakers
 - d. Ten (10) STI model SS24A1EM-EN Lock Down Buttons

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 School Communications and School Safety Network.
- B. Do not proceed until unsatisfactory conditions have been corrected.
- C. Contractor shall perform a full-scale test of the existing system and report any non-functioning equipment to the A/E, GC & Owner prior to starting construction. Any non-functioning equipment reported after the start of construction will be replaced by contractor with no additional impact to the contract.

3.2 INSTALLATION

- A. General: Install system in accordance with NFPA 70 and other applicable codes. Install equipment in accordance with manufacturer's written instructions.
- B. Furnish and install all material, devices, components, and equipment for a complete operational system.
- C. Impedance and Level Matching: Carefully match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.
- D. Control Circuit Wiring: Install control circuits in accordance with NFPA 70 and as indicated. Provide number of conductors as recommended by system manufacturer to provide control functions indicated or specified.
- E. All housings are to be located as indicated.
- F. The contractor shall provide necessary transient protection on the AC power feed, all copper station lines leaving or entering the building, and all central office trunks. All protection shall be as recommended by the equipment supplier and referenced to earth ground.
- G. Wiring within Enclosures: Provide adequate length of conductors. Bundle, lace, and train the conductors to terminal points with no excess. Provide and use lacing bars.
- H. Provide physical isolation from speaker-microphone, telephone, line-level wiring, and power wiring. Run in separate raceways, or where exposed or in same enclosure, provide 12-inch minimum separation between conductors to speaker-microphones, telephone wiring and adjacent parallel power. Provide physical separation as recommended by

- equipment manufacturer for other system conductors.
- I. Identification of Conductors and Cables: Use color coding of conductors and apply wire and cable marking tape to designate wires and cables so all media are identified in coordination with system wiring diagrams.
 - J. Provide integration of local sound reinforcement system override.
 - K. Provide integration of remote lockdown pushbuttons.
 - L. Install new speaker types as indicated on the drawings.
 - M. Speakers in high ambient noise areas (cafetorium, gymnasiums, etc.) shall be tapped as required to overcome the ambient noise generated by the public.
 - N. Provide silicone sealant to all openings and conduit penetrations at all exterior back box locations.
 - O. Weatherproofing: Provide weatherproof enclosures for items to be mounted outdoors or exposed to weather.
 - P. All exterior wall penetrations shall be properly sealed to prevent moisture from entering the building.
 - Q. Conduit and Cables
 - 1. Install conduit, fittings and boxes as specified in Division 26.
 - 2. Single system cables shall be grouped together in a common conduit of adequate capacity to facilitate the ease of installation and prevent conductor or insulation damage.
 - a. In no case shall the conduit fill exceed 40% capacity.
 - b. Do not group conductors or cables of different systems in a common conduit.
 - c. Provide and install protective bushings on all conduit stub outs and sleeves, prior to cable installation, to prevent cable damage.
 - 3. Cable:
 - a. Install cables as recommended by the system manufacturer. Conductor quantities specified are minimum required. Conductors to be installed shall be coordinated with the system equipment supplier.
 - b. Cables installed on exposed surfaces, in inaccessible locations, or underground shall be installed in conduit.
 - c. Cables installed above accessible ceiling spaces may be installed without conduit. All cables not installed in conduit shall be plenum rated.
 - d. Cables shall be routed down corridors, parallel and perpendicular to the building walls and structure. Cable to each device shall branch off a main corridor trunk.
 - e. Routing cables through classrooms, offices, storage rooms, restrooms, or any type of room other than a corridor will not be accepted. Enter rooms above the associated room doorway.
 - f. All cabling shall be home runs to head-end equipment to allow for zoning to be accomplished.
 - 4. Cables not installed in conduit shall be grouped and bundled. Cable shall be bundled on a maximum of 2'-6" on center. Support cables from D-rings or J-hooks. D-rings and J-hooks shall be secured to the structure at a maximum of 5' on center. Bundling and support shall be with plenum rated cable ties.
 - 5. Cables installed in hollow wall spaces shall be installed in conduit to an accessible location.
 - 6. Tag each circuit at each end and at each terminal with a separate tag indicating the area served.
 - R. Emergency Lockdown Buttons
 - 1. Cabling for each Emergency Lockdown Button shall be homerun to the

2. Communication System head-end equipment.
2. Communications system shall communicate with intrusion system over the network when there is a lockdown event.
3. Provide connection from the Communication System head-end equipment to the Intrusion Detection System head-end for sending notifications to the CFISD Police Department. Coordinate additional requirements and programming with Owner.
4. Button shall cause the Intercom System to send a distinct alert tone throughout all speakers in the building. Coordinate exact tone with Owner.
5. Button shall send an Emergency Call signal to all Administrative Call Stations.
6. Communication System shall alert essential personnel via SMS and e-mail that a Lockdown event has occurred at the campus. Coordinate additional requirements with Owner.
7. Buttons and alert tone shall be reset by pressing the All-Clear button on any Administrative Call Station console.
8. Coordinate Emergency Lockdown Button device identification naming with Owner.
9. Reference attachment 'A' for more information.
- S. Volume Controls
 1. Volume Controls shall be configured with emergency call override, allowing emergency announcements to be heard regardless of the position of the volume control.

3.3 ADDITIONAL REQUIREMENTS

- A. Provide visual PA indicator light in deaf education areas and wire into the communications system for bell tones.

3.4 GROUNDING

- A. Provide equipment grounding connections for Integrated Electronic Communications Network systems as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.
- B. Racks and cabinets shall be grounded to the metallic structure of the building or to the building system power ground in accordance with NEC section 250. Securely bond equipment to the ground system through a minimum 14-gauge green insulated conductor.
- C. Ground equipment, conductor, and cable shields to eliminate shock hazard and to minimize to the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.
- D. Electronic systems shall be grounded to the building system ground, with a maximum resistance of 0.1 ohm. Systems ground shall be a driven ground rod, building steel, or other approved ground of the building power systems ground.
- E. Provide all necessary transient protection on the AC power feed and on all copper station lines leaving or entering the building. Note in system drawings, the type and location of these protection devices as well as all wiring information.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Provide services of a duly factory authorized service representative for this project location to supervise the field assembly and connection of components and the pre-testing, testing, and adjustment of the system.
- B. Inspection: Make observations to verify that units and controls are properly labeled, and interconnecting wires and terminals are identified. Provide a list of final tap settings of

- paging speaker line matching transformers.
- C. Testing: Rectify deficiencies indicated by tests and completely re-test work affected by such deficiencies at Contractor's expense. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

3.6 FINAL ACCEPTANCE TESTING

- A. The Final Acceptance Testing shall be provided to the Owner, or the Owners designated representative only. Final acceptance testing to any other trade or service provider for the project will not comply with the requirements of this section.
- B. The contractor will provide a Final Acceptance Test record document signed by both the contractor and the Owner or designated Owner's Representative establishing the "In Warranty" date. The warranty period will not commence until the Final Acceptance Test is completed.
- C. Be prepared to verify the performance of any portion of the installation by demonstration, listening and viewing test, and instrumented measurements. Make additional adjustments within the scope of work and which are deemed necessary by the Owner because of the acceptance test.

3.7 COMMISSIONING

- A. The contractor shall train the Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventative maintenance of the system. This training will be in accordance with the training as outlined in Section 1.6 of these specifications. In addition to the Training Materials provided, the contractor will also furnish Operators Manuals and Users Guides at the time of this training.
- B. Schedule training with Owner through the Owner's representative, with at least seven days advance notice.

3.8 OCCUPANCY ADJUSTMENTS

- A. The contractor shall provide Occupancy Adjustments in accordance with Section 1.6 of these specifications. A response scenario amenable to both the owner and the contractor will be established and followed for the first year of service.

3.9 CLEANING AND PROTECTION

- A. Prior to final acceptance, the contractor shall vacuum and clean all system components and protect them from damage and deterioration. All blank spaces in equipment cabinets will be covered with blank panels. Top and side panels, and all cabinet doors will be installed. All general areas within and around all equipment rack/cabinets in the facility will be swept, vacuumed, and cleaned up. No cabinets will be left unlocked, and all cabinet keys will be turned over to the owner or designated owner's representative.

END OF SECTION

**SECTION 28 01 00
OPERATION AND MAINTENANCE (O&M) MANUALS
OF ELECTRONIC SAFETY AND SECURITY SYSTEMS**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Compile Electronic Safety and Security (ESS) product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare ESS operating and maintenance data as specified in this Section and as referenced in other sections of specifications.
- B. Instruct Owner's personnel in operation and maintenance of equipment and systems.
- C. Submit three (3) electronic copies, on separate devices (CD, USB Flash Drive, or some type of solid-state storage device), of complete O&M manuals in final form. The submitted manual shall be the system manufacturer's operations manual, supplemented with operations and maintenance instructions custom tailored for the system installed. Electronic documentation shall be provided in a non-proprietary PDF format, without password restrictions.
- D. Hard copies shall be provided upon request of the Owner, Architect, and/or Consultant.
- E. Recorded video of all training sessions shall be included in each copy, of each system's final submitted O&M.
- F. The final submitted manual shall include a sign-in sheet and owner/consultant signed acceptance of all training sessions.

1.2 ELECTRICAL OPERATING AND MAINTENANCE MANUAL SUBMITTAL SCHEDULE

- A. Thirty (30) days after receipt of reviewed submittals bearing the Project Technology Consultant's stamp of acceptance (including re-submittals), submit for review, an electronic copy of the first draft of the System's O&M Manual. This copy shall contain as applicable to the specific system, a minimum of the following:
 - 1. Table of Contents for each element
 - 2. Contractor information
 - 3. All shop drawings, coordination drawings and product data, bearing the Project technology Consultant's stamp of acceptance.
 - 4. All parts and maintenance manuals for items of equipment
 - 5. Warranties (without starting dates)
 - 6. Certifications that have been completed; submit forms and outlines of certifications that have not been completed
 - 7. Operating and maintenance procedures.
 - 8. Form of Owner's Training Program Syllabus (including times and dates)
 - 9. Control operations / equipment wiring diagrams
 - 10. Coordination Drawings
 - 11. Schedule of Low Voltage Wire and Cable
 - 12. Schedule of ESS Equipment
 - 13. Schedule of ESS Field Devices
 - 14. Access Control Door Schedules
 - 15. Video Surveillance Camera Schedules
 - 16. Other required operating and maintenance information that are complete.
 - 17. Cable pathway layout drawings and station map, including through wall and floor penetration locations and sleeve sizes.
- B. Copy will be returned to the Contractor within 15 days with comments for corrections.
- C. Submit the electronic completed manuals (hard copies upon request) in final form to the

28 01 00-1 OPERATION AND MAINTENANCE (O&M)
MANUALS OF SAFETY AND SECURITY
SYSTEMS

Project's Technology Consultant.

1. Prior to substantial completion for Owner's use after the Owner accepts facility maintenance.
 2. Include all specified data, test reports, drawings, dated warranties, certificates, training videos. along with other materials and information.
- D. The Project's Technology Consultant shall review the manuals for completeness within 15 days.
- E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Project's Technology Consultant. The manuals will not be retransmitted.
- F. Electronic and/or hard copies of the accepted manuals shall be delivered to the Owner prior to substantial completion.

PART 2 - PRODUCTS

2.1 BINDERS

- A. Upon the request for hard copies of the O&M manuals, the binders shall consist of the following configuration:
1. Commercial quality black, 3-ring binders with clear, durable, cleanable plastic covers.
 2. Minimum ring size: 1"; Maximum ring size: 3".
 3. When multiple binders are used, correlate the data into related groupings.
 4. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 - EXECUTION

3.1 SYSTEM OPERATION AND MAINTENANCE MANUAL

- A. Form for Manuals Submitted in Hard Copy Format:
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 flyleaf 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.
 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 / normal operating instructions
 - 2) Regulation, control, stopping, shut down and emergency instructions
 - 3) 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. Manufacturer's printed operating and maintenance instructions.
 - e. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
 - 1) Items recommended to be stocked as spare parts.
 - f. Schedule of low voltage wire and cable
 - g. Schedule of ESS equipment

SECTION 28 05 00
ELECTRONIC SAFETY AND SECURITY
BASIC MATERIALS, METHODS, AND GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of Division 01 General Requirements, and other provisions and requirements of the Contract Documents apply to work of Division 28 Electronic Safety and Security.
- B. Applicable provisions of this section apply to all sections of Division 28, Electronic Safety and Security.
- C. The general provisions of the Contract and the requirements of the following Sections apply to the Work specified in this Section. See following sections for related general and specific requirements following sections shall associate with this specification as applicable.
 - 1. Division 26 in its entirety.
 - 2. Division 27 in its entirety.
 - 3. Division 28 in its entirety.
- D. The entire drawing and specification package apply to the work specified in the Electronic Safety and Security 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.

1.2 CODES AND STANDARDS

- A. All equipment and work performed shall comply with all of the current and applicable Codes, Rules, Ordinances, Regulations and Standards (including those not specifically listed in this Specification) as interpreted and enforced by the authorities having jurisdiction including:
 - 1. Americans with Disabilities Act (ADA)
 - 2. Authorities Having Jurisdiction (AHJ) - Local
 - 3. American National Standards Institute (ANSI)
 - 4. American Society of Testing and Materials (ASTM) *Communications Cables - B694, B736, D4565, D4566, D4730, D4731, D4732*
 - 5. Building Industry Consulting Services International (BICSI)
 - 6. Code of Federal Regulations - Title 47
 - 7. Electronics Industries Association (EIA) *Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Connecting and Terminating Devices - EIA-455 Series*
 - 8. Federal Communications Commission (FCC) - Communications Act and FCC Rules
 - 9. Federal Information Processing Standards (FIPS) *Federal Building Standard for Telecommunications Pathways and Spaces - FIPS PUB 175, FIPS PUB 176*
 - 10. The Insulated Cable Engineers Association (ICEA) *Communications Cable Stands - P-47-434, S-56-434, S-80-576, S84-608, S-85-625, S-86-634, S-87-640, S-89-648, S-90-661, S-98-688, S-99-689, S-100-685*
 - 11. International Electro-technical Commission (IEC)
 - 12. Institute of Electrical and Electronic Engineers (IEEE) *Local Area Networks/Metropolitan Networks Standards Collection - LAN/MAN 802 Series*
 - 13. International Organization for Standardization (ISO) (ISO/IEC) *Premise Wiring*

28 05 00-1

ELECTRONIC SAFETY AND SECURITY
BASIC MATERIALS, METHODS, AND
GENERAL PROVISIONS

- Core and LAN/MAN Core Equivalents-11801, 8802, 14763-1*
14. International Telecommunication Union (ITU-T) *Telecommunications Standardization*
 15. National Electrical Code (NEC) *National Electrical Code - NFPA 70*
 16. National Electrical Contractor's Association (NECA) *Standards of Installation*
 17. National Electrical Manufacturers Association (NEMA) *Performance Standard for Twisted Pair Premise Voice and Data Communications Cable-WC 63.1, WC 63.2, WC 66*
 18. National Electrical Safety Code (NESC)
 19. National Fire Protection Association (NFPA) - *National Fire Alarm Code NFPA 72, Life Safety Code NFPA 101*
 20. Society of Cable Telecommunications Engineers (SCTE)
 21. Local Accessibility Standards
 22. Telecommunications Industries Association (TIA) *(ANSI/TIA/EIA) Wiring and Cabling Standards - 526, 568, 569, 570, 571, 598, 606, 607, 758, TSB 31-B, 63, 67, 72, 75 and 95*
 23. Uniform Building Code (UBC)
 24. Underwriters Laboratories, Inc. (U.L.) - *497A, 910, 1077, 1863, 1283, 1459, 1604, 1651, 1681, 1690, 1778, 1977*
- B. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.
- C. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.
- D. Obtain all permits required.

1.3 SUMMARY

- 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 a new and/or an extension of the existing installation, as shown in the associated specifications and drawings, complete in every respect.
- C. Provide complete and working ESS Systems including equipment, conduit, wiring, material, labor and training as described in this Specification and the Drawings. The ESS Systems Drawings and Specifications are the sole property of the Architect and are not to be duplicated, scanned, loaned or in any way made available to persons not designated as authorized by the Architect. All ESS Systems plans and specifications are to be returned to the Architect following completion of bid.

1.4 CONTRACTOR'S QUALIFICATIONS

- A. An approved contractor for the work under this division shall be:
 1. A specialist in this field and have the personnel, experience, training, and skill, and the organization to provide a practical working system.
 2. Able to furnish evidence of having contracted for and installed not less than ten (10) systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.
 3. Perform work by persons qualified to produce workmanship of specified quality. Persons performing work shall be required to be licensed. Onsite supervision shall have minimum of the following:
 - a. Licenses, as applicable to the system being installed

- b. Manufacturer's Certifications
 - 1) Firm Certification
 - 2) Installer Certification
 - 3) Programmer's Certification
 - 4) System Designer Certification.

1.5 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 Consultant for review. No departures shall be made without prior written acceptance of the Consultant.
- 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 Consultant in writing, shall be performed or furnished. In the case that 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. The approximate locations of system equipment and components are indicated on the Drawings. These Drawings are not intended to give complete and accurate details in regard to location of equipment, field devices, etc. Exact locations are to be determined by actual measurements at the building and will in all cases be subject to the Review of the Owner or Consultant, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.
- E. Items specifically mentioned in the Specifications but not shown on the Drawings and/or items shown on 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.
- F. Any discrepancies between the Contract Documents and actual job site conditions shall be reported to the Owner or Consultant, so that they will be resolved prior to the bidding, where this cannot be done at least 7 working days prior to bid; the greater or costlier of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.
- G. It is the intention of this Section of the Specifications, and associated drawings, to outline minimum requirements to furnish the Owner with a turnkey and fully operating system in cooperation with other trades.
- H. The contract documents are schematic in nature in that they are only to establish scope and a minimum level of quality. They are not to be used as actual working construction drawings. The actual working construction drawings shall be the shop drawings accepted by project's consultant.
- I. 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 project's consultant 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.
- J. These documents are conceptual in nature. It shall be the responsibility of the approved installer to furnish a complete and functional system, including the items shown on the

drawings, in the specifications, and items not designated in either. The installer's shop drawings and product data submittals shall represent a complete system and documents accepted by the project's consultant shall not relieve the installer from being required to provide any materials, equipment, or labor to furnish a complete and functional system as recognized by the Project's Technology Consultant and the Owner.

1.6 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, ordinances, and standards; 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 closed ceiling space and/or furred chases unless specifically noted or indicated to be exposed. Work shall be installed to avoid crippling of structural members. 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 Consultant. The Consultant 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.
- E. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.7 RELATION WITH OTHER TRADES

- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements. Extend electrical services and final connections to all items requiring same.
- B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.
- C. Where cabling pass through walls or floors, metal sleeves shall be provided and shall be sealed to prevent spread of fire and smoke. In walls, they shall extend 3" beyond the finished surface. In pipe chases, they shall extend 8" inches above floor slab and be cemented in a watertight manner. Size of these sleeves shall be at least as required to maintain a maximum 40% conduit fill ratio. 1/2 inch greater than outside diameter of the conduit.
- D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.
- E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under other Division. Determine from the General Contractor / Construction Manager for the various trades, the Owner, and by direction from the

Architect / Engineer, the exact location of all items. The construction trades involved shall furnish all roughing-in drawings and wiring diagrams required for proper installation of the electrical work.

1. Make final connections to all ESS equipment indicated on the drawings, except as noted.
- F. Request all Shop Drawings required in ample time to permit proper installation of all electrical provisions.
- G. Extend services as indicated to the various items of equipment furnished by others. Rough-in for the various items and make final connections ready for operation upon placing of the equipment.

1.8 CONCEALED AND EXPOSED WORK

- A. When the word "concealed" is defined as hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is defined as open to view, in plain sight.

1.9 GUARANTEE

- A. Guarantee work for a minimum of two years or as noted longer elsewhere from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

1.10 MATERIAL AND EQUIPMENT

- A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.11 NOISE AND VIBRATION

- A. Select equipment to operate with minimum noise and vibration. If noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, and judged objectionable by the Owner, Architect, or Engineer, rectify such conditions at no additional cost to the Owner. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.12 ACCEPTABLE MANUFACTURERS

- A. Manufacturers names and catalog number specified under sections of Division 28 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer shall be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before proposal due date. Submit complete design and performance data to the Architect. The Architect and Owner issue approvals of acceptable manufacturers as addenda to the Construction Proposal Documents.
- 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.

1.13 UTILITIES, LOCATIONS AND ELEVATIONS

- A. Locations and elevations of the various utilities included within the scope of this work:
 - 1. Obtained from utility maps and other substantially reliable sources.
 - 2. Are offered separate from the Contract Documents as a general guide only without guarantees to accuracy.
- B. Examine the site and verify the location and elevation of all utilities and of their relation to the work. Existing utilities indicated on the site plans are for reference only and shall be field verified by the Contractor with the respective public or private utility.

1.14 CONTRACT DRAWINGS

- A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.
- B. It is the responsibility of the Contractor to compare the scale of all electrical drawings with the scale of the architectural drawings and make adjustments to all electrical drawings which have the incorrect drawing scale so that his material takeoffs are not in error due to an incorrectly labeled drawing scale and his proposal is complete.

1.15 ABBREVIATIONS AND DEFINITIONS

Abbreviations:

A/V	Audio/Visual
AWG	American Wire Gauge
BCR	Building Communications Room
CMP	Communications Media Plenum
CMR	Communications Media Riser
dB	Decibel
EMI	Electromagnetic Interference
ER	Equipment Room
ESS	Electronic Safety and Security
FACP	Fire Alarm Control Panel
FCR	Floor Communications Room
Hz	Hertz
IDF	Intermediate Distribution Frame
Km	Kilometer
LCD	Liquid Crystal Display
LED	Light Emitting Diode
M	Micron
MDF	Main Distribution Frame
MHz	Megahertz
NEXT	Near-End Cross Talk
nm	Nano-meter
OFN	Optical Fiber Non-conductive
OFNP	Optical Fiber Non-conductive Plenum
OFNR	Optical Fiber Non-conductive Riser
OTDR	Optical Time Domain Reflectometer
TC	Telecommunications Closet (<i>Now referred to as TR</i>)
TR	Telecommunications Room (<i>A.K.A. TC - Telecommunication Closet</i>)
UTP	Unshielded Twisted Pair Wire

Definitions:

Low Voltage Wire - Wire or cable used for one or more systems that operate on 24 volts or less. Low Voltage Wire is used to install and interconnect one or more of the ESS Systems. Low Voltage Wire includes patch cords, jumpers and all portions of cable or wire used to make the ESS Systems operational or for system communications.

Electronic Safety and Security Systems - One or more of the following and associated equipment: Fire Detection/Alarm Systems, Intrusion Detection/Alarm Systems, Access Control Systems, Video Surveillance Systems,

1.16 QUALITY ASSURANCE

- A. Equipment Standards:
1. System and all components shall be brand new stock from manufacturer.
 2. All electronics shall be 100% solid state.
 3. System and all components shall bear a UL Label.
- B. Contractor Qualifications:
- At the time of Proposal, the Contractor shall:
1. Have manufactured, supplied or installed at least three (3) other systems of similar size, complexity, and general operation as the systems described in these specifications. The Contractor shall furnish in writing to Architect proof of compliance with this paragraph at the time of proposal.
 2. Hold all legally required Texas State Contractor's licenses necessary to accomplish the installation and activation of the described system at the facilities indicated. The Contractor shall submit copies of licenses to the Architect prior to the start of work
 3. Hold all legally required state registrations to meet local requirements for submittal drawings.
 4. Have a local office within fifty (50) miles of the project site staffed with factory trained technicians who have experience on systems of similar complexity and function as the systems described in these specifications. These technicians shall be fully capable of system engineering support, installation supervising, system start-up, and providing the Owner with training and service on both hardware and software for the systems specified.
 5. Certify complete and total compliance with the provisions of these specifications by letter or submittal of the proposal response forms, signed by an officer of the corporation, or a principal if other ownership currently exists. In addition, the letter or forms shall include a complete listing of exceptions, if any.

1.17 SUBMITTALS

- A. Provide SUBMITTALS according to Division 1 and the following.
- B. Requirements:
1. Submit paragraph-by-paragraph specification review indicating compliance or deviation with explanation.
 2. Submit proof that all system components and cables are U.L. Listed.
 3. An equipment list with names of manufacturers, model numbers, and technical information on all equipment proposed. Clearly mark exact model number proposed to be installed.
 4. Product technical information sheets for each principal components in the proposed system, including cable, wire, terminal marking, and wire marking material.
 5. Certification from the manufacturer stating that the system Contractor is an

authorized distributor or installer of the proposed system when such certifications exist.

6. A statement listing every technical and operational parameter wherein the submitted equipment varies from that which was originally specified. If the submitter fails to list a particular variance and his submittal is accepted, but is subsequently deemed to be unsatisfactory because of the unlisted variance, the submitter shall replace or modify such equipment at once and without cost to the Owner.

1.18 EXAMINATION OF SITE

- A. The Contractor shall have visited the site and familiarized himself with all existing conditions prior to submitting his proposal and shall be prepared to carry out the work within the existing limitations. Failure or neglect to do so shall not relieve the Contractor of his responsibilities not entitle him to additional compensation for work overlooked and not included in his proposal.
- B. The Contractor shall confirm the availability of the proper power source for each piece of specified equipment, through site visits and Drawings as necessary. Where proper power does not exist, the Contractor shall provide the required power, circuits, outlets, conduits, and wire as specified under Division 26.

1.19 DATA ACCURACY

- A. Absolute accuracy of information regarding existing conditions cannot be guaranteed. The Drawings and Specifications are for the assistance and guidance of the Contractor and exact locations, distances, elevations, etc., shall be governed by actual field conditions. Where variations from the contract documents are required, such variations shall be approved by the Architect / Owner.

1.20 SECURITY

- A. The Contractor is responsible for complying with all of the Owner's and facility security's requirements to prevent theft or damage to equipment, tools and materials. If any deviation from facility security requirements is necessary, approval for such deviation shall be coordinated with the Owner.
- B. The Contractor shall not disclose any confidential information of the Owner. The Contractor acknowledges that such action is highly injurious and can do damage to the Owner. The Contractor will agree to and comply with the standard policies and provisions of the Owner regarding outside Contractors and Consultants.

1.21 UTILITIES

- A. It shall be the responsibility of the Contractor to provide all temporary connection and cables, lighting, light stands and power. The facilities shall be used in accordance with all applicable regulations regarding operations, safety and fire hazards of the governmental Authorities Having Jurisdiction, provided they are not used in a wasteful manner.

1.22 PERMITS

- A. All permits required for the specified performance and completion of the work shall be secured by the Contractor. These permits shall be presented and reviewed at the initial project progress meeting.

1.23 NOTIFICATION

- A. The Contractor shall not shut off any existing systems. The Contractor shall give the Owner at least ten (10) calendar day's notice of any requirements to shut off or

interference with existing alarm, regulating, computer or other service systems. The Owner will arrange and execute any shutdown. All work such as splicing, connections, etc., necessary to establish or re-establish any system shall be completed by the Contractor in close coordination with the Owner.

1.24 INTERFERENCES WITH THE OWNER

- A. Transportation and storage of materials at the facility, work involving the facility, and all other matters affecting the habitual use by the Owner of its buildings, shall be conducted so as to cause the least possible interference, and at times and in a manner acceptable to the Owner. The Contractor shall make every effort to delivery equipment per the schedule required by the project.

1.25 PROJECT RECORD DOCUMENTS

- A. Maintain at the job site a separate set of white prints (blue line or black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is significantly at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various major and minor feeders, equipment, and other pertinent items, as installed. Record underground and underslab cables installed, dimensioning exact location and elevation of such installations.
- B. At conclusion of project, obtain without cost to the Owner, electronic AutoCAD 2014+ / Revit CAD files of the original drawings and transfer as-built changes to these. Provide the following as-built documents including all contract drawings regardless of whether corrections were necessary and include in the transmittal: "2 sets of CDs and prints for Owner's use, one set of CDs, prints, and mylars for Architect / Engineers Records". Delivery of these as-built electronic, reproducible and prints is a condition of final acceptance.
1. 3 sets of electronic AutoCAD (2014+ dwg) / Revit CAD drawing files, on CD-ROM media, of each contract as-built drawing.
 2. One reproducible Dayrex mylar film positive of each contract as-built drawing.
 3. Three sets of blue or black-line prints of each contract as-built drawing.
- C. 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 conduit and cables, etc that were deviated from construction drawings.
 6. Indicate exact location of all underground ESS raceways, and elevations.
 7. Correct schedules to reflect (actual) equipment furnished and manufacturer.
 8. During the execution of work, maintain a complete set of Drawings and specifications upon which all locations of equipment, devices, and all deviations and changes from the construction documents in the work shall be recorded.
 9. Exact location of all ESS equipment in building. Label panel schedules to indicate actual location.
 10. Exact location of all ESS equipment in and outside of the building.
 11. Location, size and routing of all ESS cables, conduits, equipment, etc. shall be accurately and neatly shown to dimension.
 12. Exact location of all roof mounted equipment, wall, roof and floor penetrations.

13. Cloud all changes.

1.26 OPERATING TESTS

- A. After all ESS 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 and Owner. Provide minimum 24-hour advance notice of scheduling of all tests. 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.

1.27 WARRANTY

- A. All equipment shall be covered for the full manufacturers warranty period and systems shall be warranted by the Contractor for a period of two years commencing with the filing date of substantial completion. The Warranty shall cover all costs for warranty service, including parts, labor, prompt field service, pick-up, transportation, delivery, reinstallation, and retesting. A contract for service shall cover the period starting with the first expected activation of each system and shall continue without interruption to cover the period to the end of the two-year warranty as defined above. The end of the warranty period shall be handled such that a smooth transition to a maintenance agreement with the Owner shall be achieved with no lapse in coverage.
- B. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.28 BUILDING CONSTRUCTION

- A. It shall be the responsibility of the sub-contractor to consult the Architectural and Engineering drawings, details and specifications and thoroughly familiarize himself as to the construction and all job-related requirements. All construction trades shall cooperate with the General Contractor / Construction Manager job site superintendent and lay out work so that all piping, cables, pathways, raceways, and other items are placed in the walls, furred spaces, chases, etc., so that there shall be no delay in the job.

1.29 TEMPORARY FACILITIES

- A. General: Refer to Division 01 for general requirements on temporary facilities.
- B. Temporary Wiring: Temporary power and lighting for construction purposes shall be provided under Division 26. Installation of temporary power shall be in accordance with NEC Article 305.
- C. Temporary facilities, wire, lights and devices are the property of this Contractor and shall be removed at the completion of the Contract.

1.28 EXTRA MATERIALS

- A. Keys: Provide three (3) sets of all keys for system cabinets.

PART 2 - PRODUCTS

2.1 WORK INCLUDED

- A. All materials listed in PART 2 - PRODUCTS of this Division Sections and on the Drawings shall be provided by the Contractor unless specifically excluded or modified in other portions of this Specification or Addendums.

2.2 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.

2.3 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.

2.4 MANUFACTURE'S INSTRUCTIONS

- A. The Contractor is responsible for furnishing the proper Electronic Safety and Security 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 Consultant, in writing, of any conflict between the Contract Documents and the manufacturer's recommendations and shall obtain, from the Consultant, 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 Consultant.

2.5 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.

2.6 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.
- B. All electronic equipment, containing sealed lead acid batteries or gel cells, shall be stored in climate-controlled area until installed or reinstalled. Do not store in non-climate controlled connex storage units.
- C. Storage is to be provided and secured by the contractor. In the event that the Owner should agree to furnish storage space, security of the space and its contents shall remain the responsibility of the contractor.

2.7 CONDITION OF MATERIALS

- A. All materials required for the installation of the Electronic Safety and Security 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 installed, or while being tested, until time of final acceptance, shall be replaced by this Contractor without extra cost to Owner.

2.8 NAMEPLATES

- A. Factory assembled components and equipment shall be provided with be factory stamped labeling. Labeling will have information required to specifically identify the component and/or equipment in the future such as the manufacturer's name, catalog number, serial number, etc. All data on the labels shall be legible at the time of final inspection.

2.9 ACCESS DOORS

- A. Wherever access is required in walls or ceilings to concealed junction boxes, pull boxes, equipment, etc., installed under this Division, furnish a hinged access door and frame with flush latch handle to another Division for installation. Doors shall be as follows:
 1. Plaster Surfaces: Milcor Style K.
 2. Ceramic Tile Surfaces: Milcor Style M.
 3. Drywall Surfaces: Milcor Style DW.
 4. Install panels only in locations approved by the Architect.

2.10 SPACE LIMITATIONS

- A. Equipment shall be chosen which shall properly fit into the physical space provided and shown on the drawings, allowing ample room for access, servicing, removal and replacement of parts, etc. Adequate space shall be allowed for clearances in accordance with applicable codes and standards. Physical dimensions and arrangement of equipment shall be subject to the approval of the Consultant.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. This project has a critical path, which must be closely followed in order to meet the completion date. The Contractor shall review the proposed schedule at the Award of Contract meeting and be prepared to staff his work force according to the schedule constraints presented at that time.
- B. Aesthetics are an important consideration in this installation. All components shall be installed so as to have aesthetically pleasing results as determined by the Owner and Architect. Actual locations of all visible components shall be coordinated in advance with the Owner and Architect.
- C. Install, make fully operational and test the system as indicated on the Drawings and in the Specifications. Where information is not available the worst-case condition must be assumed to ensure a complete, functional system.
- D. Any interfacing with other systems shall be the Contractor's responsibility under this contract, and the details, both logical and physical, of such interfaces shall be reflected in the Submittals and As-Built drawings.
- E. If appropriate, interfaces with the Owner's Data Network or Telecommunications System shall be coordinated with the Owner and Architect.
- F. All necessary back boards, back-boxes, pull-boxes, connectors, supports, conduit, cable and wire shall be furnished and installed to provide a complete and reliable system. Exact location of all backboards, boxes, conduit and wiring runs shall be presented to the Owner / Architect for approval in advance of any installation. Provide as required and as specified in Division 26.
- G. Where required provide 120-VAC, 60 Hz power from nearest electrical panel through a

- junction box, to the system devices. Provide as required and as specified in Division 26.
- H. Where required, install conduit, cable and wire parallel and square with building lines, including raised floor areas. Conduit fills shall not exceed 40%.
 - I. All equipment shall be mounted with sufficient clearance to minimize EMI as well as meet all applicable codes and facilitate observation and testing. Securely hand and/or fasten with appropriate fittings to ensure positive grounding, free of ground loops, throughout the entire system. Units shall be installed parallel and square to building lines.
 - J. Quiet and vibration-free operation of all equipment is a requirement of this installation. Properly adjust, repair, balance or replace any equipment producing objectionable (in the judgment of the Owner or Architect) noise or vibration in any of the occupied areas of any building and provide additional brackets and bracing if necessary. Any such additions or changes shall be at no additional cost to the Owner.
 - K. Installation shall comply with the CODES AND STANDARDS portion of this Section. Where more than one code or regulation is applicable, the more stringent shall apply.
 - L. Where new equipment is replacing old equipment, the Contractor is responsible for removing and disposing of the old equipment and doing whatever repair work is necessary as specified by the Owner / Architect.
 - M. Install firestopping, as specified in Division 26 for all penetrations in slabs and firewalls to meet code at the completion of work and prior to final testing demonstration to the Owner.
 - N. The installation shall be performed in a professional manner.
 - O. On a daily basis, clean up and deposit in appropriate containers all debris from work performed under the appropriate specification sections. Stack and organize all parts, tools and equipment when not being used.
 - P. Preparation, handling and installation shall be in accordance with the Manufacturer's written instructions and technical data appropriate to the product specified.
 - Q. All work shall conform to the National Electrical Contractor's Association "Standard of Installation" for general installation practice.
 - R. At the conclusion of the installation, all work areas, including all enclosures and boxes, shall be vacuumed and cleaned to remove all debris and grease.

3.2 COORDINATION WITH OWNER / ARCHITECT

- A. Close coordination with the Owner / Architect is vital to achieve a complete, aesthetically pleasing job. The Contractor shall ensure that the Owner / Architect is kept fully apprized of job progress.

3.3 CUTTING, PAINTING, AND PATCHING

- A. Structural members shall not be drilled, bored or notched in such a manner that shall impair their structural value. Cutting of holes in structural members, if required, shall be done with core drills and only with the specific approval of the Owner / Architect for each instance.
- B. All walls that require cutting or repair during the installation process shall be returned to their original condition, including the matching of colors and finishes to the satisfaction of the Owner / Architect, and at no additional cost to the Owner.

3.4 WIRE AND CABLE

- A. All low voltage cable shall be low smoke plenum rated, limited energy, with 300-volt insulation.
- B. All wires in exposed areas shall run through conduit as specified in Division 26.
- C. Provide conduits, cable trays, raceways, wireways, boxes and outlets as specified in

Division 26.

- D. After installation, and before termination, all wiring shall be checked and tested to insure there are no grounds, opens, or shorts on any conductors. In addition, all wires between buildings or underground and all coax cables shall have insulation tested with a megohmmeter (megger) and a reading of greater than 20 megohms shall be required to successfully complete the test.
- E. Run wires continuously from termination to termination without splices.
- F. Wire and cable shall be supported in each equipment and terminal cabinet and in each terminal and pull box in vertical risers and horizontal runs with wire duct and strap-type supports. At any point where wire duct is required for good wire management, whether shown on elevations or not, install appropriate duct. Where terminal boards are used, wire ducts shall be supplied on both sides and at no time shall wires cross over terminal boards. Arrange cables neatly to allow inspection, removal and replacement. Lace cables as required. Spot tie wire bundles with plastic cable ties and securely affix to panels. If screw type terminals are specified, terminal strip connections shall be locking, tongue style, pressure crimp, and solderless spade lug.
- G. Visually inspect wire and cable for faulty insulation prior to installation. Protect cable ends at all times with acceptable end caps except during actual termination. At no time shall any coaxial cable be subjected to a bend less than a 6-inch radius. Protect wire and cable from kinks. Install 1 pull rope for all 2" or larger sized conduits.
- H. Provide plastic bushings and strain relief material at all conduit exit points and where necessary, to avoid abrasion of wire and excess tension on wire and cable.
- I. Cables above accessible ceilings shall not rest on ceiling tiles. Use Velcro tie wraps, J-hooks or D-rings to hold cables. Provide independent support for all cables. Support is to be from building structure (do not support from pipes or conduits). ESS cables shall not tie off on HVAC supports, all-thread, ceiling grid hanger wire or electrical / mechanical piping system.
- J. Ground and bond equipment and circuits in accordance with NEC and Division 26.

3.5 IDENTIFICATION AND TAGGING

- A. All cables, wires, wiring forms, terminal blocks and terminals shall be identified by labels, tags to other permanent markings in accordance with TIA/EIA-606. The markings shall clearly indicate the function, source, or destination of all cabling, wiring and terminals. All cables and wires shall be identified, utilizing heat-shrink, machine printed, polyolefin wire markers (Brady Type B-32 *or equal*). Handwritten tags are not acceptable.
- B. Should a situation arise where the wire tagging format as shown on the drawings cannot be used, a substitute format shall be submitted which complies with the intent to provide documentation that will permit end-to-end tracing of all ESS Systems wiring.
- C. All panels shall be provided with permanently attached engraved lamacoid labels with identifying names and functions. All terminal points shall be appropriately labeled. Labels shall be consistent in form, color, and typeface throughout the system and all must contain the name of the system or subsystem as part of the label textual information. Design, color, font and layout shall be coordinated with, and approved by, the Owner.
- D. Identification of Equipment:
 - 1. All major equipment shall have a manufacturer's label identifying the manufacturer's address, equipment model and serial numbers, equipment size, and other pertinent data. Take care not to obliterate this nameplate. The legend on all nameplates or tags shall correspond to the identification shown on the Operating Instructions.
 - 2. A black-white-black 3-layer laminated plastic engraved identifying nameplate

- shall be permanently secured to each wireway, terminal cabinet, and ESS cabinet or rack.
- a. Identifying nameplates shall have 1/2-inch high, engraved letters.
3. Permanent, waterproof, black markers shall be used to identify each ESS grid junction box, clearly indicating the type of system available at that junction box.
 4. Pull Boxes: Field work each with a nameplate showing identity, and identifying equipment connected to it. Nameplates shall also indicate where pull box is fed from.
- E. Prohibited Markings: Markings intended to identify the manufacturer, vendor, or other source from whom the material has been obtained are prohibited for installation in public, tenant, or common areas within the project. Also prohibited are materials or devices that bear evidence that markings or insignias have been removed. Certification, testing (example, Underwriters Laboratories), and approval labels are exceptions to this requirement.
 - F. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of ESS facilities. Provide text of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with industry standards for color and design.
 - G. Wire and Cable Labeling: Provide wire markers on each conductor in all boxes, pull boxes, gutters, wireways. Identify with drop/circuit number.
 - H. Underground Warning Tape: Thomas and Betts or approved equal. Six-inch wide plastic tape, colored red or orange with suitable warning legend describing buried ESS lines. All underground conduits shall be so identified. Tape shall be buried at a depth of 6-inches below grade and directly above conduits or ductbanks. Provide magnetic marking tape below all underground conduits.

3.6 CUTTING AND PATCHING

- A. General: Comply with the requirements of Division 01 for the cutting and patching of other work to accommodate the installation of electrical work. Except as authorized by the Architect / Engineer, cutting and patching of electrical work to accommodate the installation of other work is not permitted.

3.7 INSTRUCTION OF OWNER'S PERSONNEL

- A. Before proceeding with the instruction of Owner Personnel, prepare a typed outline, listing the subjects that will be covered in this instruction, and submit the outline for review by the Owner. At the conclusion of the instruction period obtain the signature of each person being instructed on each copy of the reviewed outline to signify that he has a proper understanding of the operation and maintenance of the systems and resubmit the signed outlines.
- B. Prior to substantial completion, conduct an on-site training program to instruct Owner's operating personnel in the operation and maintenance of the ESS systems.
 1. Provide the training during regular working day.
 2. The Instructors shall be experienced in their phase of operation and maintenance of the electrical systems and with the project.
- C. Time to be allocated for instructions.
 1. Minimum of 12 hours dedicated instructor time
 2. 4 hours on each of 3 days
 3. Additional instruction time for specific systems as specified in other Sections.
- D. Before on-site training, submit the program syllabus; proposed time and dates; for review and approval, minimum 48 hours prior to proposed training time and date.
 1. One copy to the Owner

2. One copy to the Architect / Engineer
- E. The Owner shall provide a list of personnel to receive instructions and shall coordinate their attendance at the agreed upon times.
- F. Use operation and maintenance manuals as the basis of instruction. Review manual with personnel in detail. Explain all aspects of operation and maintenance.
- G. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shut down of each item of equipment.
- H. Demonstrate equipment functions (both individually and as part of the total integrated system).
- I. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.
- J. Submit a report within one week after completion of training. List time and date of each demonstration, hours devoted to the demonstration, and a list of people present, with their respective signatures.
- K. 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.
- L. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.8 OPENINGS

- A. Framed, cast or masonry openings for boxes, equipment or conduits are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.9 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions, which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
 1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
 2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
- B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.10 VANDAL RESISTANT DEVICES

- A. Where vandal resistant screws or bolts are employed on the project, deliver to the Owner 2 suitable tools for use with each type of fastener used.
- B. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.11 PROTECTION

- A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.

- B. Do not deliver equipment to this 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 shall be rejected, and the contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.

3.12 EQUIPMENT BACKBOARDS

- A. Backboards: $\frac{3}{4}$ inch, fire retardant, exterior grade plywood, painted gray, both sides.
 - 1. Provide minimum of two 4-ft. by 8-ft. sheets of plywood for each location shown.
 - 2. Provide minimum of two 4-ft. by 4-ft. sheets of plywood for each ESS location.

3.13 SITE MANAGEMENT RESPONSIBILITY

- A. The Contractor shall provide an on-site Project Manager as defined in CONTRACTOR'S QUALIFICATIONS portion of this Section.

3.14 DEMOLITION AND RELOCATION

- A. 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.
- B. 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 Consultant. Where items scheduled for relocation and/or reuse are considered unsuitable for reuse, the Contractor shall so notify the Consultant 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 no additional cost to the Owner or the Consultant.
- C. 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.
- D. 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 Consultant.

3.15 EXISTING SYSTEM TESTING

- A. Contractor shall have each low voltage system tested prior to the commencement of construction. Systems shall include all systems that fall under the Division 28 umbrellas, as identified in the Division 2 of the Construction Specifications Institute (CSI) current

Master Format7 Test shall include the functionality of all field devices and equipment. Any failures or items found to be functioning not to specification, shall be reported prior to construction. Any items found to be improperly or non-functioning upon the completion of the project, shall be replaced and/or repaired, by the contractor, at no additional cost to the project or the owner.

- B. Contractor shall document the location and any ID tag, MAC address, IP address, or bar code of any existing device that is to be removed from its current location. Devices that are to remain, shall be reinstalled in the exact location that they reside in prior to construction, unless noted otherwise.
- C. Any individual/firm that will be removing, relocating, reinstalling, or tampering with any devices; shall be licensed by the state and certified by the manufacturer of the system.
- D. Contractor shall remove any devices where construction occurs to prevent possible damage to the device. Removal of any devices which support user connection or other systems, shall be coordinated with the owner prior to removal and/or taking offline.

3.16 START-UP RESPONSIBILITY

- A. The Contractor shall initiate System operation. The Contractor shall provide competent Start-Up personnel on each consecutive working day until all ESS Systems are functional and ready to start the acceptance test phase. If the Contractor, in the Owner / Architect's judgment, is not demonstrating progress in solving any technical problems, the Contractor shall supply Manufacturer's factory technical representation and diagnostic equipment at no cost to the Owner, until resolution of those defined problems. Where appropriate, the Contractor shall bring the Systems on-line in their basic state (i.e., alarm reporting, facility code access control, etc.) It is the responsibility of the Owner to provide the specific database information that will be utilized for initial system programming.
- B. Properly ground each piece of electronic equipment prior to applying power. Properly ground all shielded wire shields to the appropriate earth ground at the hub end only, not at the remote or device end.
- C. Use a start-up sequence that incrementally brings each portion of the system on-line in a logical order that incorporates checking individual elements before proceeding to subsequent elements until the entire system is operational. The basic steps should include:
 - 1. Establish ground planes at the equipment rooms and hub end of the systems as specified in Division 26.
 - 2. Disconnect power, connect the first device, reconnect power, and verify operational correctness. Repeat until the entire system is verified and operational.

3.17 PREPARATION FOR ACCEPTANCE (SUBSTANTIAL COMPLETION)

- A. All systems, equipment, and devices shall be in full and proper adjustment and operation, and properly labeled and identified.
- B. All materials shall be neat, clean and unmarred, and parts securely attached.
- C. All extra material as specified shall be delivered and stored at the premises as directed.
- D. Test reports of each system and each system's components and As-Built Project Drawings shall be complete and available for inspection and delivery as directed by the Owner.

3.18 SYSTEM ACCEPTANCE REQUIREMENTS

- A. Before final acceptance or work, the Contractor shall perform and/or deliver each of the following in the order stated.
- B. The Contractor shall deliver three (3) composite "System Operations and Maintenance"

manuals in three-ring binders, sized to hold the material below, plus 50% excess. Each manual shall contain in appropriately tabbed sections:

1. A statement of Guarantee including date of termination and the name and phone number of the persons to be called in the event of equipment failure.
 2. A set of Operating procedures for the overall System that includes all required Owner activities, and that allows for the Owner operation of all attributes and facilities of the System.
 3. A section for each specific type of equipment containing the vendor manuals, instruction sheets, and any related literature that came in the original shipping container for that piece of equipment. Include all warranty cards.
- C. Testing:
1. The Contractor shall perform all tests required by Division 28 and those submitted as part of this Section.
 2. The Contractor shall activate all devices for proper system operation, including supervisory and trouble circuit tests. Similarly, audible alarms will not be activated except on a one-time, coordinated basis, to check the actual sounding devices.
 3. A test report for each piece of equipment shall be prepared by the Contractor and submitted to the Owner. This report shall include a complete listing of every device, the date it was tested, by whom and the results. The final test reports shall indicate that every device tested successfully. Failure to completely test and document the tests will result in a delay of final testing and acceptance.
- D. As-Built Drawings:
1. After completion of all the tests listed above, and prior to the final acceptance test, The Contractor shall submit the complete As-Built drawings as identified in PART 1 – PROJECT RECORD DRAWINGS.
 2. The final As-Built Drawings shall consist on one set of reproducible prints, two (2) sets of Point-to-Point Detail Drawings, Equipment Schedules, and the complete detailed technical data that was shipped by the manufacturer with all installed equipment.
- E. Final Acceptance Test: The Final Acceptance Test shall demonstrate the installed and activated System's performance and compliance with System Specifications. However, before this testing can begin the following must have received and reviewed by the Owner.
1. System Operations and Maintenance Manuals
 2. System Test Reports
 3. As-Built Drawings

3.19 NOTICE OF COMPLETION

- A. When the Final System Acceptance Requirements described above including the Final Acceptance Test described above have been satisfactorily completed. The Owner / Architect shall issue a Letter of Completion to the Contractor indicating the date of such completion. The Notice of Completion shall be recorded by the Contractor upon receipt of the Owner / Architect completion letter. This date of record shall be the start of the warranty period.

END OF SECTION

SECTION 28 05 07
SHOP DRAWINGS, COORDINATION DRAWINGS & PRODUCT DATA

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Prepare submittals as required by Division 1 and as outlined below.
- B. Submit product data shop drawings only for the following and for items specifically requested elsewhere in the Contract Drawings and Specifications. Architect / Engineer reserves the right to refuse shop drawings not requested for review and to imply that materials shall be provided as specified without exception.
- C. The term submittal, as used herein, refers to all:
 - 1. Shop Drawings
 - 2. Coordination Drawings
 - 3. Product data
- D. Submittals shall be prepared and produced for:
 - 1. Distribution as specified
 - 2. Inclusion in the Operating and Maintenance Manual, as specified, in the related section

1.2 SHOP DRAWINGS

- A. Present drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.
- B. Show all dimensions of each item of equipment on a single composite Shop Drawing. Do not submit a series of drawings of components.
- C. Identify field dimensions; show relation to adjacent or critical features or work or products.

1.3 COORDINATION DRAWINGS

- A. Present in a clear and thorough manner. Title each drawing with project name. Identify each element of drawings by reference to sheet number and detail, or room number of contract documents. Minimum drawing scale: 1/4"=1'-0".
- B. Prepare coordination drawings to coordinate installations for efficient use of available space, for proper sequence of installation and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.
- C. For each room containing ESS equipment and each rack with ESS equipment, submit plan and elevation drawings. Show:
 - 1. Actual ESS equipment and components to be furnished.
 - 2. NEC working space and NEC access to NEC working space.
 - 3. Relationship to other equipment and components and openings, doors and obstructions
 - 4. Rack location and dimensions
- D. Identify field dimensions. Show relation to adjacent or critical features of work or products.
- E. Verify location of ESS station devices and other work specified in this Division.
 - 1. Coordinate with drawing details, site conditions and millwork shop drawings prior to installation.
 - 2. Where required for clarification, submit shop drawings prior to rough-in and fabrication.
- F. Submit shop drawings in plan, elevation and sections, showing outlets and other devices in casework, cabinetwork and built-in furniture.

1.4 PRODUCT DATA

- A. All product options specified shall be indicated on the product data submittal. All options listed on the standard product printed data not clearly identified as not part of the product data submitted shall become part of the Contract and shall be provided.
- B. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number.
- C. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.
- D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.
- E. Mark up a copy of the specifications for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect / Engineer/Owner (Does Not Comply, Explanation:)

1.5 MANUFACTURERS INSTRUCTIONS

- A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up and adjusting.

1.6 CONTRACTOR RESPONSIBILITIES

- A. Review submittals prior to transmittal.
- B. Determine and verify:
 - 1. Field measurements
 - 2. Field construction criteria
 - 3. Manufacturer's catalog numbers
 - 4. Conformance with requirements of Contract Documents
- C. Coordinate submittals with requirements of the work and of the Contract Documents.
- D. Notify the Architect / Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.
- E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect / Engineer's acceptance.
- F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect / Engineer reviews submittals or not.
- G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect / Engineer reviews submittals or not, unless Architect / Engineer gives written acceptance of the specific deviations on reviewed documents.
- H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
 - 1. Proper sizes and capacities
 - 2. That the item will fit in the available space in a manner that will allow proper service
 - 3. Construction methods, materials and finishes
- I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

1.7 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor.
- B. Number of submittals required:
 - 1. Shop Drawings and Coordination Drawings: Submit four opaque reproductions.
 - 2. Product Data: Submit the number of copies the contractor requires, plus those to be retained by the Architect / Engineer.
- C. Accompany submittals with transmittal letter, in duplicate, containing:
 - 1. Date
 - 2. Project title and number
 - 3. Contractor's name, address and telephone number
 - 4. The number of each Shop Drawing, Project Datum and Sample submitted
 - 5. Other pertinent data
- D. Submittals shall include:
 - 1. The date of submission
 - 2. The project title and number
 - 3. Contract Identification
 - 4. The names of:
 - a. Contractor
 - b. Subcontractor
 - c. Supplier
 - d. Manufacturer
 - 5. Identification of the product
 - 6. Field dimensions, clearly identified as such
 - 7. Relation to adjacent or critical features of the work or materials
 - 8. Applicable standards, such as ASTM or federal specifications numbers
 - 9. Identification of deviations from contract documents
 - 10. Suitable blank space for General Contractor and Architect / Engineer stamps
 - 11. Contractor's signed and dated Stamp of Approval
- E. Coordinate submittals into logical groupings to facilitate interrelation of the several items.
 - 1. Finishes which involve Architect / Engineer selection of colors, textures or patterns
 - 2. Associated items requiring correlation for efficient function or for installation

1.8 SUBMITTAL SPECIFICATION INFORMATION

- A. Every submittal document shall bear the following information as used in the project manual:
 - 1. The related specification section number
 - 2. The exact specification section title
- B. Submittals delivered to the Architect / Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.9 RESUBMISSION REQUIREMENTS

- A. Make resubmittals under procedures specified for initial submittals.
 - 1. Indicate that the document or sample is a resubmittal
 - 2. Identify changes made since previous submittals
- B. Indicate any changes which have been made other than those requested by the Architect / Engineer.

1.10 CONTRACTOR'S STAMP OF APPROVAL

- A. Contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
- B. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect / Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.
- C. Do not deliver any submittals to the Architect / Engineer that do not bear the Contractor's stamp of approval and signature.
- D. Submittals delivered to the Architect / Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.11 ARCHITECT / ENGINEER REVIEW OF IDENTIFIED SUBMITTALS

- A. The Architect / Engineer will:
 - 1. Review identified submittals with reasonable promptness and in accordance with schedule. Specific equipment submittals that may be required to be expedited shall be submitted separately without other submittal items not requiring the same prompt attention.
 - 2. Affix stamp and initials or signature, and indicate requirements for resubmittal or approval of submittal
 - 3. Return submittals to Contractor for distribution or for resubmission
- B. Review of submittals will not extend to design data reflected in submittals that is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.
- C. Architect / Engineer's review is only for conformance with the design concept of the project and for compliance with the information given in the contract.
 - 1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
 - 2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes or coordination with the work of other trades.
- D. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.12 SUBSTITUTIONS

- A. Do not make requests for substitution employing the procedures of this Section.
- B. The procedure for making a formal request for substitution is specified in Division 01.

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION

3.1 SHOP DRAWINGS AND PRODUCT DATA

- A. Submittals shall not be combined or bound together with any other material submittal.
- B. Submit individually bound shop drawings and product data for the following when specified or provided:
 - 1. Low Voltage Wire
 - 2. Electronic Access Control and Intrusion Detection

3. Electronic Surveillance
4. Fire Detection and Alarm

3.2 COORDINATION DRAWINGS

- A. Submit coordination drawings as specified.

END OF SECTION

SECTION 28 05 10
CONTRACT QUALITY CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Contract quality control including workmanship, manufacturer's instructions, mock-ups and demonstrations.

1.2 QUALITY CONTROL PROGRAM

- A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work in accordance with contract documents.

1.3 WORKMANSHIP

- A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform work by persons qualified to produce workmanship of specified quality.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.
- D. Provide finishes to match approved samples; all exposed finishes shall be approved by the Architect / Engineer. Submit color samples as required.

1.4 MANUFACTURER'S INSTRUCTIONS

- A. Comply with instructions in full detail, including each step in sequence.
- B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.5 MANUFACTURER'S CERTIFICATES

- A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.6 MANUFACTURER'S FIELD SERVICES

- A. When required in individual Specification Sections, manufacturer shall provide a manufacturer's qualified personnel to observe:
 - 1. Field conditions.
 - 2. Condition of installation.
 - 3. Quality of workmanship.
 - 4. Start-up of equipment.
 - 5. Testing and adjusting of equipment.
- B. Manufacturer's qualified personnel shall make written report of observations and recommendations to Architect / Engineer.

1.7 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 where possible.
- D. Perform tests and submit results as specified.

1.8 SCHEDULING OF 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. Demonstrations

PART 2 - PRODUCTS

2.1 REFERENCE APPLICABLE SPECIFICATION SECTIONS

PART 3 - EXECUTION

3.1 ADJUSTMENTS AND MODIFICATIONS

- A. Contractor shall provide all adjustments and modifications as requested by the manufacturer's qualified personnel at no additional cost to Owner.

3.2 MOCK-UPS

- A. Mock up a typical classroom, science lab of each type, and computer lab with all wiring devices, cover plates, rough-in boxes, conduits, etc. provide all conductors from all wiring devices to above ceiling space to demonstrate conduit routing and conductor fill.

END OF SECTION

**SECTION 28 05 50
FIRESTOPS**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide firestop as required, and as specified. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.
- B. Types: Firestop required for the project includes smokestop.

1.2 QUALITY ASSURANCE

- A. UL Label: Firestops shall be UL labeled.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Nelson.
- B. 3M (Minnesota Mining Manufacturing).
- C. Hilti
- D. Specified Technologies, Inc.

2.2 MATERIAL AND COMPONENTS

- A. General: Except as otherwise indicated, provide firestop manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended by the manufacturer, and as required for installation.

2.3 FIRESTOP

- A. Conduits: Provide a soft, permanently flexible sealant for 1-1/2 to 2 hour rated fireproofing for steel conduits (up to 4" diameter).
- B. Low Voltage Cables, Fiber Optic Cable and Innerduct: Provide Specified Technologies, Inc. EZ-Path single, double, or triple pathways as required.

PART 3 - EXECUTION

3.1 INSTALLATION OF FIRESTOPS

- A. General: Install firestops in accordance with the manufacturer's installation instructions and industry practices to ensure that the firestops comply with requirements. Comply with UL and NFPA standards for the installation of firestops.

END OF SECTION

SECTION 28 10 00
ACCESS CONTROL SYSTEM (ACS)

PART 1 - GENERAL

1.1 RELATED WORK

- A. The following, in their entirety and as applicable, shall apply to this section. Including any associated drawings.
 - 1. Conditions of the Contract
 - 2. Division 1
 - 3. Division 26
 - 4. Division 27
 - 5. Division 28

1.2 WORK INCLUDED

- A. Reference Attachment 'A' of this specification for supplemental scope and product material list as it relates to the project and the Owner standards.
- B. ACS devices indicated are for reference and coordination purposes only. The System Installer shall design and provide a complete system, meeting the requirement of specification. Installer shall provide all system devices required to established controlled access and monitoring at locations designated in the contract documents. The system installation shall be in compliance with all governing authorities and the Architect, Engineer, and Owner expectations.
- C. Security system devices indicated are for reference and coordination purposes only. The System Installer shall design and provide a complete system, meeting the requirement of specification. The installer shall provide all security system devices required for complete system perimeter coverage acceptable to all governing authorities, Architect and Owner.
- D. The system shall include security for all access into building, including but not limited to the following:
 - 1. Control Panels
 - 2. Power Supplies
 - 3. Interconnection of panels
 - 4. Installation of new devices
 - 5. Card reader
 - 6. Magnetic locking hardware
 - 7. Request to exit devices
 - 8. Door position sensors
 - 9. Door Hardware (as specified herein and/or in Division 08, door hardware)
 - 10. Lockdown and Lockout Buttons
 - 11. Audio / Video Intercom Systems
 - 12. All additional material, hardware, and labor required for a fully functional, turnkey system
- E. The System Installer shall connect each controller to the ACS Management System.
- F. All system programming will be performed by the system installer. The system installer will be required to meet with the Owner, engineer, and system manager to discuss wiring and termination of the system control panels and field devices prior to installation.
- G. Licensing: The System Installer shall NOT utilize any of the owner's existing licensing for this scope of work. All licensing shall be provided by the System Installer, no exceptions. Including, but not limited to the following:
 - 1. Portal Licensing
 - 2. Controller Licensing
 - 3. Wireless Licensing

4. Video Management Software Integration Licensing

- H. System Installer to refer to Division 08 Door Hardware Specification. Provide and install all hardware specified to be provided by the “Access Control Contractor”, “Security Installer”, “Division 28”, or any variation thereof.
- I. System Installer to provide and install door hardware as specified in Specification Section 28 10 00.10 Access Control Hardware Devices - and 28 10 00.05 Access Control Hardware Devices
- J. The documents issued for this project are conceptual in nature, including but not limited to specifications and drawings. It shall be the responsibility of the approved installer to furnish a complete and functional system, including the items shown on the drawings, in the specifications, and items not designated in either. The installer’s shop drawings and product data submittals shall represent a complete system, and documents accepted do not relieve the installer from being required to provide any materials, equipment, or labor to furnish a complete and functional system as recognized by the Project’s Technology Consultant and the Owner.

1.3 REFERENCES

- A. Code of Federal Regulations (CFR).
- B. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. 802.3 Ethernet Standards.
 - 2. IEEE 1100 Recommended Practice for Powering and Grounding Electronic Equipment.
- C. International Electrotechnical Commission (IEC).
- D. International Organization for Standardization (ISO):
 - 1. ISO / IEC 10918 - Information technology -- Digital compression and coding of continuous-tone still images: Requirements and guidelines; JPEG.
 - 2. ISO / IEC 14496-10 - Information Technology - Coding Of Audio-Visual Objects - Part 10: Advanced Video Coding; MPEG-4 Part 10 (ITU H.264).
 - 3. ISO / IEC 23008-2 - High Efficiency Coding and Media Delivery In Heterogeneous Environments - Part 2: High Efficiency Video Coding; MPEG-H Part2 (ITU H.265, HEVC).
- E. Federal Communications Commission (FCC):
 - 1. FCC Part 15 – Radio Frequency Device
- F. Underwriters Laboratories (UL):
 - 1. UL294 – Access Control Systems Units
- G. Electronic Industries Alliance (EIA)
 - 1. RS485 - Electrical Characteristics of Generators and Receivers for use in Balanced Digital Multi-Point Systems
- H. Federal Information Processing Standards (FIPS)
 - 1. Advanced Encryption Standard (AES) (FIPS197)
 - 2. FIPS201-2: Open Options DNA Fusion FIPS in conjunction with an E2-SSP-D2-FIPS, NSC-100-FIPS, RSC-2-FIPS and other listed components will provide an access control solution that is fully FIPS 201-2 compliant.
 - 3. Personal Identity Verification (PIV) of Federal Employees and Contractors
- I. Homeland Security Presidential Directive 12 (HSPD12)
- J. National Fire Protection Association Standards:
 - 1. NFPA 70 - National Electrical Code
 - 2. NFPA 72 - National Fire Alarm Code
 - 3. NFPA 101 - Life Safety Code
- K. RoHS compliant

- L. SIA AC-01-1996.10 - Access Control - Wiegand
- M. Local & State Building Codes
- N. Requirements of Local Authorities having Jurisdiction

- O. Requirements of American Disabilities Act (Public law 101-336).
- P. Texas Accessibility Standards (TAS)
- Q. Texas Insurance Code.

1.4 QUALITY ASSURANCE

- A. System Installer Qualifications:
 - 1. The System Installer shall be the authorized representative of the Access Control Manufacturer to sell, install, and service the proposed manufacturer's equipment. The System Installer shall have represented the security alarm manufacturer's product for at least two years.
 - 2. The System Installer shall be licensed as required, by the State in which the project is located in, as a security services contractor to design, sell, install, and service security alarm systems.
 - 3. The System Installer shall provide 24-hour, 365 days per year emergency service with factory trained service technicians.
 - 4. The installing firm 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.
 - 5. The System Installer 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.
 - 6. The proposing System Installer for this system and the installer of this system shall be of the same organization. Absolutely no subcontracting of any portion of this system by the proposing System Installer will be allowed.
 - 7. The proposing/installing contractor of this system must be an authorized dealer / integrator for the project's specified Video Surveillance and the Intrusion Detection systems as well as the system specified in this section.
 - 8. For proper, smooth, and complete integration of the IP security camera, access control, and intrusion detection systems; the proposing/installing contractor of the video surveillance and intrusion detection systems must be the same contractors.
 - 9. The System Installer must be a current integrator of solution in the closest 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.
 - 10. The System Installer must be in good standing with the Owner and have no outstanding performance or warranty items at the time of bid. Any outstanding items or issues is grounds to disqualify the System Installer for performing any work on the project.

1.5 SUBMITTALS AND CLOSE-OUT

- A. Product Data: Within fourteen (14) days of Notice to Proceed, the system installer shall furnish the following in a single consolidated submittal:
 - 1. Permits: The Contractor shall obtain all required permits and provide copies to the Owner / Architect / Engineer.
 - 2. Product Literature: Complete manufacturer's product literature for all system

- equipment, power supplies, cable, termination components, cable supports, cable labels, field 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/Designer) and the manufacturer's supporting documentation, demonstrating compatibility with other related products shall be included. The submittal shall have some type of distinguishing marker or pointer to indicated what specific product is to be submitted.
3. Construction Schedule: A time-scaled Construction Schedule indicating general project deadlines and specific dates relating to the installation of the cable distribution system.
 4. Specification Compliance: A letter shall be provided stating, by section and subsection, that the 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.
 5. Certifications: The System Installer shall submit all of the following certifications and the certifications must contain dates which are valid from the date of proposal and not expire any sooner than 12 months after substantial completion of the project.
 - a. Manufacturer's Authorized Dealer/Installer Certification: This certification must be held by the proposing/installing contractor and state that the proposing/installing contractor is an authorized dealer/installer of the system specified within the project specifications. The certification must have been obtained by the office that is within a 75-mile radius of the project's location.
 - b. Installer Certification: This certification must be held by at least 25% of the, on-site, staff and be made available at the site if requested by the owner, architect, and/or project's technology consultant.
 - c. Licenses: This includes all licenses required by the state in which the work is being performed, the federal government, local authorities having jurisdiction, and any organization in that governs the specific system
- B. Shop Drawings: Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed:
1. Proposed circuit routing and circuit grouping plan prepared by a system registered designer. The designer's certification must be current. Identifiable, separate routing shall be shown for both the station cabling and any backbone trunk cabling.
 2. In addition to the cable routing, the submitted drawings shall indicate the following, even if the following is expected to be provided by the project's electrical or general contractor:
 - a. Location of all control equipment and remote power sources
 - b. Locations of all field devices and outlets
 - c. Location of wall penetrations (all penetrations shall be sleeved and contain protective bushings at both ends)
 - d. Location of sleeved wall and/or floor pass-thru
 - e. Size of sleeve at each location installed
 - f. Quantity of cable passing through each sleeve
 - g. Conduit routing, size, quantity, and stub-up locations for any floor mounted outlets or outlets installed in casework.

3. Drawing Compliance: A letter shall be provided stating that the system installer complies with the entire project drawing, including all general, keyed, and notes to contractor. 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 approved by the project's technology consultant.
- C. Close-out Procedures: For review and acceptance, furnish an electronic copy of the following documents to the Architect / Engineer. Upon acceptance of the submitted close-out documents, provide four (4) copies on an electronic storage media (CD or USD Flash Drive) Labeled with the project name, date of submission, and the name of the submitting firm. Final copies shall be delivered directly to the project's Technology Consultant. The closeout submittals shall include the following and be packaged in a storable container with the physical storage media and any physical items listed:
1. Inspection and Test Reports: During the course of the Project, the System Installer shall maintain an adequate inspection system to ensure that the materials supplied, and the work performed, conform to contract requirements. The System Installer shall provide written documentation that indicates that materials acceptance testing was conducted as specified. The System Installer shall also provide documentation, which indicates that all cable termination testing was completed and that all irregularities were corrected prior to job completion.
 2. Provide complete test reports for all cabling and devices that comprise system as outlined in this document.
 3. Include the Name, address and telephone of the authorized factory representative with a 24-hour emergency service number.
 4. The manual shall also include Manufacturer's data sheets and installation manuals/instructions for all equipment installed and a list of recommended spare parts.
 5. Generic or typical owner's instruction and operation manual shall not be acceptable to fulfill this requirement.
 6. An up-to-date record ("as-built") set of approved shop drawing prints that have been revised to show each and every change made to the system from the original approved shop drawings.
 7. As-built Drawings shall include cable pathways; device locations with correct labeling, control equipment locations, remote power supply locations, cross connect locations, and lightning protection locations. The as-built drawings shall be prepared using AutoCAD 2014 or later.
 8. All drawings must reflect point to point wiring, device address and programmed characteristics as verified in the presence of the engineer and/or the end user unless device addressing is electronically generated, and automatically graphically self-documented by the system.
 9. A copy of the manufacturer's warranty on the installed system.
 10. Any keys to cabinets and/or equipment and special maintenance tools required to repair, maintain, or service the system.
 11. 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)
 12. Upon completion of the work and at a time designated by the Architect or owner, provide formal training sessions for the Owner's operating personnel to include location, operation, and maintenance of all included systems and equipment.

Provide a video copy of the training session as well as all sign in and training sign off sheets

13. One (1) 30" x 42" laminated floor plan sheets illustrating device locations, system wiring configuration, and cable designation. The System Installer shall provide one complete floor plan sheet at each panel location.

1.6 DEFINITIONS

A. Abbreviations:

1. ACS Access Control System
2. VMS Video Management System
3. NVR Network Video Recorder
4. IDS Intrusion Detection System
5. GUI Graphical User Interface
6. IP Internet Protocol
7. CR Card Reader
8. DS Door Station
9. MS Master Station
10. PIR Passive Infrared Sensor
11. LD Lockdown
13. LO Lockout
14. MDF Main Distribution Frame
15. IDF Intermediate Distribution Frame

B. Definitions:

1. Access Card: A coded employee card, usually the size of a credit card, recognizable to the access control system and read by a reader to allow access. It can be used for photo identification of the cardholder and for other data collection purposes. Card technologies include magnetic strips, Wiegand-effect, proximity (active/passive), barium ferrite, smart/intelligent cards, and NFC enabled applications on mobile devices.
2. Access Control System: An interconnected set of controllers, managing the entrance and exit of people through secured areas.
3. Access Level: The door or combination of doors and/or barriers an individual is authorized to pass through and the times they are permitted.
4. Anti-Pass back (Anti-Tailgating): This feature protects against more than one person using the same card or number. It defines each system card reader and card ID number as IN, OUT or other. Once a card is granted access to an IN reader, it must be presented to an OUT reader before another IN reader access is granted. Cards will continue to have access to all authorized OTHER readers.
5. Alarm: A signal that indicates a problem.
6. Alarm input: A device that is monitored by the access control panel. An alarm signal will be generated if the device is activated.
7. Badge: Badge is a template or a design for creating a card. DNA Fusion includes a full-featured badge layout utility for designing, creating, and printing badges. Badge design includes magnetic stripe encoding, bar coding, signatures, and so on.
8. Bar Code: A method of encoding information using lines and blank spaces of varying size and thickness to represent alphanumeric characters.
9. Biometrics: A general term for the verification of individuals using unique biological characteristics (i.e. fingerprints, hand geometry, voice analysis, the retinal pattern in the eye).
10. Card and Card Holder: A card is an identity proof of a person and a card holder is

- a person who holds the card. Multiple cards can be assigned to a single card holder to provide different access.
11. **Controller:** A microprocessor-based circuit board that manages access to a secured area. The controller receives information that it uses to determine through which doors and at what times cardholders are granted access to secure areas. Based on that information, the controller can lock/unlock doors, sound alarms, and communicate status to a host computer.
 12. **Card Reader:** A device that retrieves information stored on an access card and transmits that information to a controller.
 13. **Digital Video Recorder:** A security system device that records the video from the surveillance cameras (IP and Analog) on a hard disk.
 14. **Door:** A generic term for a securable entry way. In many access control applications, a "door" may be a gate, turnstile, elevator door, or similar device.
 15. **Duress:** Forcing a person to provide access to a secure area against that person's wishes.
 16. **Input:** An electronic sensor on a controller that detects a change of state in a device outside the controller.
 17. **Integrated lockset:** An integrated, intelligent locking solution that typically runs on batteries, but can be externally powered, that contains most of the door components, i.e. reader, door contact, and request to exit in a single, mountable unit.
 18. **Keypad:** An alphanumeric grid which allows a user to enter an identification code. A flat device which has buttons that may be pressed in a sequence to send data to a controller, and which differs from a typewriter-like computer keyboard.
 19. **Output Relay:** A device that changes its state upon receiving a signal from a controller. Typically, the state change prompts an action outside of the controller such as activating or deactivating a device. The auxiliary relays found in access control panels or NODES that control external devices.
 20. **Shunt Time:** The length of time a door open alarm is suppressed (shunted) after a valid card access or free egress request. This time should be just enough to allow a card user to open a door or gate, pass through, and then close it.
 21. **Time Schedules:** Schedules that allow cards to function or not function depending on the time of day. This is used to limit access to the facility. The schedule may include not only time but which days of the week a card is valid.
 22. **Video Management System:** An enterprise-class video management and storage solution

1.7 PRE-INSTALLATION MEETINGS

- A. No less than a minimum of two weeks prior to rough-in or installation of any access control device, the ACS Installer will be required to attend a pre-construction meeting with the Door Hardware provider / installer to aid in coordination and help avoid gap / overlap during the installation phase.

1.8 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. **Handling:** Handle materials to avoid damage.

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 recommended limits.

1.10 SEQUENCING

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.11 WARRANTY

- A. The ACS furnished by the System Integrator including wiring, software, hardware and third-party products shall be fully warranted for parts, materials and labor for a minimum of 1 year from date of the final acceptance.
- B. Manufacturer shall provide a limited 3-year warranty for the product to be free of defects in material and workmanship.

PART 2 - PRODUCTS

2.1 Reference Attachment 'A' of this specification for supplemental scope and product material list as it relates to the project and the Owner standards

2.2 MANUFACTURERS

- A. Approved Manufacturers:
 - 1. AMAG Technology Inc.
20701 Manhattan Place
Torrance, Ca 90501
(310).518.2380
<http://www.amag.com>
- B. Requests for substitutions will be considered in accordance with provisions of Division 1. In the absence of direction by Division 1, substitution request must be submitted no less than ten (1) business days from the time of proposal. Any substitution proposed will have to be proposed as a complete system replacement across the Owner's entire platform, including any cabling and/or hardware changes required to convert all of the Owner's existing sites.

2.3 SERVERS AND USER INTERFACE

- A. Servers and User Interfaces are existing to remain. The system installer shall coordinate the installation of all new equipment and/or existing equipment that is affected by the project's scope. All equipment shall be modified and/or added in compliance with the existing systems parameters. The system installed shall provide and additional equipment to furnish a complete expansion of the system as shown on the project drawings, access control schedule, details, and legends.

2.4 ACCESS CONTROL SYSTEM (ACS)

- 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. The ACS shall include, but is not be limited to, the following:
 - 1. Client/Server model operating central server host software modules and client workstation software applications in a multi-user and a multi-tasking

environment.

- a. The ACS to permit multiple instances of client software applications to run simultaneously on the network. The base system shall include one (1) software application licenses per site with an unlimited number of licenses available subject to connection fees.
2. Partitioning: The system to support security partitioning enabling system administrator to segment the configuration database and group multiple entities within the security partition.
 - a. Security partitions limit what users can view in the configuration database. Administrators, who have all rights and privileges, can segment a database into multiple security partitions. A user who is given access to a specific partition will only be able to view entities (components) within the partition they have been assigned.
3. Encryption: The system to support encrypted communication between the central server software and client software applications (server-to-server and client-to-server) using a 128-bit AES encryption algorithm (at a minimum).
 - a. Communication between the central server host software module and system controllers to be encrypted if supported by the controllers.
 - b. The ACS client software applications to be password protected with passwords stored in the central server database in an encrypted manner.
4. Distributed Processing: The system is a fully distributed processing application allowing information, including time, date, zones, valid codes, tasks, access levels, and similar data, to be downloaded from the central host station to controller interface devices allowing access-control decisions with or without central host station communication. If communications to a central host station are lost, the controllers will automatically buffer event transactions until communications are restored and events are automatically uploaded to the central host station.
 - a. Provide for a higher level of distributed database management at defined perimeter access points such that no single point of failure will allow more than two access points to fail, or affect more than two access points at perimeter points system wide.
5. Single Data Base: The system to support a single database for access control site setup, credential and identity file creation, alarm and control setup, and system user operation and command functions.
6. System Access Management: The system to allow operators through password authentication the ability to make access granted or denied decisions, define access levels, time zones, holidays, assign cardholders, access groups, develop tasks, and generally manage access control, alarm monitoring and response activities system wide from a single login. Operator and user privileges are managed by a system administrator allowing for different levels of system access and system control. Authorization management is fully Owner definable.
7. Cardholder Management: The system to include a cardholder management system integrated within the access control system. This cardholder management functionality allows the enrollment of cardholders into the database, and import / export of employee data.
8. Access Groups and Access Levels: The system to provide adequate access groups and access level assignment capability to meet Owner requirements for the specified project. If required, software application can be expandable to support unlimited access groups and access levels.
9. Alarm Monitoring: The system is able to monitor, report, and provide

- information about the time and location of alarms, along with their priority.
10. Event Monitoring: The system is able to monitor, report, and archive network access control activity.
 11. Transaction Logs: The system to support an unlimited number of logs and historical transactions (events and alarms) with the maximum allowed being limited by the amount of hard disk space available.
 12. System Monitoring: The system to have ability to report on the integrity of all network assigned devices, circuits and communications and provide a diagnostics screen showing field level communications system wide
 13. Lock/Unlock Commands: The system to allow an operator to manually lock and unlock doors overriding scheduled access control restrictions and configurations if necessary.
 14. Hardware Interface: The system to integrate with and control specified electrified hardware, signaling and monitoring devices.
 15. Report Generator: The system to have the ability to generate and output reports with any and all combinations of system fields and data including, but not limited to: by cardholder, by door, by site, by time, by groups of doors and by cardholder field. Any and all combinations of fields must be available for reporting. The report feature to allow exporting of generated reports over a network connection or by remote printing.
 16. Multi-User/Web Based Network Capabilities: The system to support multiple operator workstations via local area network/wide area network (LAN/WAN), the Internet, or VPN. The system to be capable of supporting minimum of concurrent users/clients with software expansions to an unlimited number of workstations based on the Owners network requirements.
- B. Open Protocol: The ACS manufacturer to provide non-proprietary, open protocol hardware for the system control processors and associated device sub-controllers. Systems utilizing a single manufacturer solution that encompasses combined proprietary software and integrated electronic hardware combinations are not acceptable. In addition, integrated electronic locking hardware requiring a processor or sub-controller module upgrade, or extensive access control firmware upgrades to accommodate integrating with an alternate software package, will not be considered.
- C. Network Support: Communication network connecting the central server host software modules, client workstation software applications, and hardware controllers to be designed to support all of the following:
1. LAN/Ethernet enterprise ring topology and localized star topology based on TCP/IP.
 2. Direct-connected RS-232 and RS-485 communication cabling.
 3. Dial-up modem connection using a standard dial-up telephone line.
- D. Provide local communication port at each panel for local configuration of system with laptop.
- E. Locate all main control panels in MDF and IDF rooms of each building.
- F. Provide 120v at all controller and power supply locations.
- G. Provide and transfer all required licensing to the owner.
- H. Provide local communication port at each panel for local configuration of system with laptop.
- I. Integrated Elevator Destination Dispatch Control Solutions
1. The ACS shall provide means of integration with the following elevator systems destination dispatch control solution. Integration shall be by software or input/output connection (software, if available between the specified ASC and Elevator System):

- a. Otis
 - b. Krone
 - c. Thyssen-Krupp
2. The destination dispatch control solution shall provide the following functions:
- a. Provide card reader security within the elevator(s) as required.
 - b. Provide card reader security at the Destination Dispatch kiosk(s), as required.
 - c. Allow Default Floor call registration upon card swipe.
 - d. Allow for card flags such as VIP and ADA from a card swipe
 - e. Enforce elevator access levels

2.5 ACCESS CONTROL PANEL HARDWARE

- A. Reference Attachment 'A'
- B. System Back-Up Battery: The System Installer shall provide backup batteries as required to furnish ninety (90) minutes of run time to the complete system, including but not limited to lock power and system power.

2.6 FIELD DEVICES

- A. General: Coordinate with door hardware and access control schedule as to whether each access control portal is wireless or directly connected to a control panel. Provide all Controllers, Sub-Controllers, and licensing as required to connect all card reader locations shown on plan.
- B. Card Readers: Provide card readers as shown on the floor plans, access control schedule, and access control details.
- C. Credentials: Coordinate Facility Code, External Start Number, and Internal Start number with the Owner prior to procuring credentials.
- D. Miscellaneous Devices: Provide the following devices as designated per the project floor plans, access control schedules, and access control details:
 1. DP/DT Door Position Sensors (Door Contacts)
 2. PIR Motion Request to Exit Sensor
 3. Lockdown Buttons
 4. Door Release Buttons
 5. Video Intercom Door Stations (Provide and Install per drawings and Division 28 Audio / Video Intercom specification)
 6. Video Intercom Master Stations (Provide and Install per drawings and Division 28 Audio / Video Intercom specification)

2.7 WIRING

- A. All cable associated with the ACS shall be purple in color.
- B. Ethernet cabling to access control panels shall be as specified in the Structured Cabling System (SCS) specifications and shall be provided by the SCS Installer. In the event that there is not SCS installer on the project, cabling shall be provided and installed by the ACS Installer and shall comply with the Division 27 SCS specification, minimum of Category 6A cable shall be utilized if not specified otherwise.
- C. Provide cabling and connections for all access control doors in this scope, existing and new. Conventional access control cable shall be a jacketed composite cable. The minimum conductor requirement shall be as follows:
 1. Standard
 - a. Lock Power: 4-conductor, 18AWG, shielded
 - b. Card Reader: 6-conductor, 22AWG, OA shielded

- c. Door Contact: 2-conductor, 22AWG, shielded
 - d. Request to Exit/Spare: 4-conductor, 22AWG, shielded
- 2. Extended Distance
 - a. Lock Power: 4-conductor, 16AWG, shielded
 - b. Card Reader: 6-conductor, 18AWG, OA shielded
 - c. Door Contact: 2-conductor, 18AWG, shielded
 - d. Request to Exit/Spare: 4-conductor, 18AWG, shielded
- D. Wire scheme and conductor quantity shall be as required by the manufacture's specifications. The System Installer to provide and install shielded cable as required.
- E. All 120v Power shall be furnished by the Division 26 contractor. In the event that a division 26 contractor is not contracted for the project, the system installer shall contract a licensed electrical firm to provide and install all materials required to furnish a complete and operational system.
- F. All Security Conduit as required for a complete installation of this system shall be furnished by the division 26 contractor as part of their scope of work. In the event that a division 26 contractor is not contracted for the project, the system installer shall provide and install all conduit required.
- G. Coordination with the Division 26 contractor is the responsibility of the ACS Installer to ensure all conduit is in place for a complete installation.
- H. All systems shall be connected to a dedicated circuit and on an emergency power source if available.

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 6A data cable from the Master Control Panel to the MDF network rack. Category 6A 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. System Installer is required to provide all mapping and software configuration required to operate system as per manufacturer's recommendations.

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:
 - 1) Panduit
 - 2) Arlington
 - 3) Caddy
 - 4) Support system shall be 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 system installer shall provide a dedicated threaded rod extending within 5' of the finished ceiling and mount the cable support hook to the treaded rod.
3. The 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 system installer to coordinate with all other trades on the project to ensure 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.

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 and the project's Technology Consultant 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.

ATTACHMENT 'A'
PROJECT SPECIFIC SCOPE OF WORK AND EQUIPMENT LIST

PART 1 – PROJECT SCOPE

1.1 DESCRIPTION OF WORK

- A. This project is an expansion of an existing access control system and consists of the provision and installation of a complete and functional Access Control System (ACS) as required to furnish controlled access and access detection to all controlled portals identified on the project drawings. This project is for Cypress Falls High School renovation for the Cypress-Fairbanks Independent School District.
- B. It should not be assumed that any portions of a complete and functional system are to be furnished and/or provided by anyone, other than the ACS installer, unless specifically stated otherwise.
- C. Provide new access control panels throughout level 1. Existing readers shall be connected to new control panels. Remove and return to owner existing edge controllers. Demo data cabling for existing edge controllers back to source.

PART 2 – EQUIPMENT LIST

2.1 The ACS installer shall perform no portion of the work requiring submittal and review of record drawings, shop drawings, product data, or samples until the respective documentation has been approved by project's Security Consultant.

2.2 VESTIBULE ACCESS CONTROL PANEL

- A. All hardware is to be mounted in an Altronix Trove 2 enclosure with RSB2 switch plate located in the nearest IDF to the main entry vestibule.
- B. One (1) Intelligent Door Controller and door SubControllers shall be populated in the Altronix enclosure sufficient to provide access controls for all doors to be controlled from the IDF, for a minimum of eight (8) doors. The Intelligent Controller shall be IP-based. SubControllers should connect to the Intelligent Controller via network or RS-485 Data Bus.
- C. An Altronix eFlow 10XNB power supply is required to be provided and installed along with a PDS8CB or PD16W Power Distribution Module and ACM8CB Access Power Controller. A (1) VR6 regulator in the enclosure to provide correct power distribution.
- D. Panel must have a provided emergency power circuit to the R2B2 switch panel to enable ease of power shut off for the power supply by one switch and main panel transformer on the secondary switch.
- E. Two Category 6A network drops are required within the panel for local configuration of system with laptop and primary panel communication. Each drop should be properly labeled per network cabling guidelines.
- F. Panel IP network configuration information shall be provided by the owner.
- G. All vestibule doors are to be wired back to this main panel with approved composite access control cable and terminated in the following order
 - 1. Front Entry Door- Reader 1 -24VDC/12VDC output 1
 - 2. Reception Entry Door- Reader 2 -24VDC/12VDC output 2
 - 3. Vestibule Exit Door- Reader 3 -24VDC/12VDC output 3
 - 4. Reception Exit Door- Reader 4 -24VDC/12VDC output 4
- H. Final software configuration / programming of system integration will require owner and system installer consultation.
- I. Vestibule Access Control Panel shall not be limited to provide access control power and controllers to the vestibule only, but shall be available for other controlled doors in the area of influence of that IDF.

2.3 PERIMETER AND INTERIOR DOOR CONTROL PANELS

- A. Door Control Panels are to be installed as needed in MDF/IDF rooms throughout the campus, to provide communications and power for access control devices in the area of influence of each IDF.
- B. All hardware is to be mounted in an Altronix Trove 2 enclosure with RSB2 switch plate. Panel must have a provided emergency power circuit to the RB2 switch panel to enable ease of power shut off for the power supply by one switch and main panel transformer on the secondary switch.
- C. One (1) Intelligent Door Controller and door SubControllers shall be populated in the Altronix enclosure sufficient to provide access controls for all doors to be controlled from the IDF, for a minimum eight (8) doors. The Intelligent Controller shall be IP-based. SubControllers should connect to the Intelligent Controller via network or RS-485 Data Bus.
- D. An Altronix eFlow 10xNB power supply is required to be provided and installed along with a PDS8CB or PD16W Power Distribution Module and ACM8CB Access Power Controller. A (1) VR6 regulator in the enclosure to provide correct power distribution.
- E. Two Category 6 network drops are required within the panel for local configuration of system with laptop and primary panel communication. Each drop should be properly labeled per network cabling guidelines.
- F. Panel IP network configuration information shall be provided by the owner.
- G. Final software configuration / programming of the system integration will require owner / contractor consultation.

2.4 VEHICLE ACCESS GATES

- A. Access Controlled gates shall be connected to an IP-based 2-Door controller which may be installed near the building perimeter wall, closest to the gate, to provide additional cabling distance.
- B. 2N IP Verso Video Intercom (w/ Wiegand and Prox Reader module) to be installed on pedestal housing for access control entry through controlled vehicle gate.
- C. All gates must have a Tagmaster XT-1 RFID reader installed as the secondary for utilization of district vehicle tag system.
- D. Consultation is required with the owner to determine is additional Vehicle Tags will be required at the time of installation and the amounts needed.

2.5 FIELD DEVICES

- A. Card Access Equipment
 - 1. All Card Readers locations to be installed on walls or pedestrian gates shall be PR10 card readers as manufactured Schlage.
 - 2. All Card Readers locations to be installed on doors shall be Harmony series readers as manufactured by Sargent.
 - 3. Access Control contractor shall provide ALL electronic components required for a complete and functioning access control system, to include card reader, door contact, lock power supply, electrified locking device with integrated request to exit, power transfer hinge and wiring harnesses. The door hardware contractor shall be responsible for non-electrified, mechanical door hardware.
 - 4. Access Control contractor shall provide all cabling required for connection to any device incorporated and not incorporated in door hardware.
 - 5. Contractor shall provide 300 HID proximity cards 1386 Series for this campus. CFISD has a Corporate 1000 account set up with HID. The contractor shall purchase cards through HID using this account to ensure card numbers and

facility numbers are followed.

6. Provide Ethernet Network Interface to connect school to district-wide access control system. Connect to local area network at each facility.
7. Contractor shall provide all cabling and accessories required to provide complete access control solution and proper integration with building intrusion alarm system for door contact shunting.
8. Provide all door controllers as required to connect all perimeter card reader locations shown on plan plus one additional of each type for attic stock.

2.6 WIRING

- A. Access Control Contractor shall provide and install Access Control system cabling.
 1. Color code of all security intrusion detection system an access control wiring shall be purple in color.
Approved products: Lake Composite Access Control Cable: S800081709-07
 2. Reference Specification Section 27 10 00 Technical Cabling and Section 28 16 00 Intrusion Detection for cable types.
 3. All systems shall be connected to an emergency power source as available.
 4. All 120v Power and system conduits as shown on the drawings shall be furnished by a licensed electrical contractor as part of their scope of work.
 5. Coordination with the electrical contractor is the responsibility of the Security contractor to ensure all conduit is in place for a complete installation.

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 provides 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 traversing the respective box as well as the number of terminations required.
- H. Network Connection Cable: Provide a Category 6 data cable from the Master Control Panel/Node 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 Velcro ties and J-Hooks. (Ref. 28-13-00 3.3A)
- J. Contractor is required to provide all mapping and software configuration required to operate system as per manufacturer's recommendations.

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® Corporate 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 threaded 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 ENSURE 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 the 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.

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, Door Hardware Installer, 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 the 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.
- B. Installed main system devices must be awarded the same warranty provided to the installer by the Manufacturer of the product.

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 10 00.05
AUDIO / VIDEO INTERCOM (IP)

PART 1 - GENERAL

1.1 RELATED WORK

- A. The following, in their entirety and as applicable, shall apply to this section. Including any associated drawings.
 - 1. Conditions of the Contract
 - 2. Division 1
 - 3. Division 26
 - 4. Division 27
 - 5. Division 28

1.2 SYSTEM DESCRIPTION

- A. General Requirements:
 - 1. The specified unit shall be of manufacturer's official product line, designed for commercial and/or industrial 24/7/365 use.
 - 2. The specified unit shall be based upon standard components and proven technology using open and published protocols.
- B. Sustainability
 - 1. The specified unit shall be manufactured in accordance with ISO 14001.
 - 2. The specified unit shall be compliant with the EU directives 2011/65/EU (RoHS) and 2012/19/EU (WEEE).
 - 3. The specified unit shall be compliant with the EU regulation 1907/2006 (REACH).

1.3 CERTIFICATIONS AND STANDARDS

- A. General abbreviations and acronyms
 - 1. AES: Advanced Encryption Standard
 - 2. API: Application Programming Interface
 - 3. Bit Rate: The number of bits/time unit sent over a network
 - 4. DHCP: Dynamic Host Configuration Protocol
 - 5. DNS: Domain Name System
 - 6. FPS: Frames per Second
 - 7. FTP: File Transfer Protocol
 - 8. H.264 (Video Compression Format)
 - 9. IEEE 802.1x: Authentication framework for network devices
 - 10. IP: Internet Protocol
 - 11. IR light: Infrared light
 - 12. ISO: International Standards Organization
 - 13. JPEG: Joint Photographic Experts Group (image format)
 - 14. LAN: Local Area Network
 - 15. LED: Light Emitting Diode
 - 16. MPEG: Moving Picture Experts Group
 - 17. Multicast: Communication between a single sender and multiple receivers on a network
 - 18. NTP: Network Time Protocol
 - 19. ONVIF: Global standard for the interface of IP-based physical security products
 - 20. PACS: Physical Access Control System
 - 21. PoE: Power over Ethernet (IEEE 802.3af/at) standard for providing power over network cable

22. Progressive scan: An image scanning technology which scans the entire picture
 23. QoS: Quality of Service
 24. RPC: Remote Procedure Call
 25. SIP: Session Initiation Protocol
 26. SMTP: Simple Mail Transfer Protocol
 27. SNMP: Simple Network Management Protocol
 28. SSL: Secure Sockets Layer
 29. TCP: Transmission Control Protocol
 30. TLS: Transport Layer Security
 31. Unicast: Communication between a single sender and single receiver on a network
 32. UPS: Uninterruptible Power Supply
 33. VBR: Variable Bit Rate
 34. VMS: Video Management System
 35. WDR: Wide dynamic range
- B. The specified unit shall carry the following EMC approvals:
1. EN55032: 2012
 2. EN55024: 2010
 3. 2014/35/EU
 4. 2014/30/EU
 5. 2012/19/EU
 6. 2011/65/EU
 7. EN 55032 Class A
 8. EN 55032 Class B
 9. EN 55024
 10. FCC Part 15 - Subpart B Class A
 11. FCC Part 15 - Subpart B Class B
 12. FCC Part 15 - Subpart B Class A + B
 13. ICES-003 Class A
 14. ICES-003 Class B
- C. The specified unit shall meet the following product safety standards:
1. IEC/EN/UL 60950-1
- D. The specified unit shall meet the following standards
1. Audio:
 - a. G.711
 - b. G.729
 - c. G.722 (wideband)
 - d. L16 / 16kHz (wideband)
 2. Video:
 - a. H.263+
 - b. H.263
 - c. H.264 (MPEG-4 AVC)
 - d. MPEG-4 Part 2
 - e. MJPEG
 3. Networking:
 - a. IEEE 802.3af/802.3at (Power over Ethernet) [applies to products with PoE]
 - b. IEEE 802.1X (Authentication)
 - c. IPv4 (RFC 791)
 - d. QoS
 4. Mechanical Environment:

- a. IEC/EN 60529 IP54
- b. IEC/EN 62262 IK08

1.4 QUALITY ASSURANCE

A. Contractor Qualifications:

1. The system installer shall be the authorized representative of the manufacturer to sell, install, and service the proposed manufacturer's equipment. The system installer shall have represented the security alarm manufacturer's product for a minimum of five (5) years' with experience installing and servicing systems of similar scope and complexity and evidence that is completed at least three (3) projects of similar design and is currently engaged in the installation and maintenance of systems herein described.
2. The system installer shall be licensed as required, by the State in which the project is located in, as a security services contractor to design, sell, install, and service security alarm systems.
3. The system installer shall provide 24-hour, 365 days per year emergency service with factory trained service technicians.
4. The installing firm shall have personnel on their staff that has been actively engaged in the business of designing, selling, installing, and servicing security systems for at least ten (10) years.
5. 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.
6. The proposing/installing contractor of this system must be an authorized dealer / integrator for the project's specified Access Control, Video Surveillance and the Intrusion Detection systems as well as the system specified in this section.
7. Contractor must be a current integrator of solution in the closest 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.
8. All installation, configuration, setup, program and related work shall be performed by electronic technicians thoroughly trained by the manufacturer in the installation and service of the equipment provided.
9. The system installer shall submit credentials of completed manufacturer certification, verified by a third-party organization, as proof of the knowledge.
10. The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity that became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system
11. Contractor must be in good standing with the Owner and have no outstanding performance or warranty items at the time of bid. Any outstanding items or issues is grounds to disqualify the Contractor for performing any work on the project.

B. System Qualifications:

1. The specified unit shall be manufactured in accordance with ISO9001.

1.5 SUBMITTALS AND CLOSE-OUT

A. Product Data:

1. Within fourteen (14) days of Notice to Proceed, the system installer shall furnish the following in a single consolidated submittal:
 - a. Permits: The Contractor shall obtain all required permits and provide

- copies to the Owner / Architect / Engineer.
- b. Product Literature: Complete manufacturer's product literature for all system equipment, power supplies, cable, termination components, cable supports, cable labels, field 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/Designer) and the manufacturer's supporting documentation, demonstrating compatibility with other related products shall be included. The submittal shall have some type of distinguishing marker or pointer to indicated what specific product is to be submitted.
 - c. Construction Schedule: A time-scaled Construction Schedule indicating general project deadlines and specific dates relating to the installation of the cable distribution system.
 - d. Specification Compliance: A letter shall be provided stating, by section and subsection, that the 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.
 - e. Certifications: The contractor shall submit all of the following certifications and the certifications must contain dates which are valid from the date of proposal and not expire any sooner than 12 months after substantial completion of the project.
 - 1) Manufacturer's Authorized Dealer/Installer Certification: This certification must be held by the proposing/installing contractor and state that the proposing/installing contractor is and authorized dealer/installer of the system specified within the project specifications. The certification must have been obtained by the office that is within a 75-mile radius of the project's location.
 - 2) Installer Certification: This certification must be held by at least 25% of the, on-site, staff and be made available at the site if requested by the owner, architect, and/or project's technology consultant.
 - 3) Licenses: This includes all licenses required by the state in which the work is being performed, the federal government, local authorities having jurisdiction, and any organization in that governs the specific system
- B. Shop Drawings:
- 1. Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed:
 - a. Proposed circuit routing and circuit grouping plan prepared by a system registered designer. The designer's certification must be current. Identifiable, separate routing shall be shown for both the station cabling and any backbone trunk cabling.
 - b. In addition to the cable routing, the submitted drawings shall indicate the following, even if the following is expected to be provided by the project's electrical or general contractor:
 - 1) Location of all control equipment and remote power sources
 - 2) Locations of all field devices and outlets

- 3) Location of wall penetrations (all penetrations shall be sleeved and contain protective bushings at both ends)
 - 4) Location of sleeved wall and/or floor pass-thru
 - 5) Size of sleeve at each location installed
 - 6) Quantity of cable passing through each sleeve
 - 7) Conduit routing, size, quantity, and stub-up locations for any floor mounted outlets or outlets installed in casework.
- c. Drawing Compliance: A letter shall be provided stating that the system installer complies with the entire project drawing, including all general, keyed, and notes to contractor. 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 approved by the project's technology consultant.
- C. Close-out Procedures: For review and acceptance, furnish an electronic copy of the following documents to the Architect / Engineer. Upon acceptance of the submitted close-out documents, provide four (4) copies on an electronic storage media (CD or USD Flash Drive) Labeled with the project name, date of submission, and the name of the submitting firm. Final copies shall be delivered directly to the project's Technology Consultant. The closeout submittals shall include the following and be packaged in a storable container with the physical storage media and any physical items listed:
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. Provide complete test reports for all cabling and devices that comprise system as outlined in this document.
 3. Include the Name, address and telephone of the authorized factory representative with a 24-hour emergency service number.
 4. The manual shall also include Manufacturer's data sheets and installation manuals/instructions for all equipment installed and a list of recommended spare parts.
 5. Generic or typical owner's instruction and operation manual shall not be acceptable to fulfil this requirement.
 6. An up-to-date record ("as-built") set of approved shop drawing prints that have been revised to show each and every change made to the system from the original approved shop drawings.
 7. As-built Drawings shall include cable pathways; device locations with correct labeling, control equipment locations, remote power supply locations, cross connect locations, and lightning protection locations. The as-built drawings shall be prepared using AutoCAD 2014 or later.
 8. All drawings must reflect point to point wiring, device address and programmed characteristics as verified in the presence of the engineer and/or the end user unless device addressing is electronically generated, and automatically graphically self-documented by the system.
 9. A copy of the manufacturer's warranty on the installed system.
 10. Any keys to cabinets and/or equipment and special maintenance tools required to repair, maintain, or service the system.

11. 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 labelled with the project name and description. (4 copies)
12. Upon completion of the work and at a time designated by the Architect or owner, provide formal training sessions for the Owner's operating personnel to include location, operation, and maintenance of all included systems and equipment. Provide a video copy of the training session as well as all sign in and training sign off sheets
13. One (1) 30" x 42" laminated floor plan sheets illustrating device locations, system wiring configuration, and cable designation. Contractor shall provide one complete floor plan sheet at each panel location.

1.6 WARRANTY

- A. All security system components and labor furnished by the contractor including wiring, software, hardware and custom parts shall be fully warranted for parts, materials, labor and travel expenses for a minimum of three (3) years start from the date of substantial completion.
- B. The manufacturer shall provide warranty and optional extended warranty for the unit for a total period of maximum five years. If enacted as part of the contract, the contractor will repair or replace parts and/or labor per the warranty for the length of this warranty at no cost to the client.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Intercoms shall be IP-based and comply with established network and video standards.
- B. Intercoms shall be powered by the switch utilizing the network cable.
- C. Intercoms shall be fully supported by an open and published API (Application Programmers Interface), which shall provide necessary information for integration of functionality into third party applications.

2.2 INTERCOM SCHEDULE

- A. Intercom types listed below describing various resolutions, form-factor and features shall be supplied by a single intercom manufacturer.
- B. The intercom manufacture and model numbers will be as follows:
 1. Modular IP intercom shall be 2N IP Verso with camera. Part # 02907-001
 2. IP intercom base station shall be 2N Indoor View. Part # 02088-001
 - a. 2N Base station stand required. Part # 02039-001
 3. 2N Combo Reader Module. Part # 016939-001
 4. 2N Secure Door Set Tamper. Part # 01975-001
 5. 2N Weigand Module. Part # 01259-001
 6. 2N Surface frame plate. Part # 01289-001
 7. 2N Surface back plate. Part # 01294-001

2.3 INTERCOM

- A. Modular IP intercom
 1. The intercom shall meet or exceed the following design specifications:
 - a. Intercom shall include a built-in web server.
 - b. Intercom shall be able to perform defined local access control functionality without being connected to the network.
 - c. Intercom shall be of modular design, include a replaceable front-end

- frame, providing 1 or 2 additional slots for functional modules, and should support multiple frames stacked side by side. The intercom shall support at least 29 functional modules when fully expanded.
- d. Intercoms' main unit shall be available with and without camera, and shall support the following functional modules:
 - 1) ID card reader
 - 2) Fingerprint reader
 - 3) Keypad
 - 4) Button module
 - 5) Touch screen
 - 6) Bluetooth
 - 7) Wiegand interface
 - e. The intercom shall be equipped with an IR-sensitive progressive scan megapixel sensor and be able to provide images also under dark conditions.
 - f. The intercom shall be equipped with built-in power adaptive IR-illumination/LED.
 - g. The camera shall provide an automatic IR-cut filter, providing day/night functionality.
2. The intercom shall meet or exceed the following performance specifications:
- a. Video
 - 1) The intercom shall provide video streams in 640x480 at up to 30 frames per second using H.264, H.263, H.263+ or up to 15 frames per second using MJPEG.
 - 2) The intercom camera shall provide images in resolutions up to 1280x960.
 - 3) The intercom shall support the following video encoding algorithms:
 - a) H.263+
 - b) H.263
 - c) H.264
 - d) MPEG-4 Part 2
 - e) MJPEG
 - 4) The intercom shall provide independently configured simultaneous H.264 and MJPEG streams.
 - 5) The intercom shall in H.263, H.263, H.264 support Constant Bit Rate (CBR) to protect the network from unexpected bit rate peaks.
 - 6) The intercom shall provide configurable compression levels.
 - 7) Support standard baseline profile H.264 with motion estimation.
 - 8) Support motion estimation in H.264/MPEG-4 Part 10/AVC.
 - 9) The intercom shall allow for video to be transported over:
 - a) HTTP (Unicast)
 - b) HTTPS (Unicast)
 - c) RTP (Unicast & Multicast)
 - d) RTP over RTSP (Unicast)
 - e) RTP over RTSP over HTTP (Unicast)
 - 10) The intercom shall support Quality of Service (QoS) to be able to prioritize traffic.
 - b. Image
 - 1) The camera shall incorporate automatic white balance.

- 2) The camera shall support manually defined values for:
 - a) Color level
 - b) Brightness
- c. Audio
 - 1) The intercom shall support two-way full duplex audio:
 - a) Input sources
 - (1) Internal microphone
 - b) Output sources
 - (1) Built-in speaker, 2W
 - (2) Line out
 - 2) The intercom shall support separately adjustable volume levels for:
 - a) Call
 - b) Key
 - c) Ring tones
 - d) Preloaded audio clips
 - e) Warning tones
 - f) Paging
 - 3) The intercom shall support adaptive gain control.
 - 4) Encoding
 - a) The intercom shall support:
 - (1) G.711
 - (2) G.722 (wideband)
 - (3) G.729
 - (4) L16 / 16kHz (wideband)
 - 5) The intercom shall provide a sound pressure level of at least 78dB at 1kHz at 1m.
 - 6) The intercom shall be equipped with active echo cancellation.
 - 7) The intercom shall allow for audio to be transported over:
 - a) RTP (Unicast & Multicast)
 - b) RTP over RTSP (Unicast)
 - c) RTP over RTSP over HTTP (Unicast)
 - 8) The intercom shall support Quality of Service (QoS) to be able to prioritize traffic.
- d. Call functionality
 - 1) The intercom shall support SIP for integration with VoIP, peer-to-peer or integrated into SIP/PBX.
 2. The intercom shall support the use of SIP Proxy, which can be the same as the SIP registrar for outgoing calls.
 - 3) The intercom shall support dialing up to twelve separate numbers in sequence or as ring group.
- e. Access control functionality
 - 1) The intercoms' reader outputs shall be wired through the Weigand module to the existing access control system.
- f. User Interface
 - 1) Web server
 - a) The intercom shall contain a built-in web server making functionality and configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software.

- 2) IP addresses
 - a) The intercom shall be set with dynamically assigned IP addresses provided by a Dynamic Host Control Protocol (DHCP) server.
 - b) The intercom shall allow for automatic detection of the intercom based on WS Discovery when using a computer with an operating system supporting this feature.
 - c) The intercom shall provide support for IPv4.
- g. Event functionality
 - 1) The intercom shall be equipped with an integrated event functionality, which can be triggered by:
 - a) Tamper / case open
 - b) SIP Call state incl. incoming call
 - c) Change of SIP registration status
 - d) Video Motion Detection
 - e) Noise Detection
 - f) SIP DTMF sequences
 - g) External input
 - h) Access control events such as code, card, fingerprint entered
 - i. Predefined time
 - 2) Response to triggers shall include:
 - a) Send notification, using HTTP or email
 - b) Activate sound alarm
 - c) Make or end call
 - d) Send notification, using HTTP, HTTPS, Wiegand or email
 - e) Send images, using FTP or email
 - f) Activating external output
 - g) Play audio clip
- h. Protocol
 - 1) The intercom shall incorporate support for at least HTTP, HTTPS, SIP 2.0, TFTP, RTSP, RTP, SMTP, DHCP opt 66, NTP, Syslog.
 - 2) The SMTP implementation shall include support for SMTP authentication.
 - 3) The camera shall incorporate support for at least IPv4, HTTP, HTTPS, SIP, SSL/TLS, QoS Layer 3 DiffServ, TCP, ICMP, SNMPv2c, RTSP, RTP, UDP, IGMP, RTCP, SMTP, FTP, DHCP, ARP, DNS, NTP,
- i. Security
 - 1) The intercom shall support the use of HTTPS and SSL/TLS, providing the ability to upload signed certificates to encrypt and secure authentication and communication of both administration data and video streams.
 - 2) The intercom shall block its login page for 30 seconds after three faulty passwords have been submitted.
 - 3) The intercom shall force user to change admin password upon first installation.
 - 4) The intercom shall provide centralized certificate management,

- with the ability to upload CA certificates. The certificates shall be signed by an organization providing digital trust services.
- 5) The intercom shall support IEEE 802.1X authentication.
 - 6) Selected services, such as RTSP or web config shall be configurable to only allow access from local devices.
 - 7) The intercom shall restrict access to the built-in web server by username and password.
 - 8) The intercom shall be equipped with tamper detection.
- j. API support:
- 1) The intercom shall be fully supported by an open and published API (Application Programmers Interface), which shall provide necessary information for integration of functionality into third party applications.
 - 2) The intercom shall conform to ONVIF profile S as defined by the ONVIF Organization.
 - a) For ONVIF profile specifications, see www.onvif.org/
 - 3) The intercom shall be interoperable/certified with major PBX and gateway manufacturers, including:
 - a) Cisco
 - b) Avaya
 - c) Broadsoft
- k. Installation and maintenance
- 1) The intercom shall support secure configuration using HTTPS.
 - 2) The intercom shall support the use of SNMP-based management tools according to SNMP v2c.
 - 3) The intercom shall allow updates of the software (firmware) over the network, using TFTP, HTTP or web interface.
 - 4) The intercom shall be time synchronized to the district NTP (Network Time Protocol) server.
 - 5) The intercom shall support back-up and restore of configuration.
 - 6) The intercom shall store all customer-specific settings in a non-volatile memory that shall not be lost during power cuts or soft reset.
- l. Access log
- 1) The intercom shall be able to log events such as codes, phone calls, RFID cards etc., and provide them using HTTP interface for monitoring.
 - 2) The administrator shall be able to set whether the particular messages are sent by the intercom immediately after any event occurs, or if the client registers for event logging and then asks for full report since last registration, all events at once.
 - 3) The client shall be able to select which messages are reported from event log.
- m. Intercom diagnostics
- 1) The intercom shall be equipped with LEDs, capable of providing visible status information. LEDs shall indicate the intercom's operational status and provide information about power, the network status and the intercom status.
 - 2) The intercom shall be monitored by a Watchdog functionality, which shall automatically re-initiate processes or restart the unit if a malfunction is detected.

- n. Hardware interfaces
 - 1) Network interface
 - a) The intercom shall be equipped with one 10BASE-T/100BASE-TX Fast Ethernet-port, using a standard RJ45 connector and shall support auto negotiation of network speed (100 MBit/s and 10 MBit/s) and transfer mode (full and half duplex).
 - 2) Doors
 - a) The intercom shall be equipped with programmable input supporting both short circuit activation or up to +30VDC for door monitor or Request to Exit (REX).
 - b) The intercom shall be equipped with two independent outputs for door control. One active providing at least 8VDC / 400mA and one NO/NC relay supporting up to 30V AC/DC 1A.
 - 3) Audio
 - a) The intercom shall be equipped with line output.
 - 4) Power
 - a) The intercom shall be equipped with a removable terminal block providing connectivity for external power.
 - 5) Multifunctional connector
 - a) The camera shall, by using a “multi wire ribbon cable”, provide connectivity between main unit and modules.
- o. Enclosure
 - 1) The intercom shall:
 - a) Be manufactured with IP54 rated housing, and be IK08 (IK07 when using Touchscreen module).
 - b) Be fitted with a tamper switch.
 - c) Be of modular design, supporting main unit and up to 29 additional modules.
 - d) Be available in black and brushed nickel versions.
- p. Power
 - 1) Power over Ethernet IEEE 802.3af/802.3at Type 1 Class 0
 - 2) 12 V DC
 - a) Max: 2A
- q. Environmental
 - 1) The intercom shall:
 - a) Operate in a temperature range of -40 °C to +60 °C (-40 °F to 140 °F)
 - b) Operate in a humidity range of 10–95% RH (non-condensing).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The Contractor shall carefully follow instructions in documentation provided by the manufacturer to ensure all steps have been taken to provide a reliable, easy-to-operate complete system.
- B. All equipment shall be configured in accordance with instructions provided by the manufacturer and systems administrator prior to district inspection.
- C. All firmware found in products shall be the latest and most up-to-date provided by the

- manufacturer.
- D. The contractor shall provide a 2N Indoor Touch 2.0 master station at the primary operator's desk with its appropriate stand.
 - E. Contractor is responsible for working with other trades to ensure proper installation of all devices per recommended codes.
 - F. All equipment requiring users to log on using a password shall be configured with district specific password. No system/product default passwords shall be allowed.

END OF SECTION

SECTION 28 20 00
VIDEO SURVEILLANCE SYSTEM (VSS)

PART 1-GENERAL

1.1 RELATED WORK

- A. The following, in their entirety and as applicable, shall apply to this section. Including any associated drawings.
1. Conditions of the Contract
 2. Division 1
 3. Division 26
 4. Division 27
 5. Division 28

1.2 DESCRIPTION OF WORK

- A. Provide a complete and tested IP based digital video surveillance system (VSS) including 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. 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.
- B. The system shall be Non-Proprietary in nature and be available through multiple distribution channels in the nearest metropolitan marketplace. Systems that are manufactured and installed by a factory office and are not available through multiple distribution channels will not be accepted.
- C. 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.
- D. Acceptable manufacturers of NVR equipment shall be Seneca Data only. Contractor must be a current Exacq Enterprise Certified integrator of the solution in the Houston marketplace and be able to include information on current support staff to be able to service this client. Seneca NVR part numbers and configuration are listed in the specification to define equipment capabilities and requirements for this project.
- E. Contractor must be a current integrator of solution in the Houston marketplace and be able to include information on current support staff to be able to service this client as needed 24x7 for emergency support.
- F. Contractor shall provide a complete turnkey solution to the owner and be responsible for the complete installation of a security camera system.
- G. The contractor must be in good standing with the district and have no outstanding performance or warranty items at the time of bid. Any outstanding items or issues is grounds to disqualify the contractors bid.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications:
1. The Video Surveillance System Installer shall be Exacq Enterprise certified and shall meet all applicable regulations. The Contractor shall

- be a firm normally employed in the security and surveillance 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 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.

1.4 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.

1.5 SUBMITTALS

- A. Project Initiation: Within fourteen (14) days of Notice to Proceed, the data network system installer shall furnish the following in a single consolidated submittal:
1. Permits: The Contractor shall obtain all required permits and provide copies to the Owner / Architect / Engineer.
 2. Product Literature: Complete manufacturer's product literature for all material, hardware, and equipment to be used in the installation of the specified system. In addition, whenever substitutions for recommended products are made, samples (when requested by the Owner / Designer) and the manufacturer's supporting documentation demonstrating compatibility with other related products shall be included. The submittal shall have some type of distinguishing marker or pointer to indicated what specific product is to be provided
 3. Construction Schedule: A time-scaled Construction Schedule, indicating general project deadlines and specific dates relating to the installation of the cable distribution system.
 4. Specification Compliance: A letter shall be provided stating, by section and subsection, that the SCS 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 approved by the Owner.
 5. Each Submittal must have a detailed parts list. Quantities will not be required as the quantity of any portion of this system shall be as required for a complete and functional system and in conjunction with the contract documents.
 6. Certifications: The contractor shall submit all certifications for approved products and the certifications must contain dates which are valid from the date of proposal and not expirer any sooner than 12 months after substantial completion of the project.
 - a. Physical Security Professional (PSP) Certification: This certification must be held by an on-staff, full-time employee of the system installer. The holder must be staffed out of the office that is located within 75 miles of the projected.
 - b. Manufacturer Authorized Dealer Certification must be held by the system installer's office that is located within 75 miles of the project and shall be a company certification, not and individual certification.
 - c. Installer Certifications: Certification indicating that an individual has successfully completed installer training, issued by the VMS and Cameras Manufacturers specified herein, must be held by at least 25% of the, on-site, staff and be made available at the site if requested by the owner, architect, and/or project's technology consultant.
- B. Shop Drawings: Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed:
1. Proposed cable routing and grouping plan.
 2. In addition to the cable routing, the submitted drawings shall indicate the following, even if the following is expected to be provided by the project's electrical or general contractor:
 - a. Location of sleeved wall and floor pass-thru

- b. Size of sleeve at each location installed
 - c. Quantity of cable passing through each sleeve
 - d. Location of devices and head end equipment.
 - e. Conduit routing, size, and quantity
3. Drawing Compliance: A letter shall be provided stating that the system installer complies with the entire project drawing, including all general, keyed, and notes to contractor. 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 approved by the Owner.
 4. All subcontractors shall provide submittals to general contractor for normal distribution to Architects, Engineers and the Owner's project managers.
- C. At Substantial Completion: Provide drawings, to the Owner, to reflect installed cabling with correct labeling and cable routing.
- D. Close-out Procedures: Two (2) copies of the following documents shall be delivered to the building owner's representative at the time of system acceptance. Close out technology documents shall be separated from all other trade's documents. The close out finals shall include:
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. Include the Name, address and telephone of the authorized factory representative with a 24-hour emergency service number.
 3. The manual shall also include Manufacturer's data sheets and installation manuals/instructions for all equipment installed a list of recommended spare parts.
 4. Generic or typical owner's instruction and operation manual shall not be acceptable to fulfill this requirement.
 5. An up-to-date record ("as-built") set of approved shop drawing prints that have been revised to show each and every change made to the structure cabling system from the original approved shop drawings. Drawings shall consist of a scaled plan of each building showing the placement of each individual item of the technical cabling system equipment as well as raceway size and routing, junction boxes, and conductor size, quantity, and color in each raceway.
 6. As-built Drawings shall include cable pathways, camera locations with correct labeling and MDF/IDF locations. A copy of the As-Built drawings reflecting the final locations of all cabling shall be given to the designated Owner's representative. The as-built drawings shall be prepared using AutoCAD 2012 or later. Provide the Owner with electronic versions of the as-builts on CD media.
 7. All drawings must reflect final graphic numbering, point to point wiring, device address and programmed characteristics as verified in the presence of the engineer and/or the end user unless device addressing is electronically generated, and automatically graphically self-documented by the system.
 8. A copy of the manufacturer's warranty on the installed system.
 9. Any keys to cabinets and/or equipment and special maintenance tools required to repair, maintain, or service the system.
 10. 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)

11. Upon completion of the work and at a time designated by the Architect or owner, provide formal training sessions for the Owner's operating personnel to include location, operation, and maintenance of all included systems and equipment. Minimum amount of training time shall be at least 4 hours.

1.6 QUALITY ASSURANCE

A. Contractor Qualifications:

1. The system installer shall be the authorized representative of the manufacturer to sell, install, and service the proposed manufacturer's equipment. The system installer shall have represented the security alarm manufacturer's product for a minimum of five (5) years' with experience installing and servicing systems of similar scope and complexity and evidence that is completed at least three (3) projects of similar design and is currently engaged in the installation and maintenance of systems herein described.
2. The system installer shall be licensed as required, by the State in which the project is located in, as a security services contractor to design, sell, install, and service security alarm systems.
3. The system installer shall provide 24-hour, 365 days per year emergency service with factory trained service technicians.
4. The installing firm shall have personnel on their staff that has been actively engaged in the business of designing, selling, installing, and servicing security systems for at least ten (10) years.
5. 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.
6. The proposing/installing contractor of this system must be an authorized dealer / integrator for the project's specified Access Control, Audio / Video Intercom, and the Intrusion Detection systems as well as the system specified in this section.
7. Contractor must be a current integrator of solution in the closest 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.
8. All installation, configuration, setup, program and related work shall be performed by electronic technicians thoroughly trained by the manufacturer in the installation and service of the equipment provided.
9. The system installer shall submit credentials of completed manufacturer certification, verified by a third-party organization, as proof of the knowledge.
10. The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity that became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system
11. Contractor must be in good standing with the Owner and have no outstanding performance or warranty items at the time of bid. Any outstanding items or issues is grounds to disqualify the Contractor for performing any work on the project.

1.7 PRE-INSTALLATION MEETINGS

- A. No less than a minimum of two weeks prior to rough-in or installation of any system devices, the Installer will be required to attend a pre-construction meeting with the

Owner, Architect, and Security Consultant.

1.8 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. Handling: Handle materials to avoid damage.

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 recommended limits.

1.10 SEQUENCING

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.11 WARRANTY

- A. The VSS furnished by the System Integrator including wiring, software, hardware and third-party products shall be fully warranted for parts, materials and labor for a minimum of 1 year from date of the final acceptance.
- B. Manufacturer shall provide a limited 3-year warranty for the product to be free of defects in material and workmanship.

PART 2 -PRODUCTS

2.1 GENERAL

- A. The data cabling to each camera location on this project shall be provided and installed by the data cabling contractor. The security camera installing contractor shall be responsible for the installation of all power wiring for exterior PTZ domes and power supplies.
- B. The Contractor is responsible for providing all incidental and/or miscellaneous hardware not explicitly specified below as required for a complete and operational system.
- C. Materials shall be as listed no alternate products will be allowed without prior consent of the projects security consultant. Any items approved as equivalent products shall be published by addendum ten days prior to proposal for Architect/Engineer review.
- D. All equipment and materials used shall be standard components, regularly manufactured, regularly utilized in the manufacturer's system.
- E. All systems and components shall have been thoroughly tested and proven in actual use.
- F. All systems and components shall be provided with the availability of a toll free 24-hour technical support phone number from the manufacturer. The phone number shall allow for immediate technical assistance for either the dealer/installer or the end user at no charge.
- G. All systems and components shall be provided with an explicit manufacturer warranty.

2.2 DATA CLOSET (MDF/IDF) TERMINATION HARDWARE

- A. Provide and Install new Tripplite, #B030-008-17-IP, NetDirector 8-Port 1U Rack-Mount Console HDMI KVM Switch with 17 in. LCD and IP Remote Access, Dual Rail.
- B. Security contractor is responsible to coordinate with district police technology department on acquiring network connections as well as any network configuration information such as IP numbers that will be required to connect NVR servers to district network.
- C. Security contractor is responsible to provide network cabling connection, either fiber or category 6A, to owner provided network equipment. This connection allows NVR to

- be connected to owner's local area network.
- D. Security contractor shall provide (1) Minuteman – E2000RTXL2U ups per NVR unit at each rack location to support NVR equipment. Provide 120v. electrical connection at location where NVR is installed.

2.3 CABLE AND INSTALLATION

- A. The Contractor shall provide and install all low voltage plenum rated power cable to exterior PTZ dome camera locations from a central power supply(s). Each power cable shall be individually fused at the power supply so a short in one power cable will blow that fuse and not affect the other cameras. The power supply will be UL listed in an approved enclosure. It is the responsibility of the Contractor to size the power supply to handle the full load of the cameras.
- B. The data cabling to each camera location on this project will be provided and installed by cabling contractor certified by Systimax and authorized to install the cable plant and connectivity products. All category 6A cable shall be Systimax Purple 2071 CAT6A.
- C. Camera contractor is responsible to request and oversee all penetrations and all conduit runs as necessary for installation of CCTV installation.
- D. All exterior penetrations require necessary weatherproofing to avoid moisture penetration.
- E. All Cameras will require 10ft purple Cat6A patch chord at camera location and 7ft purple Cat6A patch chord at panel location provided by certified Systimax Data contractor.
- F. All outdoor cable runs underground shall be in fiber rated for underground use according to Technology specs.
- G. All power circuits required for the NVR servers are to originate as emergency power from its provided UPS.
- H. Contractor shall not run any power cabling for any security equipment on rack tray system due to EMI considerations. Contractor shall provide individual cabling support for all low voltage power cabling.
- I. All cabling for entire project shall be installed at 5'-0" intervals in dedicated support system using a j-hooks support system. Cable supports will be securely attached directly to building structure. Do not attach cabling or supports to ductwork, piping, grid hangers, conduit, or equipment.
- J. Refer to CFISD structured cabling specifications for Category 6A materials and methods.
- K. All category 6A cabling shall be routed to existing MDF and IDF locations and be terminated on existing racks. Provide additional patch panels as required and label ports using existing labeling scheme.
- L. For all cameras that will exceed the maximum category 6A cable limitation the contractor shall provide and install Veracity Outreach Max universal Ethernet and Poe Extender and clearly identify on as-builts. If installed a spare unit will be provided to the owner.

2.4 PROPOSALS

- A. All proposals shall be in the format as shown in the General Conditions Section of the Specification.

2.5 DIGITAL VIDEO RECORDING, MANAGEMENT AND TRANSMISSION SYSTEM

- A. The contractor shall provide and install Network Video Recorders for this project.
- B. Final connection for all new IP cameras shall be provided by the camera contractor.

- Coordinate all recording settings and functions with owner prior to programming.
- C. Network Video Recorders shall be preprogrammed to include a floor plan graphic of each school and the exact camera locations and name of cameras. Field verification of camera names is required to complete this task.

2.6 EQUIPMENT REQUIRED

- A. Provide a 5 year warranty for all NVR equipment.
- B. Digital Video Recorders:
1. Provide One Seneca Assurance, CT-CFISD-HDMI-RL server per 50 cameras to be installed unless stated otherwise by the owner.
 2. The contractor shall coordinate correct Exacq software version prior to submitting or procuring equipment.
 3. NVR must have SSA agreement in place for two years at time of install.
 4. In response to proposal, contractor shall provide owner with amounts for annual service maintenance agreement that can be purchased after warranty period has expired.

2.7 CAMERAS

- A. Camera Types:
1. All ceiling mounted cameras shall be surface mounted on the ceiling using ceiling mounting kit and accessible by 10ft ladder.
 2. All cameras shown on the drawings to be corner mounted shall receive corner mount kit by specified camera manufacturer, no exception.
 3. Interior Fixed cameras shall be Bosch Flexidome 5000i or AXIS P3265LV if primary is not available. – TYPE C
 4. Exterior Fixed cameras shall be Bosch Flexidome 5000i or Axis P3265-LVE if primary is not available. – TYPE B
 5. Interior Fish Eye cameras shall be Bosch Flexidome 5100i 6mp. – TYPE E
 6. Multi sensor Interior/Exterior Camera shall be Axis P3727-PLE or Wisenet PNM-C16083RVQ– TYPE A
 7. Duo Cameras shall be AXIS P4707-PLVE Platform with IR or Wisenet PNM-7082RVD if Axis is unavailable. – TYPE D
 8. Axis F9114 and Axis F4105-LRE sensors shall be provided to view around a column or skylight where a center mounted single camera cannot be employed. All F4105-LRE lens must be installed with Axis TU6005 plenum cable accessory. – TYPE F
 9. Specialty PTZ camera will be Axis Q6318-LE PTZ if specifically called for by owner-TYPE G
- B. Field of View Determination by the contractor as necessary for fixed camera locations shall be performed at no additional cost to provide the view desired by the owner. Contractor shall coordinate all final camera views and locations with owner for final approval.
- C. IP camera address scheme will be provided to contractor by the owner. All Camera addresses shall follow the provided scheme and be sequential.
- D. Refer to Drawings for additional camera part numbers, Quantities.
- E. Confirmation of camera type per location requires customer verification.

2.8 ADDITIONAL HARDWARE OR EQUIPMENT REQUIRED

- A. Licensing to be provided for all necessary equipment.
- B. Camera mounts and brackets shall be per camera manufacturer.
- C. One ViewSonic VX3211-2K-MHD 32" LED Monitor is required per NVR.

- D. One of each type of camera used on the project is required upon final inspection for spare replacement equipment.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. 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.
- B. Provide three sided pre-finished metal hood and seal to wall where conduit penetrates exterior wall.
- C. 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.
- D. Do not install wall mounted cameras into metal fascia. Ensure they are mounted into brick, and sealed top sides (Not bottom)
- E. Wall Penetrations:
 - 1. Exterior Penetrations- shall be performed by a certified electrical contractor and be sleeved with metallic conduit and resealed with an Underwriter Laboratories (UL) approved sealant.
 - 2. Interior Penetrations- shall be sleeved with metallic conduit and resealed with an Underwriter Laboratories (UL) approved sealant.
- F. 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.

3.2 EQUIPMENT RACK CONFIGURATION

- A. 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.
- B. All incoming cables shall be routed on the cable tray and neatly dressed down to the patch panels
- C. 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.

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.
- D. 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 rings on 36" 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.
- B. 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. 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.
- B. 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. All such warranties shall include all parts (NVR's, and Cameras).

END OF SECTION

SECTION 28 31 00
INTRUSION DETECTION SYSTEM (IDS)

PART 1 - GENERAL

1.1 RELATED WORK

- A. The following sections shall associate with this specification as applicable.
 - 1. General Conditions
 - 2. Supplementary Conditions
 - 3. Division 1
 - 4. Division 26 in its entirety.
 - 5. Division 27 in its entirety.
 - 6. Division 28 in its entirety.

1.2 WORK INCLUDED

- A. The Contractor shall furnish and install a complete microprocessor based Intrusion Detection System (IDS) as specified herein. The IDS 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. IDS devices indicated are for reference and coordination purposes only. 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 IDS shall include intrusion detection coverage as shown on the system floor plans. Whether shown on the floor plans or not, complete coverage of the following areas shall be included:
 - 1. All access points into the building(s), including but not limited to:
 - a. Doors
 - b. roof hatches
 - c. windows
 - 2. Interior space motion detection at the following locations:
 - a. All level 1 spaces with window and/or doors
 - b. All entrances on any level
- D. The IDS shall be the product of a single manufacturer and consist of, but not be limited to the following:
 - 1. Control Panels
 - 2. Field Devices
 - 3. Enclosures
 - 4. Locks and Keys
 - 6. Power Supplies
 - 7. Accessories required to provide a complete IDS
 - 8. System O and I Manuals
 - 9. System Programming
 - 10. Batteries
 - 11. Wiring
- E. The IDS installer shall be responsible for, but not limited to:
 - 1. Tagging of all conductors and cables at each end.
 - 2. Provision and installation of IDS control panels.
 - 3. Provision and installation of IDS devices.
 - 4. Full coverage of all windows, doors, roof hatches.

6. Preconstruction meeting with Owner's personnel, installing technician and project superintendent.
- F. The contractor shall connect this location to the Owner's monitoring station as designated by the owner.
- G. The Contractor shall be responsible for identifying requirements for permits, from the local the Local Authority Having Jurisdiction (AHJ), for the installation of the alarm system specified herein and shall assist the Owner in obtaining the relevant alarm permits.
- H. All conduits and back boxes shall be provided and installed by the project's electrical contractor. In the event that there is no electrical contractor on the project, responsibility will be that of the IDS installer.
- I. The documents issued for this project are conceptual in nature, including but not limited to specifications and drawings. It shall be the responsibility of the approved installer to furnish a complete and functional system, including the items shown on the drawings, in the specifications, and items not designated in either. The installer's shop drawings and product data submittals shall represent a complete system, and documents accepted do not relieve the installer from being required to provide any materials, equipment, or labor to furnish a complete and functional system as recognized by the Project's Technology Consultant and the Owner.
- J. Contractor shall integrate all Emergency Eyewash systems into the IDS. Provide cabling connecting both systems. Coordinate with Emergency Eyewash systems contractor.
- K. Contractor shall connect the Intrusion Detection System to the electrical automatic transfer switch in order to notify the District Police Department when the building is on emergency power. Provide same, connected to existing transfer switch at the existing Commons building, servicing the existing High School buildings. Provide all required cabling and devices for fully functional systems.

1.3 CODES AND STANDARDS

- A. The system shall comply with the applicable Codes and Standards as follows:
 1. National Electric Code, Article 760.
 2. National Fire Alarm Code (NFPA 72).
 3. Life Safety Code (NFPA 101)
- B. Administrative Council for Terminal Attachments (ACTA):
 1. ANSI/TIA-968-A-2002 Technical Requirements for Connection of Terminal Equipment to the Telephone Network.
- C. 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.
- D. California State Fire Marshal (CSFM):
 1. Title 19, California Code of Regulations, Building Material Listing Program (BML).
- 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. 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
- I. Local & State Building Codes
- J. Requirements of Local Authorities having Jurisdiction
- K. Requirements of American Disabilities Act (Public law 101-336).
- L. Texas Accessibility Standards (TAS)
- M. State Fire Marshall.
- N. State Insurance Code.

1.4 QUALITY ASSURANCE

- A. Contractor Qualifications:
 1. The installing contractor shall be the authorized representative of the IDS authorized/certified to sell, install, and service the proposed manufacturer's equipment. The installing contractor shall have represented the IDS manufacturer's product for at least five (5) years.
 2. The installing contractor shall be certified to install and setup the IDS software with Security Engine and Access Engine Modules attached.
 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 and access control system.
 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. The System Installer must submit to the owner prior to starting any work the factory training certificates for all personnel that will be working on the specified IDS. No person is allowed to work on the IDS without proper manufacturer's certification.

1.5 SUBMITTALS AND CLOSE-OUT

- A. Product Data: Within fourteen (14) days of Notice to Proceed, the system installer shall furnish the following in a single consolidated submittal:
 1. Permits: The Contractor shall obtain all required permits and provide copies to the Owner / Architect / Engineer.
 2. Product Literature: Complete manufacturer's product literature for all system equipment, power supplies, cable, termination components, cable supports, cable labels, field 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/Designer) and the manufacturer's supporting

- documentation, demonstrating compatibility with other related products shall be included. The submittal shall have some type of distinguishing marker or pointer to indicated what specific product is to be submitted.
3. Construction Schedule: A time-scaled Construction Schedule indicating general project deadlines and specific dates relating to the installation of the cable distribution system.
 4. Specification Compliance: A letter shall be provided stating, by section and subsection, that the 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.
 5. Certifications: The System Installer shall submit all of the following certifications and the certifications must contain dates which are valid from the date of proposal and not expirer any sooner than 12 months after substantial completion of the project.
 - a. Manufacturer's Authorized Dealer/Installer Certification: This certification must be held by the proposing/installing contractor and state that the proposing/installing contractor is and authorized dealer/installer of the system specified within the project specifications. The certification must have been obtained by the office that is within a 75-mile radius of the project's location.
 - b. Installer Certification: This certification must be held by at least 25% of the, on-site, staff and be made available at the site if requested by the owner, architect, and/or project's technology consultant.
 - c. Licenses: This includes all licenses required by the state in which the work is being performed, the federal government, local authorities having jurisdiction, and any organization in that governs the specific system
- B. Shop Drawings: Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed:
1. Proposed circuit routing and circuit grouping plan prepared by a system registered designer. The designer's certification must be current. Identifiable, separate routing shall be shown for both the station cabling and any backbone trunk cabling.
 2. In addition to the cable routing, the submitted drawings shall indicate the following, even if the following is expected to be provided by the project's electrical or general contractor:
 - a. Location of all control equipment and remote power sources
 - b. Locations of all field devices and outlets
 - c. Location of wall penetrations (all penetrations shall be sleeved and contain protective bushings at both ends)
 - d. Location of sleeved wall and/or floor pass-thru
 - e. Size of sleeve at each location installed
 - f. Quantity of cable passing through each sleeve
 - g. Conduit routing, size, quantity, and stub-up locations for any floor mounted outlets or outlets installed in casework.
 3. Drawing Compliance: A letter shall be provided stating that the system installer complies with the entire project drawing, including all general, keyed, and notes to contractor. 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 approved by the project's technology consultant.

- C. Close-out Procedures: For review and acceptance, furnish an electronic copy of the following documents to the Architect / Engineer. Upon acceptance of the submitted close-out documents, provide four (4) copies on an electronic storage media (CD or USD Flash Drive) Labeled with the project name, date of submission, and the name of the submitting firm. Final copies shall be delivered directly to the project's Technology Consultant. The closeout submittals shall include the following and be packaged in a storable container with the physical storage media and any physical items listed:
1. Inspection and Test Reports: During the course of the Project, the System Installer shall maintain an adequate inspection system to ensure that the materials supplied, and the work performed, conform to contract requirements. The System Installer shall provide written documentation that indicates that materials acceptance testing was conducted as specified. The System Installer shall also provide documentation, which indicates that all cable termination testing was completed and that all irregularities were corrected prior to job completion.
 2. Provide complete test reports for all cabling and devices that comprise system as outlined in this document.
 3. Include the Name, address and telephone of the authorized factory representative with a 24-hour emergency service number.
 4. The manual shall also include Manufacturer's data sheets and installation manuals/instructions for all equipment installed and a list of recommended spare parts.
 5. Generic or typical owner's instruction and operation manual shall not be acceptable to fulfill this requirement.
 6. An up-to-date record ("as-built") set of approved shop drawing prints that have been revised to show each and every change made to the system from the original approved shop drawings.
 7. As-built Drawings shall include cable pathways; device locations with correct labeling, control equipment locations, remote power supply locations, cross connect locations, and lightning protection locations. The as-built drawings shall be prepared using AutoCAD 2014 or later.
 8. All drawings must reflect point to point wiring, device address and programmed characteristics as verified in the presence of the engineer and/or the end user unless device addressing is electronically generated, and automatically graphically self-documented by the system.
 9. A copy of the manufacturer's warranty on the installed system.
 10. Any keys to cabinets and/or equipment and special maintenance tools required to repair, maintain, or service the system.
 11. 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)
 12. Upon completion of the work and at a time designated by the Architect or owner, provide formal training sessions for the Owner's operating personnel to include location, operation, and maintenance of all included systems and equipment. Provide a video copy of the training session as well as all sign in and training sign off sheets
 13. One (1) 30" x 42" laminated floor plan sheets illustrating device locations, system wiring configuration, and cable designation. The System Installer shall

provide one complete floor plan sheet at each panel location

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND INSTALLERS

- 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). Web: www.boschsecurity.us.
- B. Substitutions: Not permitted.
- C. Requests for substitutions will be considered in accordance with provisions of Division 1

2.2 CONTROL COMMUNICATOR (Panel)

- A. The IDS control panel shall be Bosch Security Systems, Inc., model # B9512G comprising a fully integrated intrusion, fire, and access control system. The control panel shall support the following:
 - 1. The IDS system is capable of being utilized as a combination Intrusion and Fire system per code. Fully integrated intrusion, access and fire functions allow users to interface with 1 system instead of 3
 - 2. Telephone Line Module Interface with programmable options for signaling and supervision.
 - 3. Conettix IP based communication option provides high-speed, secure alarm transport and control.
 - 4. 32 programmable areas with perimeter and interior partitioning.
 - 5. 8 on-board, class B hardwired points with expansion capability for a total of at minimum 500 wired or wireless points.
 - 6. Compatibility with touch-screen color LCD, vacuum fluorescent, ATM style LCD or LED style Alarm Command Centers.
 - 7. Local or remote programming, test, and diagnostic capability via a computer running the Remote Programming Software (RPS).
 - 8. The system shall support the use of an Apple iOS device for control. Functions to include arming, disarming, control of outputs, lock, unlock, cycle and secure access doors.
 - 9. 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.
 - 10. Provide 1.4 amps of power for standby operation and 2 amps of alarm power, both rated at 12 VDC.
 - 11. 2 wet-contact relay outputs and 1 Auxiliary wet-contact relay output with expansion capability for up to an additional 128 dry-contact relay outputs.
 - 12. Integrated battery charger with reverse hook up protection, battery supervision and battery deep discharge protection.
 - 13. Supervision of peripheral devices and communications interface(s).
- B. All small installations such as press boxes or tractor sheds shall use Bosch Model #5512 main control panel.
- C. Programmable features shall include:
 - 1. Independently control zones through an independent zone control keypad.
 - 2. Automatic test reports.
 - 3. Selective zone shunting.
 - 4. Custom text on the associated command centers.
- D. Zone Expansion - Expanded to 500 (8 on-board, 492 off-board) individually annunciated points of protection through the addition of a two-wire multiplex zone expansion system (ZONEX). Points of protection are annunciated with custom text at the B915 Command

- Center and they can be reported to a Radionics D6600Receiver.
- E. User Pass Codes – nine hundred ninety-nine (999) user pass codes shall be available to identify the user when arming/disarming the system.
 - F. Protective Circuits shall consist of zones designed for fire and/or panic (holdup, duress, or emergency) and/or burglary and/or supervisory. Each zone represents a protective circuit and shall accommodate normally opened and closed devices with end-of-line resistor supervision. Each of the 500 points are programmable as to whether they are controlled versus 24 hours; interior versus perimeter; instant versus delayed; silent versus audible (and if audible, pulsed or steady); and local or reporting.
 - 1. Additional programmable parameters for each point include the ability to suppress trouble or restoral reports, designate it as a priority zone (system cannot be armed if this point is off-normal), report two separate telephone numbers and provide for automatic shunting of points from the system in the event that the detection device malfunctions and creates numerous false alarms.
 - 2. Each POPIT shall accommodate normally opened and normally closed devices with end-of-line resistor supervisor.
 - 3. Minimum total points, 500.
 - G. Entry/exit delays shall be independently programmable from 10 to 150 seconds. A pre-warn audible shall be coincident with the entry delay.
 - H. Programming of all system functions shall be achievable at system site or remotely via the use of the dial-up telephone network. Minimum programmable functions shall include:
 - 1. User pass codes, entry/exit delay times, master zone personality, day/date/time, telephone numbers, point of protection text labels, and bell time.
 - 2. A programmable system pass code shall be used to prevent unauthorized remote programming attempts.
 - 3. Remote programming capability shall be automatic or require user enabling at the discretion of the user.
 - I. Remote control via the use of the dial-up telephone and owner's local area network shall include:
 - 1. System arming.
 - 2. Reset of audible signals.
 - 3. Activation/deactivation of relay contacts.
 - 4. Interrogation of battery.
 - 5. Zone and armed status.
 - 6. Enable/disable of reporting functions and removing reporting devices for servicing while the remainder of the system is operative.
 - J. Recognitions shall include: UL for central station fire and/or burglary, local burglary and/or fire; FM for fire, California Fire Marshal for fire; and NYBSA for fire.
 - K. Miscellaneous built-in features shall include:
 - 1. Real-time clock.
 - 2. Interrogator.
 - 3. Auto-answer modem.
 - 4. Phone line monitor.
 - 5. Loop start/ground start telephone interface.
 - 6. Auto bell test.
 - 7. Lug-in terminal strips, and user controlled zone bypass.
 - L. Command centers shall be microprocessor-based
 - 1. 16 character illuminated alpha-numeric display.
 - 2. Burglary and fire sounders.
 - 3. Backlight 15-key touchpad.

4. Pre-warn tone.
 5. The arming station shall have the ability to annunciate the English language format via the 16 character alphanumeric display by the following:
 - a. Master zone (alarm, service, faulted, and function), POPIT (alarm, service, faulted, missing, extra, function, and location), arm/disarm status (system diagnostics, time/day/date, and userprompts).
 6. Additional features shall include local system test, sensor reset, panic and/or medical and/or duress alarm initiation, independent master zone by-pass with automatic restoration to normal status to next system arming, perimeter watch mode, user changeable pass codes, remote programming initiation, and system/monitoring service test.
 7. Radionics model B915, and shall be functional at each of the locations shown on the floorplans.
 8. Non-school oriented buildings will use Radionics Model B942 Touch Screen Keypads
- M. Modules and Accessories
1. POPEX Module (Zone Expansion B299)
 2. B8103 Main Panel Enclosure & D101 Lock set- one required for the main panel and one for each quadrant of the project receiving a B299.
 3. D9002-5 6 location 3 hole Mounting plate- adapter used for hanging modules in all expansion panels.
 4. B430 Telephone Line Interface
 5. B308 Octo-Relay module - provides eight form "C" dry contact relay outputs for a variety of programmable responses to alarm, trouble and other system conditions.
 6. Auxiliary power supplies as required for powering of motion detectors, Altronix Power Supply (Part # SMP10PM12P8) - one required for each quadrant of the project receiving a B299.

2.2 FIELD DEVICES

- A. Ceiling mounted 360 Degree, infrared sensors / microwave motion sensors. Model DS 9370
 1. Bracket for direct mounting to standard 3-1/2" and 4" electrical back boxes.
 2. All units must be adjusted/masked to reduce false signals for the covered area.
 3. Contractor to provide a dedicated POPIT for each motion detector on the project.
- B. Ceiling mounted 200ft Long Range infrared sensor. Model DS794Z
 1. Bracket for direct mounting to standard 3-1/2" and 4" electrical back boxes.
 2. All units must be adjusted/masked to reduce false signals for the covered area.
 3. Contractor to provide a dedicated POPIT for each motion detector on the project
- C. Wall mounted, high performance, Tri Tech PIR/Microwave sensor, Model ISC-CDL1-W15G
 1. Bracket for direct mounting to standard 3-1/2" and 4" electrical back boxes.
 2. All units to have areas of coverage, which would cause false alarm signals to be generated, masked out and adjusted to reduce false signals.
 3. Provide model correct protective wire cage in gymnasiums.
 4. Contractor to provide a dedicated POPIT for each motion detector on the project.
- D. Magnetic Door / Hatch / Overhead Contacts
 1. Where exposed contacts are used they shall be heavy duty switches protected by die cast aluminum housing and the leads shall be encased in steel armor jacket. The leads must pass through the back box by the correct size twin screw cable clamp connector.

2. Magnetic Door / Hatch contacts shall be model Sentrol 2505A-L contact
 3. Overhead Roll up contacts shall be model Ademco 958 contact
 4. Contractor to provide a dedicated POPIT for each entry door, set of doors, roof hatch or rollup door on the project.
- E. Glass Break Detector
1. Bracket for direct mounting to standard 3-1/2" and 4" electrical back boxes.
 2. Provide model correct protective wire cage in gymnasiums.
 3. Glass breaks shall be Model GE 5812-RND or Bosch DS-1108DI
 4. Contractor to Provide dedicated POPIT for each room of glass break detectors on the project.
- F. Sirens
1. Shall be installed on Wall / Ceiling within 50 foot of every keypad location.
 2. Wired directly to corresponding relay module and not the main control panel.
 3. Sirens shall be Model SSX-52 Amseco.

2.3 WIRING

- A. All wiring shall be by the manufactures (Bosch/Radionics) specifications. All cable is preferred but not limited to be shielded.
- B. Each area of a building shall provide its own Popex Module(s), Power supply(ies) and enclosure(s) in that areas IDF. All areas considered should be at minimum 500ft from the main panel or as otherwise instructed by owner.
- C. All 120v Power shall be furnished by the contractor.
- D. All Security system conduits as show on the drawings shall be furnished by the contractor as part of their scope of work.
- E. Coordination with the electrical contractor is the responsibility of the Security Contractor to ensure all conduit is in place for a complete installation.
- F. All systems shall be connected to an emergency power source as available.
- G. Color code of all security intrusion detection system and access control wiring shall be purple in color.
- H. Approved Products:
 1. 18/2 unshielded:
Belden #6300UE0071000
Tappan Wire & Cable, Inc. #P40020.122
 2. 18/4 unshielded:
Belden #6302UE0071000
Tappan Wire & Cable, Inc. #P41387.28
 3. 18/6 unshielded:
Belden #6304UE0071000
Tappan Wire & Cable, Inc.

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 maybe 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 Systimax Category 6 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 with 10ft of slack at minimum.
 - J. Each set of glass breaks 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 drop ceiling in an area easily accessible by an 8 or 6 ft ladder.
 - 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 or before substantial completion of project.
 - R. Contractor shall install communication wire from provided exterior connection at freezer/cooler control panels to burglar alarm via POPIT module interface to notify panel should freezer/cooler encounter high temperature condition. Coordinate programming and testing of module 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.
 - U. All Eyewash stations and Lockdown buttons shall have a dedicated POPIT module interface per device on the project and be wired Normally closed for monitoring purposes.
 - V. Any generator on site must be monitored through a dry Normally closed contact connection to a dedicated POPIT module and tested to confirm its function for main building AC Loss.

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. The 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 SYSTEM OPERATION

A. When an alarm condition is detected by any of the alarm initiating devices, the following functions shall occur:

1. The system keypad's interior audible device shall sound until silenced by using proper security code or after system time out.
2. A custom system alarm message shall be displayed on the LCD display. This display will show the alarm device location in plain English. Location and partition custom messages shall be field programmable.
3. The remote signaling tie connection shall be activated at the Owner's approved

- central security monitoring location and/or other Owner designated location.
4. Printer shall provide printed copy of events recorded in logger. Install adjacent to security panel.

3.4 SYSTEM ZONING AND PARTITIONING

- A. The system shall employ intelligent initiating devices and interface devices capable of being recognized and enunciated at the main system keypad and devices partition keypad.
- B. All zoning/device locations shall be field programmable.
- C. Input control zones shall be coordinated with the owner prior to final programming:

3.5 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.

3.6 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.
- B. Any Extended Manufacturer's Warranty will be provided to the Owner if the Sub-contractor entitled to the job has an agreement for an extended warranty already in place with the Manufacturer.

3.7 SOFTWARE

- A. Provide two electronic copies of the final programming and program software to the Owner's Police Technology Foreman after final approval.

END OF SECTION

SECTION 28 46 02
EXPANSION OF EXISTING FIRE DETECTION AND ALARM SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide all detailed engineering, documentation, materials and devices, installation, calibration, software programming and check-out necessary for a complete and fully operational fire detection and alarm system in accordance with the full intent and meaning of the drawings and specifications including, but not limited to, the following:
 - 1. Supply, install and connect all hardware necessary to provide a complete and operational fire detection and alarm system.
 - 2. Supply, install and wire all field hardware, power supplies, power circuits, alarm initiating devices, audible and visual alarm devices, auxiliary control relays, signal initiating and signaling devices, conduits, wires, fittings and all accessories required for the system to perform as specified as required. Use and expand the existing fire alarm control panel.
 - 3. Supply, install, debug and test all software required to provide all software functions described in accordance with the full intent and meaning of the drawings and specifications.
 - 4. Coordinate the work specified under this Section with other trades and contractors to assure a complete and fully operational system.
- B. The intent of fire detection and alarm system work is specified in this section and indicated on the drawings. The installing contractor shall design and provide a complete system, meeting the requirement of this section. The Contractor shall provide all fire alarm and initiation devices in new and renovated areas required for a complete system acceptable to all governing authorities. Provide proper spacing and coverage of all devices.
- C. Scope of work includes providing voice evacuation throughout the entire building and expanding from existing system for new additions. Verify and/or provide necessary equipment and programming to provide point-to-point reporting for monitoring.

1.2 RELATED SECTIONS

- A. Divisions 22, 23 and 26
- B. Fire Suppression Systems
- C. Elevators
- D. Food Service

1.3 CODES / STANDARDS / REFERENCES (LATEST EDITIONS)

- A. National Fire Protection Association (NFPA):
 - 1. NFPA1 Fire Code
 - 2. NFPA 13 Systems, Installation
 - 3. NFPA 17 Dry Chemical Extinguishing Systems
 - 4. NFPA 70 National Electrical Code
 - 5. NFPA 72 National Fire Alarm and Signaling Code.
 - 6. NFPA 80 Fire Doors and Fire Windows
 - 7. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems.
 - 8. NFPA 92A Smoke Control Systems
 - 9. NFPA 101 Life Safety code.
 - 10. NFPA 105 Smoke Control Door Assemblies
 - 11. NFPA 1221 Standard for the Installation, Maintenance and Use of

- Emergency Services Communications Systems.
12. NFPA 2001 Fire Extinguishing Systems, Clean Agent
- B. UL: Underwriters Laboratories, Inc.
1. 217 Single and Multiple Station Smoke Detectors.
 2. 268 Smoke Detectors for Fire Protective Signaling Services.
 3. 864 Control Units for Fire Protective Signaling Services.
 4. 864 Transient protection
 5. 1480 Speakers for Fire Protective Signaling Systems
 6. UL Fire Protection Equipment Directory.
 7. UL Electrical Construction Materials Directory.
- C. Factory Mutual P7825 Approval Guide
- D. American National Standards Institute (ANSI).
- E. National Electrical Manufacturer's Association (NEMA).
- F. Institute of Electrical and Electronic Engineers (IEEE).
- G. Electronic Industries Association (EIA-232-C): Interface between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange.
- H. Requirements of American Disabilities Act (Public Law 101-336).
- I. Local Accessibility Standards, Codes, and Ordinances
- J. State Fire Marshall or Requirements of Local Authorities having Jurisdiction
- K. State Insurance Code.
- L. National Building Code.
- M. International Building and Fire Code adopted by Local Authority Having Jurisdiction
- N. Uniform Building Code.
- O. Local & State Building Codes.
- P. In addition the above requirements, comply with all local codes. Where discrepancies exist between codes, drawings or specifications, the more stringent requirement shall prevail. Installation shall be subject to approval, inspection and test of applicable regulatory agencies.

1.4 MANUFACTURER'S, PLANNER'S AND INSTALLER'S QUALIFICATIONS

- A. The manufacturer shall regularly and presently produce, as the manufacturer's principle products, the equipment and material of the type and design specified for this project, and shall have manufactured the item for at least 5 years. All components of the system shall be UL compatible with the existing main fire alarm control panel. Manufacturer of all components shall match existing manufacturers of similar or same type components unless otherwise specified or noted on the drawings.
- B. The installing contractor shall have been actively engaged in the business of designing, selling, installing, and servicing fire alarm systems for at least ten (10) years.
- C. The entire Fire Detection and Alarm System shall be installed by a factory authorized representative of the existing main fire alarm control panel and certified by the manufacturer to distribute, sell, and install the specified fire alarm and smoke detection system. Include all components, elements, and testing and acceptance procedures.
- D. If the submitted system is being supplied by an authorized distributor of the equipment manufacturer, the distributor shall have been actively engaged in the sale, installation and service of the type of system proposed for this project for a minimum of 10 years.
- E. Any proposed installer who cannot show evidence of such qualifications may be rejected. The services of a technician provided and certified by the equipment manufacturer shall be provided to supervise the installation and tests of the system.
- F. Furnish evidence there is an experienced and effective service organization, which carries

- a stock of repair parts for the system to be furnished.
- G. The installing contractor shall be licensed by the State Fire Marshall to design, sell, install, and service fire alarm systems as required by the State Insurance Code.
 - H. The installing contractor shall have on his staff a minimum of two (2) Fire Alarm Planning Superintendent (APS) 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 State Insurance Code.
 - I. The APS shall be a certified NICET Level III state licensed fire alarm planner under whose supervision system design shall take place. In lieu of a NICET certified state licensed fire alarm planner, the contractor or supplier may provide design supervision by a registered professional engineer, who regularly engages in the design of fire alarm systems.
 - J. The installing contractor shall provide 24-hour, 365 days per year emergency service with factory trained, state licensed service technicians.
 - K. Material shall be new and in perfect condition when installed.
 - L. Electrical or electronic equipment provided under this Division which has been damaged, exposed to weather, or is, in the opinion of the Architect/Engineer otherwise unsuitable because of improper fabrication, storage, or installation, shall be removed and replaced with new equipment, at no additional cost to the owner.

1.5 COORDINATION

- A. It shall be the responsibility of the installing contractor to coordinate all requirements surrounding installation of the fire alarm system with all other trades.

1.6 DEFINITIONS

- A. General: Wherever mentioned in this specification or on the drawings, the equipment, devices and functions shall be defined as follows:
 - 1. Alarm Signal: A signal, which signifies a state of emergency requiring immediate action and immediate notification of the Fire Department. These are signals such as:
 - a. The operation of a manual station.
 - b. The operation of a fire suppression system switch.
 - 2. Pre-Alarm Signal: A signal, which indicates a detection device, has operated. These signals require and immediate response, but do not require immediate notification of the Fire Department.
 - 3. Supervisory Signal: A signal, which signifies the impairment of fire protection system, which may prevent its normal operation.
 - 4. Trouble Signal: A signal, which indicates that a fault, such as an open circuit or ground, has occurred in the system.
 - 5. Alarm Zone: An alarm initiating device or combination of devices connected to a single alarm initiating device circuit.
 - 6. Pre-Alarm Zone: A detector or group of detectors connected to a single detector circuit, which can send an alarm to the central control panel.
 - 7. Supervision Zone: A supervisory signal initiating device or combination of such devices connected to a single supervisory signal circuit.
 - 8. Communication Zone: A fire alarm indicating device or series of devices arranged to visually and/or audibly indicate a fire alarm signal.

1.7 SUBMITTALS

- A. Before the shop drawings are submitted to Architect / Engineer, submit drawings to the Authority Having Jurisdiction for approval. All approvals shall be noted on the drawings

or by letter from the Authority Having Jurisdiction. Submit copies of the Authority Having Jurisdiction approved shop drawings to the Architect for review.

- B. Fire alarm submittal shall be bound and separate from all other submittals. The installing contractor and/or equipment supplier shall provide complete and detailed shop drawings and include:
1. Provide a complete written, item-by-item, line-by-line, specification review stating compliance or deviation in full description.
 2. Complete point-to-point wiring diagrams of new equipment.
 3. Complete floor plan drawings locating all new system devices and existing panels used for expansion.
 4. Complete system bill of material.
 5. Detailed system operational description. Any specification differences and deviations shall be clearly noted and marked.
 6. Provide a complete description of system operation.
 7. Manufacturer's installation instruction.
 8. Bound form with contractor's name, supplier's name, project name, state fire alarm license, Fire Alarm Planning Superintendent license and all Technician(s) license adequately identified.
 9. Submittal sheets sequentially numbered with the format: sheet number of number total. For example: 1 of 3.
 10. Complete set of manufacturer's operating instructions, circuit diagrams and the information necessary for proper installation, operation and maintenance.
 11. Field and factory wiring diagrams of all new systems and for typical devices showing all connections with all terminals and interconnections identified.
 12. Complete schematic circuit diagrams for all new equipment, including panel modules.
 13. Floor plan drawings including all existing main and new panel and device locations, conduit sizes between devices and panels; number, size and type of conductors between devices and panels; walls, doors and graphic room numbers; exact power requirements and conduit routing with the location of all junction boxes and exact locations of devices and equipment. Submit a floor plan drawing circuiting/zoning shall be identified on the drawings.
 14. Complete wiring, routing, and schematic diagrams, software descriptions, and details required to demonstrate that the system has been coordinated and will function as a system.
 15. Manufacturers catalog cut sheets shall be provide for each piece of equipment with the appropriate model or part number highlighted in cases where multiple model numbers or part numbers are shown.
 16. Detailed list of all hardware components, which are included.
 17. Installation details for each type of field mounted device installed under this contract.
 18. Point-to-point termination schedules with cable identification numbers and terminal strip numbers.
 19. New fire detection and alarm system's panel configuration complete with peripheral devices, batteries, power supplies, and interconnection diagrams.
 20. Submit a riser diagram of trunk wiring and device-to-device wiring and device to fire alarm control panel wiring. Riser shall show:
 - a. Conduit sizes and types.
 - b. Number, size and type of conductors.
 - c. Fire detection and alarm devices arranged in the required circuiting/zoning, as defined in the specifications and on the drawing.

- d. Battery calculations to show compliance with the requirements of the specifications for both alarm and supervisory mode.
21. Indicate visual alarm device candela setting required for coverage.
22. Sample of proposed graphic/text annunciation.

1.8 OPERATION AND MAINTENANCE MANUALS

- A. Submit complete sets of operation and maintenance manuals. Manual, less as-builts, and sign-off sheets, shall be provided upon completion of the work. Approval of the manual will be required prior to substantial completion.
- B. The Operation and Maintenance Manual shall consist of the following:
 1. The manual shall include the names, addresses and telephone numbers of each Contractor installing products, and of the nearest service representative for each product. The manual shall have a Table of Contents and tab sheets. Update manuals to include modifications made during installation, checkout and acceptance. The manual shall include the sections described in the following paragraphs.
 2. The Functional Design Section shall identify the operational requirements for the system and explain the theory of operation, design philosophy, and specific functions. Hardware and software functions, interfaces, and requirements shall be provided for system operating modes.
 3. The Hardware Section shall describe equipment provided, including general description and specifications, installation and checkout procedure, electrical schematics and layout drawings. Alignment and calibration procedures, manufacturer's repair parts list indicating source of supply, interface definition, signal identification and wiring diagrams. Also, include a complete parts list of all components as well as a list of recommended spare parts. The spare parts list shall include, for each item, the manufacturer's name, the model of the part, and serial number, if appropriate, and a physical and electrical description of the part.
 4. The Software Section shall describe programming and testing, starting with a system overview and proceeding to a detailed description of each software module, to instruct the user on programming or reprogramming any portion of the system and other information necessary to enable proper system usage.
 5. The Operation Section shall provide instructions for operation of the system, including system start-up procedures, use of system and applications software, alarm presentation (where applicable), failure and recovery procedures, preventive maintenance schedule, parameter schedules and sequence definition, and system access requirements.
 6. The Maintenance Section shall provide descriptions of maintenance for equipment including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.
 7. The Shop Drawings section shall include copies of all approved shop drawings and submittal materials updated to "AS BUILT".

1.9 AS-BUILT DRAWINGS

- A. Prepare and submit detailed "As-Built" drawings. The drawings shall include certified test of the system, testing and acceptance sign-off sheets, and other items specified elsewhere to be performed after initial submission of operation and maintenance manuals, complete wiring diagrams showing connections between all devices and equipment, both factory and field wired. Include a riser diagram and drawings showing the as built location of all devices and equipment. The drawings shall show the system as installed, including all deviations from both the project drawings and the approved shop drawings.

The drawings shall be prepared on uniform sized sheets, the same size as the project drawings. The plan drawings shall be 11x17 inch and inserted in the specified Operations and Maintenance Manuals. Provide electronic copies in PDF and Autocad.dwg format.

1.10 WARRANTY

- A. All new fire alarm devices, new panels, new equipment and new accessories, including labor and material, shall be free from defects in workmanship and materials, under normal use and service, for a period of one year from the date of substantial completion. Any equipment or workmanship shown to be defective shall be repaired, replaced or adjusted during normal working hours at no cost to the owner within 4-hour notification.
- B. Repair services and replacement parts for the system to be furnished under this Contract shall be available for a period of ten years after the date of final acceptance. Service during the warranty period shall be provided within four hours after notification and all repairs shall be corrected within 24 hours after notification throughout the warranty specified in this section.
- C. The installing contractor shall provide 24 hour, 365 days per year emergency service with factory trained, state licensed service technicians.
- D. The equipment manufacturer shall be represented by a local service organization and the name of such shall be furnished to the Owner, Architect, and Engineer.
- E. Provide a certified fire alarm test of the complete system at the end of the warranty period and correct any and all items located in the area of renovation to bring the system to an approved status at no cost to the Owner. Clean all smoke detectors and replace all defective parts within the area of renovation at no cost to the Owner.
- F. Guarantee labor, materials, and equipment provided under this contract against all defects for a period of one year after the date of final acceptance and receipt and approval of "As-Built" drawings and schematics of all equipment.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers acceptable contingent upon Products' compliance with the specifications:
 - 1. Existing fire alarm system: Notifier NFS2-3030

2.2 SYSTEM DESCRIPTION

- A. System shall be a fully functional fire detection and alarm system, tested and left in first class operating condition. Voice evacuation systems where required or specified shall have voice alarm notification wherever audible notification is required.
- B. The system shall provide communication with initiating and control devices individually. All of these devices shall be individually annunciated at the fire alarm control panel. Annunciation shall include the following conditions for each point:
 - 1. Alarm
 - 2. Trouble.
 - 3. Open
 - 4. Short
 - 5. Device missing/failed.
- C. System circuits shall be wired as follows: Initiating device circuit (IDCs) shall be Style B, indicating appliance circuit (IACs) shall be Style Y, and signal line circuit (SLCs) shall be Style 4 as describe in NFPA 72.
- D. The system shall contain independently supervised initiating device circuits. The alarm activation of any initiation circuit shall not prevent the subsequent alarm operation of any other initiation circuit.

- E. There shall be supervisory service initiation device circuits for connection of all sprinkler water flow switches and valves. Device activation shall cause a general alarm at the fire alarm control panel. Each flow and tamper switch shall have an individual address.
- F. There shall be independently supervised and independently fused indicating appliance circuits for all alarm signaling devices. Disarrangement conditions of any circuit shall not affect the operation of other circuits.
- G. Auxiliary manual controls shall be supervised so that an "off normal" position of any switch shall cause an "off normal" system trouble.
- H. The incoming power to the system shall be supervised so that any power failure must be audibly and visually indicated at the fire alarm control panel. A green "power on" LED shall be displayed continuously while incoming power is present at the building fire alarm control panel.
- I. The system batteries shall be supervised so that a low battery condition or disconnection of the battery shall be audibly and visually indicated at the building fire alarm control panel.
- J. The system modules shall be electrically supervised for module placement. Should a module become disconnected, the system trouble indicator shall illuminate and the audible trouble signal shall sound.
- K. The system shall have provisions for disabling and enabling all circuits individually for maintenance or testing purposes.
- L. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal 120 VAC power in a normal or supervisory mode for a period of 24 hours with 20 minutes of alarm operation at the end of this period as a minimum. The system shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging operations shall be automatic. If batteries are fully discharged, the charger shall recharge them back to full charge in four hours.
- M. All external circuits requiring system operating power shall be 24 VDC and shall be individually fused at the respective fire alarm control panel.
- N. All addressable devices shall have the capability of being disabled or enabled individually from the fire alarm control panel.
- O. A maximum of 90 addressable devices shall be multi-dropped from a single pair of wires. Systems that require factory reprogramming to add or delete devices within the capability of the designed system are unacceptable. Expansion of the designed system shall be accomplished by factory reprogramming.
- P. The communication format to the addressable devices shall be a completely digital poll/response protocol to allow t-tapping of the circuit wiring. A high degree of communication reliability must be obtained by using parity data bit error checking routines for address codes and check sum routines for the data transmission portion of the protocol.
- Q. Each addressable device must be uniquely identified by an address code. The system must verify that proper type device is in place and matches the desired software configuration. All remote or external panels shall have an individual address for monitoring.
- R. Wiring type, distances, survivability, and wiring configuration types shall be approved by the equipment manufacturer. The system shall allow a line distance of up to 2,500 feet to the furthest addressable device on a Style Y circuit. Fire alarm cable shall have an outer jacket insulation color of red. Minimum wire size shall be #18 AWG.
- S. Each panel extender shall have an individual address.

2.3 FIRE ALARM CONTROL PANEL (FACP)

- A. Existing to remain.
- B. The fire alarm control panel shall be left with 25% spare initiating point and battery capacity for future use.
- C. New power supplies (if required) shall provide all control panel and peripheral power needs with filtered power as well as unregulated 24VDC power for external audio-visual devices. The audio-visual power shall be increased as needed by adding additional modular expansion power supplies. All power supplies shall be designed to meet UL and NFPA requirements for POWER LIMITED operation on all external signaling lines, including initiating circuits and indicating circuits. Design the system power supplies and power trunk wiring for all annunciation devices required, and to add a minimum of two (2) 110cd visual devices in the future. Individual circuit design loading shall not exceed 70% of power supply and system wiring capacity when including the additional spare capacity for the 110cd visual devices
 - 1. Input power shall be 120VAC 60Hz. The power supply shall provide internal supervised batteries and automatic charger. The power supply shall provide positive and negative ground fault supervision, battery/charger fail condition, and AC power fail indicators. The power supply shall also provide supervision of modular expansion power supplies as may be required.
 - 2. Surge protection shall be integral to the control panels.
 - 3. Each power supply shall be monitored and have an individual address.

2.4 DIGITAL FIRE ALARM COMMUNICATOR

- A. Existing to remain.

2.5 EMERGENCY VOICE ALARM COMMUNICATION SYSTEM

- A. Existing to remain.
- B. Compatible and UL listed with existing fire alarm system.

2.6 NEW FIELD DEVICES WHERE REQUIRED

- A. All devices shall be supervised for trouble conditions. The fire alarm control panel shall be capable of displaying the type of trouble condition (open, short, device missing/failed). Should a device fail, it shall not hinder the operation of other system devices.
- B. Visual Signals
 - 1. Strobe lights shall be low profile and operate on 24 VDC. The strobe light shall be capable of producing 75 candela on axis to comply with ADA and UL 1638 requirements, and 15, 30, or 110 candela to comply with UL 1971 requirements. Visual signals in common areas of illumination shall have synchronized flash. Provide white with red letters.
 - 2. All wall mounted strobe units installed in student's toilets, gymnasiums, corridors, student locker/dressing rooms shall have a protective cover.
- C. Combination Alarm Signal and High Intensity Visual Signals
 - 1. Strobe lights shall operate on 24 VDC. The strobe light shall be capable of producing 75 candela on axis to comply with ADA requirements, and 15, 30 or 110 candela to comply with UL 1971 requirements. Visual signals in common areas of illumination shall have synchronized flash. Each unit shall provide a Code 3 Temporal tone. The horn shall be capable of an output of 95dB at 10', and intensity adjusted accordingly for the area of coverage. Electronic Mini-Sounder or horn set on low setting shall be provided in interior rooms 900 square feet or less. Mini-sounder shall not be used in any corridors, mechanical electrical rooms and similar large spaces and areas of high ambient noise level. Provide white

- with red letters.
2. All wall mounted combination units installed in student toilets, gymnasiums, corridors, student locker/dressing rooms shall have a protective cover
 3. The audible emergency alarms shall produce a sound that exceeds the prevailing sound level in the room or space by at least 15 dba or shall exceed any maximum sound level with a duration of 60 seconds by 5 dba, whichever is louder. Sound levels for alarm signals shall not exceed 110 dba at the minimum hearing distance from the audible appliance.
- D. Exterior Audible Signal:
1. Semi-flush mounted, molded of high impact red thermoplastic and listed for weatherproof locations.
- E. Combination Voice Signal and High Intensity Visual Signals (where indicated or required by local AHJ):
1. Strobe lights shall operate on 24 VDC. The strobe light shall be capable of producing 75 candela on axis to comply with ADA requirements, and 15, 30 or 110 candela to comply with UL 1971 requirements. Visual signals in common areas of illumination shall have synchronized flash.
 2. All combination units installed in student toilets, gymnasiums, student locker / dressing rooms shall have a protective cover.
 3. The visual signal lens housing shall be white with red lettered FIRE or as approved by Architect. The speaker and visual signal shall be mounted to a common white speaker baffle. The visual signal shall flash at a rate of minimum of 1 Hz and maximum of 3 Hz, and shall use a strobe type lamp or other high intensity long life light source. The lamp intensity shall be a minimum of 75 candela.
 4. The speaker shall be UL 1480 compatible with the control equipment. Unit shall operate within a temperature range of 150°F to -30°F. High output speakers, UL minimum 87dB at 10 feet with speaker taps of .33.66/1.25/2.5 watts. Standard output speakers, UL 75-81 dB at 10 feet with speaker taps of .5/1/1.75/2.75 watts. Capacitor for line supervision.
- F. Ceiling mounted recessed mounted speakers (where indicated or required by local AHJ) shall be UL 1480 compatible with the control equipment. Unit shall operate within a temperature range of 150°F to -30°F. UL minimum 78-87 dB at 10 feet with speaker taps of .25, .5/1.0/2.0 watts. Round, white baffle or 2x2 lay-in grid with UL enclosure, tile bridge supports when recessed in lay-in ceiling tiles (where indicated or required by local AHJ) and capacitor for line supervision.
- G. Surface mounted speakers (where indicated or required by local AHJ) shall be UL 1480 compatible with the control equipment. Unit shall operate within a temperature range of 150°F to -30°F UL minimum 100 dB at 15 watts at 10 feet. Speaker taps via 7-position selector switch, 25-vol., .48/.94/1.8/7.5/15 watts. Fully enclosed wiring terminals. Capacitor for line supervision.
- H. Addressable Manual Pull Stations:
1. The manual station shall provide address-setting means using rotary decimal switches. No binary coding shall be required.
 2. Manual stations shall be designed for semi-flush mounting on standard electrical box. The station shall be constructed of hi-impact red molded Lexan with instructions for station operation in raised white letters. Stations shall be of the dual action type.
 3. Install Stopper STII 100 series covers with horns on all manual pull stations, except the one at the FACP and Remote Annunciator.

4. At renovation: Remove all manual pull stations except one at main fire alarm panel and one at remote annunciator panel, unless otherwise called for by code.
 5. At new construction: Install only two manual pull stations; one at main fire alarm panel and one at remote annunciator panel, unless otherwise called for by code.
 6. Do not specify or use ionization only type detectors unless reviewed and approved by CFISD. Multi-criteria detectors that include ionization detection as one of the criteria to initiate and alarm are acceptable.
- I. Intelligent Multi-Criteria Photoelectric Smoke Detectors
1. The intelligent multi-criteria detection device shall include the ability to combine the signal of the thermal sensor with the signal of the photoelectric signal in an effort to react hastily in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a false alarm condition by examining the characteristics of the thermal and smoke sensing chambers and comparing them to a database of actual fire and deceptive phenomena.
 2. The detectors shall use the photoelectric principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the ANALOG level of smoke density. The detector shall provide automatic sensitivity "drift" compensation. The detector shall also provide a "maintenance alert" feature whereby the detector shall initiate a trouble condition should the unit's sensitivity approach the outside limits of the normal sensitivity window.
 3. The detectors shall provide address setting means electronically and automatically at the control panel.
 4. The detectors shall provide operational status and alarm state LED. Under normal conditions, the LED shall flash, indicating the detector is operational and in regular communication with the control panel. An output connection shall also be provided in the base for connecting an external remote alarm LED.
 5. The detector shall be semi-flush ceiling mounted and be provided with modular detector head with twist lock base. No radioactive material shall be used.
 6. Voltage and RF transient suppression techniques shall be employed as well as smoke signal verification circuit and an insect screen.
- J. Intelligent Photoelectric Smoke Detectors
1. The detectors shall use the photoelectric principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the ANALOG level of smoke density. The detector shall provide automatic sensitivity "drift" compensation. The detector shall also provide a "maintenance alert" feature whereby the detector shall initiate a trouble condition should the unit's sensitivity approach the outside limits of the normal sensitivity window.
 2. The detectors shall provide address setting means electronically and automatically at the control panel.
 3. The detectors shall provide operational status and alarm state LED. Under normal conditions, the LED shall flash, indicating the detector is operational and in regular communication with the control panel. An output connection shall also be provided in the base for connecting an external remote alarm LED.
 4. The detector shall be semi-flush ceiling mounted and be provided with modular detector head with twist lock base. No radioactive material shall be used.
 5. Voltage and RF transient suppression techniques shall be employed as well as smoke signal verification circuit and an insect screen.
- K. Duct photoelectric smoke detectors:
1. Detectors shall be analog addressable type.

2. To minimize nuisance alarms, detectors shall have an insect screen and be designed to ignore invisible airborne particles or smoke densities that are below the factory set alarm point. No radioactive material shall be used.
 3. Removal of the detector head shall interrupt the supervisory circuit of the fire alarm detection loop and cause a trouble signal at the control panel.
 4. Voltage and RF transient suppression techniques shall be employed as well as smoke signal verification circuit and an insect screen.
 5. Remote alarm/power LED indicator with test switch shall be provided. Unit shall be wall or ceiling mounted in readily visible and accessible area near the location of detector; exact location of unit to be approved by the Architect/Engineer.
 6. Detectors shall operate on the same principles and exhibit the same basic characteristics as area type photoelectric smoke sensors. The detector shall operate in air velocities of 300 FPM to 4,000 FPM. Each detector shall interface directly to the system SLC loop without the requirement of interface zone modules.
 7. The unit shall consist of a clear molded plastic enclosure (or remote mounted LED status indicator shall be provided next to the smoke detector) with integral conduit knockouts to provide visual viewing of detector/sensor for monitoring sensor operation and chamber condition. The duct housing shall be provided with gasket seals to insure proper seating of the housing to the associated ductwork. Each unit's sampling tubes shall extend the width of the duct and be provided with porosity filters to reduce sensor/chamber contamination.
 8. The detectors shall provide alarm and power status indication by LED. Under normal conditions, the LED shall flash, indicating the detector is operational and in regular communication with the control panel. Steady illumination of the LED shall indicate that the control panel has detected and verified an alarm condition. An output connection shall also be provided in the base for connecting an external remote alarm LED.
 9. The detectors shall provide address setting means electronically and automatically from the control panel.
- L. Intelligent Thermal Detectors
1. The detectors shall use dual electronic thermostats to measure temperature levels in its chamber and shall, on command from the control panel, send data to the panel representing the analog temperature level.
 2. The detectors shall provide address setting means electronically and automatically at the control panel.
 3. The detectors shall provide operational status and alarm state LED. Under normal conditions, the LED shall flash, indicating the detector is operational and in regular communication with the control panel. An output connection shall also be provided in the base for connecting an external remote alarm LED.
 4. The detector shall be semi-flush ceiling mounted and be provided with modular detector head with twist lock base.
 5. Thermal Detectors shall be combination rate-of-rise and fixed temperature- rated at 135°F for areas where ambient temperatures do not exceed 100°F and shall be 200°F for areas where ambient temperatures exceed 100°F but not 150°F. The fixed temperature element shall consist of a fusible alloy retainer and actuator shaft. Detectors shall have a smooth ceiling rating of 2,500 square feet. Detectors shall be located as shown on the drawings and where required by local code authority.
 6. Provide fixed temperature 190°F detector in kitchen and kiln room in lieu of

- combination rate-of-rise / fixed-temperature type.
- M. Auxiliary AHU Relays: Air Products model MR-101C relays shall be provided for HVAC and AHU control and interface. Relays shall be heavy-duty type with contacts rated up to 10 amps at 120V AC, 60 HZ. Relays shall be provided with NEMA I dust cover assembly and be provided with DPDT contacts as well as activated LED indicator.
 - N. Voltage sensing relays: Addressable control modules for voltage sensing relay interface shall be FCM-1.
 - O. Monitor Module:
 - 1. Addressable monitor modules shall be provided where required to interface to contact alarm devices. The monitor module shall be used to connect a supervised zone of conventional initiating devices to an intelligent SLC loop.
 - 2. The monitor module shall provide address setting means electronically and automatically at the control panel. A status/alarm LED shall be provided which shall indicate that the monitor module is operational and in regular communication with the control panel, and indicate detection of an alarm condition.
 - P. Control Module
 - 1. Control/relay modules shall be provided where required to provide audible alarm interface and/or relay control interface. The control module shall be used to connect a supervised zone of conventional indicating devices to an intelligent loop. The zone may be wired class A or class B - field selected. The control module may be optionally wired as dry contact (form C) relay.
 - 2. The control module shall provide address setting means electronically and automatically at the control panel. A status/alarm LED shall be provided which shall indicate that the control module is operational and in regular communication with the control panel and indicate when the device is actuated via the fire alarm control panel.
 - Q. Auxiliary Interface Points: All auxiliary input points (kitchen hoods, water flow, tamper switches, fire extinguishing systems etc.) shall be connected as required, and addressed as a separate initiating point of annunciation at the fire alarm panel and any remote annunciator as required.
 - R. Water flow switches / Valve supervisory switches shall be provided and installed by the fire protection contractor and connected by the fire alarm contractor. Wiring of these field devices to the fire alarm system shall be the responsibility of the fire alarm contractor. It is the responsibility of this contractor to ensure the proper function of the system. Each fire protection zone (flow switch) and (Valve switch) shall be addressed electronically and automatically at the control panel as a separate point of annunciation at the fire alarm panel. Coordinate exact location with fire protection contractor and civil drawings.
 - S. Beam detectors:
 - 1. Microprocessor based beam detectors, consisting of a separate transmitter and matching receiver.
 - 2. Coverage up to 350 ft. X 60 ft.
 - 3. LED status indicators for normal (green), alarm (red), and trouble (yellow).
 - 4. The detectors shall provide address setting means electronically and automatically at the control panel.

2.7 MAGNETIC DOOR HOLDERS, AUTOMATIC FIRE DOORS / SHUTTERS, AND SECURITY GRILLES AND INTERIOR SPACE CONTROLLED ACCESS EGRESS DOORS WITH AUTOMATIC EMERGENCY EGRESS ELECTRIC LOCK EMERGENCY RELEASE

- A. Magnetic fire door hold open devices, interface for automatic roll down fire doors/shutters, and interface for security grilles and controlled access egress doors with emergency egress shall be provided. Coordinate with Division 8 and Architectural Drawings for exact location.
- B. The operation of any alarm in the fire alarm system shall cause the following:
 - 1. Release of the magnetic fire door holding devices, permitting the fire doors to be closed by the door closer.
 - 2. Permit the automatic roll down fire doors/shutters to close automatically.
 - 3. Permit the security grilles with emergency egress to open automatically.
 - 4. Unlock the electrically controlled access doors in all interior spaces.
- C. The magnetic door holders, automatic roll down fire doors/shutters, security grilles, and interior electrically controlled access doors with emergency egress, shall be associated with two smoke detectors located on the ceiling with one on either side of the fire door/shutter, security grille opening, or interior egress path electrically controlled door. The operation of either of these detectors shall also cause the magnetic holder to release the fire door, the automatic fire door/shutter to close, and the security grille with emergency egress to open.
- D. The operation of smoke detectors associated with a magnetic door holder, automatic roll down fire door, security grille, or electrically controlled access door shall transmit a pre-alarm signal to the fire alarm panel.

2.8 REMOTE PAGING UNIT

- A. Remote all-call paging unit or to activate one of the pre-recorded messages over the speaker circuits.

2.9 REMOTE ALPHANUMERIC DISPLAY ANNUNCIATORS

- A. (Where indicated or required by Local Authority Having Jurisdiction) Remote alpha-numeric annunciator(s) to annunciate all system events and duplicate the displayed status at the main FACP. The annunciator(s) shall be an 80-character display similar to the main FACP and operate via the system RS485 or RS232 serial output terminal from the main FACP. The unit shall operate from FACP 24VDC power and function during system power failure while the system resides on standby batteries. The remote annunciator(s) shall include:
 - 1. Integral time/date clock
 - 2. System reset
 - 3. System silence
 - 4. System acknowledge
 - 5. Display/step switch
 - 6. Integral trouble buzzer
 - 7. LCD contrast adjust
 - 8. Fire Drill Operation
 - 9. Owner's list of additional remote annunciator control buttons.
- B. Annunciator shall upon command display the first system alarm, last alarm, and system alarm count. The following primary controls shall be visible through a front access panel:
 - 1. 80 character alphanumeric display, LCD, LED, or gas plasma
 - 2. Individual red system alarm LED
 - 3. Individual yellow supervisory service LED
 - 4. Individual yellow trouble LED
 - 5. Green "POWER ON" LED
 - 6. Alarm acknowledge key

7. Trouble acknowledge key
8. Alarm silence key
9. System reset key
10. LED test
11. Additional control buttons as directed by Owner.

2.10 AUXILIARY EQUIPMENT MONITORING

- A. The fire alarm system shall monitor for alarm, supervisory, and trouble conditions; and annunciate the status of the following equipment when provided, or is existing to remain, as part of this project. A failed status shall activate the trouble alarm.
 1. Emergency Generator: Run Status
 2. Emergency Generator: Trouble Signal
 3. Fire Pump: Run Status
 4. Fire Pump: Trouble Signal
 5. Emergency Service Communications Systems, as required by NFPA 72 and NFPA 1221.

PART 3 - EXECUTION

3.1 EXPANSION OF EXISTING SYSTEM

- A. Testing of existing systems:
 1. Provide complete operational test of existing fire alarm system prior to any demolition or construction. Verify operation of each device, control panel, distribution equipment and associated accessories.
 2. Provide a complete written report to the Architect, indicating any deficiencies of the existing system in relation to each component's intended function. In addition, provide deficiencies of the existing system with regard to current Code, ADA, and Local Accessibility Standards requirements. Provide the written report 14 days prior to any work related to the expansion of the existing system.
 3. Testing of the existing system shall include all areas and all buildings served by the existing system.
- B. Expand the existing system in all expansion or renovation areas to include requirement specified and as required by the local authority having jurisdiction. Verify compatibility of new equipment with existing system.
- C. Provide smoke detectors in the following locations in addition or renovated areas:
 1. All paths of egress and adjoining spaces within the same envelope including but not limited to: corridors, hallways, stairs, lobbies, and elevator landings.
 2. At each electrical room, telecommunications/data room, elevator machine room, kiln room, and mechanical room not subject to un-treated or un-filtered outside air.
 3. At each computer lab/room.
 4. At each library or book storage room.
 5. At each storage room, stock room, or warehouse space.
 6. At each pre-K and kindergarten classrooms.
 7. At nurse's area/clinic and patient care/cot areas.
 8. At each special needs, life skills, adaptive behavior, developmental classrooms or similar designated areas without food preparation or cooking equipment.
 9. At each student toilet/restroom. Provide STI protective covers. Do not locate over plumbing fixtures or near partitions.
- D. Provide heat/thermal detectors in the following locations in addition or renovated areas:
 1. At each mechanical room subject to un-treated or un-filtered outside air.
 2. At each janitor's closets and laundry rooms.

3. At each commercial kitchen and adjoining storage rooms; at each food preparation area.
 4. At each employee break room.
 5. At each vocational shop.
 6. At each science, physics, chemistry, or biology classroom and their associated preparation and storage rooms.
 7. At each special needs, life skills, adaptive behavior, developmental classrooms or similar designated areas with food preparation or cooking equipment.
- E. Provide carbon monoxide detection and smoke detection devices in all areas designated as day-care for minors.
- F. Provide duct smoke detectors in all air handling units with air volumes of 2,000 cfm or larger.
1. Where duct smoke detectors are installed above ceilings, provide external remote status/alarm LED mounted flush with ceiling in close proximity to the duct detector location. If space is open without ceiling, wall mount remote status/alarm LED in close proximity to the detector between 96 and 108-inches AFF, or as directed by Owner.
- G. Provide duct smoke detectors on outside air units only as required by local Code and / or AHJ.
- H. Provide VESDA type detectors at the following locations when appropriate:
1. Atriums to avoid exposed conduits.
 2. High ceiling areas 25 feet and higher where maintenance of spot type detectors will be difficult.
 3. Skylights to avoid exposed conduits.
 4. Coolers/Freezers 200 square feet and larger.
- J. Provide weatherproof exterior audio/visual alarm devices mounted on the building at the exact location as directed by Architect:
1. Main entry.
 2. Courtyards and outdoor assembly areas adjacent to the building.
 3. Mechanical yards adjacent to the building.
 4. Covered playgrounds or covered assembly areas adjacent to the building.
 5. Additional locations where indicated on drawings.
 6. Outdoor paved play areas.
- K. Provide audio and visual alarm devices in all areas normally occupied by students or minors and all common use areas.
- L. Provide beam type detectors at the following locations when appropriate:
1. Atriums.
 2. High ceiling corridors where maintenance of spot type detectors may be difficult.
 3. Areas with skylights.
- M. Provide carbon monoxide detection and smoke detection devices in all areas designated as day-care for minors.
- N. Provide carbon monoxide detection in classrooms and other instructional spaces served by a fuel-burning appliance, fuel-burning HVAC equipment (including roof mounted equipment), or with gas fuel outlets for connection to portable fuel-burning space heaters and appliances such as Bunsen burners which are typically used in laboratories or science classrooms.

3.2 GENERAL REQUIREMENTS

- A. Installation shall include the delivery, storage, setting in place, fastening to the building structure, interconnection of the system components, alignment, adjustment and all other

- work, whether or not expressly specified, which is necessary to result in a tested and operational system.
- B. All installation practices shall be in accordance with, but not limited to, the specifications and drawings. Installation shall be performed in accordance with the applicable standards, requirements and recommendations of NFPA 72 and the National Electrical Code and any authorities having jurisdiction. Proper protection against corrosion shall be provided on all electrical equipment in accordance with the requirements of the National Electrical Code. The installation shall conform to all manufacturers' recommendations.
 - C. All equipment shall be firmly secured in place unless requirements of portability dictate otherwise. Fastenings and support shall be adequate to support their loads with a safety factor of at least three.
 - D. All boxes, equipment, etc., shall be plumb and square. The contractor must take such precautions as are necessary to prevent and guard against electrostatic hum, to supply adequate ventilation, and to install the equipment to provide reasonable safety for the operator.
 - E. Visual displays, GUIs, or other indicators for main fire alarm panel and all remote annunciators shall be at maximum 66 inches AFF.
 - F. All remote booster and associated equipment panels shall be mounted with top of enclosure maximum 66 inches AFF.
 - G. In the installation of equipment and cables, coordinate with Architectural drawings for possible conflicts with millwork, casework, marker boards, furniture, lockers, etc., and notify the architect of any discrepancies. Verify modifications before proceeding with installation.
 - H. Mount end-of-line resistor for each box circuit in backbox located at the last manual alarm station or automatic initiating device in a circuit. Mark device accordingly in the field.
 - I. Provide three dedicated Cat 6 cables from MDF/IDF to fire alarm panel. Cable shall be installed in 3/4" conduit. Two cables for phone POT lines and one Ethernet data connection.
 - J. Upright and/or Wall Post-Indicating Valve: Provide conduit and wiring from fire alarm control panel to post-indicating valve if electronically supervised, coordinate exact location of PIV with fire sprinkler contractor prior to rough-in. Coordinate final location with Civil Drawings and Fire Protection Contractor. Where equipment is located inside a vault, stub required conduit inside vault, turn up and cap.
 - K. Contractor shall submit on completion of system verification, a point-by-point check list indicating the date and time of each item inspected and issue a certificate confirming that the inspection has been completed and the system is installed and functioning in accordance with the Specifications prior to date of substantial completion.
 - L. Provide remote alphanumeric display annunciators in the administrative area in constantly attended area, as required by the Local AHJ, and additional annunciators where indicated on the drawings, as directed by Owner / Architect.
 - M. Alarm devices shall be ceiling mounted unless indicated specifically otherwise. Alarm devices in Mechanical, Electrical, Communications, IDF / MDF Rooms and Central Plant shall be wall mounted and coordinated with other equipment, piping and ductwork.
 - N. Provide combination speaker strobes. Provide strobe only alarms when additional speaker placement will compromise voice intelligibility. Provide horn/strobes in coolers and freezers.
 - O. Detectors shall be installed per NFPA 90A and be listed with the fire alarm control panel.
 - P. Auxiliary Equipment Monitoring Wiring and connection to equipment shall be the responsibility of the fire alarm contractor.

- Q. Power for magnetic door holders shall be provided from the nearest receptacle circuit wired through fire alarm relay.
- R. Smoke detectors shall be mounted to a 4-inch octagon box with hanger bar or with box secured to building structure.
- S. Provide power via 120-volt, 20-Amp dedicated circuits with lock-on provisions at the respective circuit breaker for each new main fire alarm control panel, each new panel extender and each new remote power supply at no additional cost to the Owner. The complete fire alarm system shall be powered under emergency power when emergency life safety power is available at the project site. When emergency life safety power is not available at the project site, power shall originate from the nearest available 120-volt panel, or as indicated.

3.3 CABLE AND BOXES INSTALLATION

- A. All circuits shall be protected to avoid interruption of service due to short-circuiting or other conditions, which might adversely affect the connected devices. Each individual signaling circuit shall be classified as a circuit pair.
- B. All cabling in racks, cabinets and junction boxes shall be neatly strapped, dressed and adequately supported. Cable installation shall conform to good engineering practices and to the standards of the National Electrical Code.
- C. Cables shall be terminated with the proper connector required for the associated operation of the equipment to which it is connected. Screw terminal blocks shall be furnished for all cables, which interface with racks, cabinets, consoles or equipment modules.
- D. All cables within a rack, console or junction box shall be grouped according to the signals being carried to reduce signal contamination.
- E. Where shielded conductors enter a panel or enclosure, and where power wiring exists, provision shall be made to provide physical isolation of signal and power conductors.
- F. Supply and install all fittings and accessories whether or not they are specified, required for proper, safe and reliable operation of the system.
- G. 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%.
- H. Minimum conduit size shall be 3/4" EMT with insulated bushings. Install conduit per engineered shop drawings.
- I. 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 to view and or subject to damage.
- J. 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.
- K. All junction boxes containing fire alarm wiring are to be painted red.
- L. All plenum wiring is to be installed parallel and perpendicular to the building structure. Cable shall be bundled with cable ties on a maximum of 2'-6". Install cables in D-ring hangers secured to the structure at a maximum of 5' on center. Cable shall not lie on ceiling grid or ceiling tiles, light fixtures, piping, ductwork or foreign equipment.
- M. The system ground is to be connected to the local ground bus. Under no conditions shall the AC neutral either in a power panel or in receptacle outlets be used for a reference ground.
- N. All wiring shall be in accordance with NFPA 72, the National Electrical Code, and Local Codes. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.

- O. All wire shall be UL Listed FPL for limited energy (300V) and fire alarm applications and shall be installed in conduit. Limited energy FPLP or 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 and approved by the local authority having jurisdiction.
- P. No other wiring shall be run in the same conduit as fire alarm wiring.
- Q. All fire alarm wiring to be red. All fire alarm circuits shall be identified at each termination and at each 25 feet between terminations.
- R. Copper wiring leaving or entering main building shall be protected on both ends with surge suppression; otherwise use fiber-optic cabling.

3.4 ALARM SYSTEM SEQUENCE OF OPERATION

- A. General:
 - 1. All fire alarm circuits shall be electrically supervised.
 - 2. Automatic response functions shall be accomplished by the first device initiated. Alarm functions resulting from initiation by the first device shall not be altered by subsequent alarms. An alarm signal shall be the highest priority. A pre-alarm signal shall have second priority and supervisory or trouble signals shall have third and fourth level priority. Signals of a higher level priority shall take precedence over signals of lower priority even though the lower priority condition occurred first.
- B. Fire alarm operating sequences shall be as follows:
 - 1. Activation of any automatic detector, manual station, fire suppression system, sprinkler flow switch or any other system required by NFPA 72 to be monitored to initiate an alarm condition shall cause the location of the alarm to be identified in an audible and visual manner at the building fire alarm control panel (FACP), and shall initiate the following events:
 - a. The system common alarm LED on the CPU Module shall flash. The internal audible trouble device shall sound. Acknowledging the alarm condition shall silence the audible trouble device and revert the flashing common alarm LED to a steady state.
 - b. The 80-character display shall indicate all applicable information associated with the alarm condition including: zone, device type, device location based on actual room graphic name and number (not architectural plan names and numbers), 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 point shall be illuminated as herein specified.
 - d. The remote signaling connection shall be activated relaying the alarm signal to an approved central station (central station connection and service provided by Owner). Point ID and descriptor must be sent and received.
 - e. All automatic events programmed to the alarm point shall be executed and the associated indicating devices and/or outputs activated.
 - f. De-activate local sound reinforcement systems that are not UL listed nor integrated with the fire alarm system control panel for providing fire alarm or mass notification instructions. Building wide public address systems shall remain active only for manual mass notification. Public address system auxiliary audio inputs used for background music or

- other remote non-emergency audio sources shall be silenced to only allow priority level manual mass notification using the public address system.
- g. Activate all audible/visual alarm devices. Where prerecorded voice announcement is required or specified, the prerecorded announcement shall be preceded with attention tone(s), followed by the approved prerecorded announcement and continue in a cycle until the system is reset. Manual voice announcement shall interrupt the prerecorded cycle and the prerecorded cycle shall resume automatically after three minutes.
 - h. De-activate all HVAC systems including low speed high volume (LSHV) circulating blade type fans.
 - i. De-energize the kitchen hood supply/exhaust fans as required by local authority having jurisdiction.
 - j. Close all related smoke dampers.
 - k. Close all related smoke/fire dampers.
 - l. Release all magnetic door hold open devices.
 - m. Release the electric strike, unlocking, but not unlatching, locked doors controlled by an access control system.
 - n. Release Counter Shutters and hold-open devices on all fire and smoke doors.
 - o. Open all security grilles with emergency egress.
 - p. Activate to close all related fire and smoke doors and shutters.
 - q. Activate signaling connection to the elevator as required by the local authority having jurisdiction.
 - r. Signal the building automation system and Owner's security / police personnel as directed by Owner / Architect. The audible alarms shall be inhibited from being silenced for a period of 3 minutes after commencing operation unless alarm is acknowledged, and appropriate action has been taken.
 - s. Activate automatic recall operation of elevators as required by local authority having jurisdiction.
 - t. Record all events on the system printer.
2. Activation of duct mounted smoke detector on the HVAC equipment, or a smoke detector mounted in the return/supply air stream of any fan shall shut down all units as required by NFPA. The activation of one of these detectors shall initiate the Alarm Sequence of Operation.
 3. Activation of a control valve supervisory switch shall initiate the following events:
 - a. The activation of any sprinkler valve supervisory (tamper) switch shall activate the system supervisory service audible signal and illuminate the LED at the building fire alarm control panel (FACP). Differentiation between valve tamper activation and opens and/or grounds on the initiation circuit wiring shall be provided.
 - b. Activation of a sprinkler system control valve supervisory switch shall not prevent the events listed under Article 3.4.
 - c. Restoring the valve to the normal position shall cause the supervisory service audible signal to pulse, indicating the restoration to normal position. The supervisory service reset key shall be provided to silence the audible signal.
 4. Activation of the smoke detector and heat detector in the elevator machine room and at top of elevator shaft shall cause the elevators' controllers to be tripped by

- way of the shut trip breaker, and shall also initiate the events listed under Article 3.4.
5. Any subsequent fire alarm shall reactivate the alarm indicating appliances and activate the respective control sequences described above.
 6. Upon silencing the alarm, all visible alarm devices shall remain active until system reset, and all local sound reinforcement systems de-activated by the fire alarm system shall resume normal operation.
 7. Upon reset of the fire alarm control panel, HVAC units shall be capable of being started, and resume normal operation.
- C. Activation of the manual evacuation pull (drill) switch shall operate the alarm indicating appliances and de-activate local sound reinforcement system without causing other control circuits to be activated. However, should true alarm occur, all alarm functions should occur as described.
- D. ALARM VERIFICATION shall be field programmed for each respective detector. Global verification will not be acceptable. The verification sequence is activated after a "check" procedure and the panel will wait a field programmable delay period (0-50 seconds) then proceed to re-sample the detector for continued presence of smoke. If the alarm condition still exists or a non-verified device is actuated during the verification period, the system will then initiate all alarm sequences specified herein. The system shall incorporate the ability to log in memory the number of verification events that have occurred for each selected device.

3.5 EQUIPMENT IDENTIFICATION

- A. Each new panel or equipment enclosure shall be provided with a permanently engraved or embossed or silkscreen identification tag. The tag shall include the following information:
1. Name of manufacturer.
 2. Manufacturer's equipment description.
 3. Serial number and model number.
 4. Voltage and current rating.

3.6 SPARE PARTS AND TOOLS

- A. Interchangeable Parts: All spare parts furnished shall be directly interchangeable with the corresponding components of the installed system. Spare parts shall be packaged and identified by nameplate, tagging, or stamping. Spare parts shall be delivered to the site in unopened cartons for storage as directed by the Owner.
- B. Spare Parts: Provide minimum of one, or 5% of renovation area total, whichever is greater unless noted otherwise.
1. Spare shut down modules
 2. Spare detectors of each type in the system
 3. Spare alarm indicating devices of each type in the system
 4. Spare manual pull stations
 5. Spare protective covers of each type in the system.
 6. Spare relays/controls required for connection to smoke and fire/smoke dampers
 7. Devices listed above are to be installed as directed by Architect/Engineer or local code authorities at no additional cost to the Owner. Unused spare parts are to be parts for Owner's cabinet.
- C. Provide one smoke, heat and carbon monoxide detector testing kit. SDfire #TF2823 with Solo Testfire #2001 tester with 15-foot access pole and three 4-foot pole extensions, detector removal tool, and carrying bag.
- D. Provide two copies of the final software programmed into the fire alarm system.

- E. Parts list: Furnish a list, in duplicate, of all other parts and accessories the manufacturer of the system recommends to be stocked for maintenance.

3.7 KEYS

- A. Keys and locks for all equipment shall be identical to the existing building master key for the fire alarm system.

3.8 SMOKE DAMPERS AND FIRE/SMOKE DAMPERS

- A. Smoke dampers and combination fire/smoke dampers shall be controlled by an automatic alarm initiating device. Smoke dampers installed to isolate the air handling system shall be arranged to close automatically when the system is in alarm.
- B. Coordinate motor operator voltage with supplier.
- C. Open all dampers prior to starting air handling equipment.
- D. Provide 120V power from nearest general purpose 20A receptacle circuit as required, or as noted otherwise.

3.9 GRAPHIC FLOOR PLANS FOR AHJ SITE PERMITTING INSPECTION AND OWNER USE

- A. It is the intent of these specifications that the fire alarm system shall pass AHJ inspection on the first try. The fire alarm system shall be fully functional, commissioned, and mapped both on fire alarm graphic maps and fire alarm annunciator device descriptions to fully and correctly described the device type and detailed location. Provide color coded floor plans detailed with actual room names, actual graphic room numbers as directed by the Owner and adequate information to direct people to the fire alarm devices in alarm and to exits with non-fading floor plan media. Do not use architectural plan room names and numbers. Fire alarm maps shall include all relevant building information and fire alarm device information as required for the local AHJ permitting site walk-through inspection.
- B. Each plan shall clearly relate the room numbers on the annunciator to the area description on the floor plan. All fire alarm devices located to correspond with the annunciator.
- C. Provide two color coded floor plans for Owner use that shall be solvent welded in acrylic plastic.
 - 1. Mount in an extruded aluminum frame next to the main fire alarm control panel.
- D. Install graphic floor plans as directed by Architect/Owner prior to substantial completion. Each area or room designation shall be verified with the fire alarm device during testing.

3.10 ADDITIONAL REQUIREMENTS

- A. Coordinate with Owner for appropriate off-site monitoring service and communication technology to be used. Provide all necessary programming for interfacing with the Owner's on-site and off-site remote signaling receiving station, including programming of descriptors and addresses at the receiving station.
- B. The contractor is to ensure all areas of the renovation and new construction are covered with visual and audio alarm devices for occupant notification of a fire alarm including remote portable or temporary buildings.
- C. Coordinate door hold devices with door and door hardware.
- D. Provide interface with and coordinate shunt-trip circuit breakers and control devices with kitchen hood fire control systems (where new kitchen hood fire control systems are provided) and elevator equipment (where new elevators are provided).
- E. Alarm circuit power supplies and circuiting shall be designed and installed to accept an additional five (2) 110cd visual devices for future expansion. The initial design shall not

exceed 70% of the rated power supply and circuit capability with the two additional 110cd devices installed.

- F. Provide programming or re-programming of all hot keys as directed by Owner including, but not limited to, fire drill, AHU shutdown bypass, horn/strobe disable, elevator test.

3.11 COMMISSIONING THE SYSTEM

- A. The installing contractor shall be responsible for verifying that each new or relocated component of the system is fully operational and in conformity with the specifications. He shall also be responsible for insuring that all elements function together as a system in accordance with the specifications.
- B. A state licensed and factory trained technical representative of the manufacturer with NICET Level 3 minimum certification shall supervise the final control panel connections and testing of the system. Upon completion of the acceptance tests, the owner and/or his representatives shall be instructed in the proper operation of the system.
- C. The installing contractor shall functionally test each and every device in the entire system for proper operation and response. Any new or relocated items located within the construction or renovation area found not properly installed or non-functioning shall be replaced or repaired and retested. The final test indicating a fully functional fire alarm system shall be recorded; electronic Excel and printed copy submitted to the Architect, Engineer and Owner.
- D. The installing contractor shall provide a complete written report and printout of the functional test of the entire system after all existing deficiencies of the existing system have been corrected by the Owner, or as directed by the Owner. The test report shall be signed and dated by the licensed fire alarm superintendent responsible for supervising the final system test and checkout. This test shall be completed and accepted by the Owner prior to testing for the local Fire Marshall.
- E. The installing contractor's fire alarm superintendent shall test the entire system in the presence of the local authorities having jurisdiction. The contractor shall be responsible for making any changes, adjustments, or corrections, as may be required by the local authorities. The Contractor shall affix his certification label and installation certificate to the interior of the main fire alarm control panel.
- F. The testing and acceptance shall be performed within 30 days after the fire alarm installation is completed. The test shall be performed by a minimum of two qualified fire alarm system technicians acceptable to the authority having jurisdiction. The test which is a comprehensive 100 percent inspection and test of all fire alarm system equipment shall include the following:
 - 1. Fire alarm control equipment: a visual and functional test of the fire alarm control and auxiliary control equipment.
 - 2. A visual inspection shall be conducted to establish that all electrical connections and equipment, as required, are properly installed and operating.
 - 3. A functional fault simulation test shall be conducted on all relevant field wiring terminations to ensure that wiring is properly supervised as required.
 - 4. Indicators shall be tested to ensure proper function and operation.
 - 5. Control panel auxiliary functions shall be functionally tested to verify proper operation.
 - 6. Control panel supervisory and alarm current readings shall be taken to verify that the control panel has the appropriate power supplies and standby batteries to operate the system as required. A three-minute general alarm stress test, both under AC power and standby power, shall be conducted to further ensure complete operation of the system.

7. Fire alarm peripheral devices; All fire alarm peripheral devices shall be functionally tested and the location and testing information recorded for each device.
 8. Manual initiating devices:
 - a. Each manual fire alarm station shall be functionally tested for alarm operation.
 - b. Each manual fire alarm station shall be functionally tested for proper wiring supervision.
 9. Automatic initiating devices:
 - a. Each automatic initiating device shall be activated in accordance with manufacturer's instructions to ensure proper operation.
 - b. Each automatic initiating device shall be functionally tested for proper wiring supervision.
 - c. Each automatic initiating device shall be inspected to ensure proper placement and mounting as required by specifications.
 10. Alarm signaling devices:
 - a. Each alarm signaling device shall be tested and decibel reading taken at 10' from the device and recorded to ensure proper operation. Each area's voice alarm signaling devices shall be tested for intelligibility.
 - b. Each alarm signaling device shall be functionally tested for proper wiring supervision.
 - c. Decibel reading shall be taken to ensure that the alarm signal level can be clearly heard in all areas of the facility.
 - d. All visual alarm indicators shall be functionally tested to ensure proper operation and that they are clearly visible.
 11. Elevators: Each elevator shall be tested and automatic recall function verified.
 12. Reporting: Upon completion of the initial verification audit, a report shall be sent to the Architect/Engineer indicating that all fire alarm equipment has been tested and is in 100 percent operation. The report shall also contain the audit testing information as to the location and operational status of each peripheral device. The 100 percent audit shall be performed by a factory-trained representative. The report shall include the voice intelligibility performance in each area and indicate compliance with NFPA and local AHJ requirements.
- G. It is the intent of these specifications and of the Architect/Engineer that a continued program of system maintenance will be provided by the Owner in compliance with NFPA 72. It is mandatory that the installing Contractor provide such services and make available these services to the Owner upon completion of the project.
- H. Upon completion of installation and full acceptance testing, submit NFPA 72 certificate of compliance that the total fire alarm system, including any subsystems, is fully functional and that the components are UL listed for function intended.

3.12 SUBSTANTIAL COMPLETION

- A. Final acceptance of the FIRE ALARM SYSTEM by the owner, local code authorities and Occupancy Permit has been issued.
- B. All fire alarm system shop drawings, operating and maintenance manuals, maps and as-built drawings shall be submitted to and accepted by the Architect / Owner prior to date of substantial completion.

END OF SECTION

SECTION 28 55 00
RF SURVEY FOR IN-BUILDING EMERGENCY RESPONDER RADIO COVERAGE (ERRC)
AND
TESTING OF EXISTING ERRC ENHANCEMENT SYSTEMS (ERRCES)

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. The purpose of this specification is to establish the requirements and standards for surveys for public safety radio signal strength in buildings as required by the NFPA, IBC, IFC and local AHJ. This specification is only for a RF survey. If an existing ERRCES is on premise and is operational, provide verification and documentation of the existing ERRCES as specified.
1. This survey is required as part of the contract documents and shall be implemented as specified in this specification unless indicated or specified otherwise.
 2. This survey is required for in all buildings with basements, all buildings four stories and taller, and all buildings with an aggregate total building area of 50,000 square feet or more; this survey may still be required for other buildings that do not meet these structural requirements.
 3. This survey may not be required if the local AHJ has pre-determined that an Emergency Responder Radio Coverage Enhancement System (ERRCES) is not required for the subject building(s). If a survey is not required by the AHJ, notify the Architect, Engineer, Owner prior to scheduling the survey.
 4. The survey requirements specified in this section are intended to be slightly more stringent than minimum IBC and IFC requirements. This is to help mitigate radio coverage deficiencies that could be caused by future minor variations in building use configurations and changing atmospheric conditions.
- B. Where the subject building(s) do not have an existing ERRCES, this survey shall be for ERRC measurements and compliance evaluation only, it is not intended as a requirement for designing nor a requirement for providing an ERRCES.
- C. Where the subject building(s) have an existing and operational ERRCES, this survey shall include a full yearly functionality test of the existing ERRCES hardware, antennae, wave guides, cabling, wiring, and connectivity as required by the local AHJ, IBC, IFC, and NFPA. This survey shall then be able to be used for the required yearly inspection and testing report of the existing ERRCES. If deficiencies of an existing ERRCES are observed or detected during field signal measurement, the contractor shall document those deficiencies and report them to the Owner in writing within two Owner's business days of completion of the testing so that the Owner can take immediate remedial action. Corrections and modifications to existing ERRCES are not part of this specification section requirements.
- D. Technical information for this survey shall be obtained from the local AHJs pertaining the specific technical information and requirements for the emergency responder communications coverage system. This information shall include but not be limited to the various frequencies required, the location of radio antennae sites, the effective radiated power of the AHJ radio antennae sites, the maximum propagation delay in microseconds, the applications being used, and other supporting technical information that would be necessary for an ERRCES design and to fully test an existing ERRCES.
- E. Surveys for new construction shall be performed after the building is fully dried in, with interior wall construction and all exterior wall glazing completed, and prior to start of installation of electrical wiring. It is the intent that this survey be completed as soon as practical, results reported to the Owner and analyzed, and if required or specified as part

of the contract documents or if it is to be provided by others, a radio antenna/repeater system can be designed, installed, fully operational, and commissioned without delaying the scheduled contract date for certificate of occupancy (CO) or the AHJs final inspection and approval for full Owner and public occupation of the building.

- F. Conduct surveys using a RF Spectrum Analyzer, a calibrated system-compatible radio or another suitable instrument with traceable certificate of calibration to analyze the RF signal strength of Emergency Responder Radio Signal into the building and determine if amplification of the signal is required or that if existing, the existing ERRCES is functioning properly and providing the proper radio coverage. All test equipment shall have been calibrated within the previous 12-months of the date(s) of testing. Both inbound and outbound signal strength shall be determined, measured, calculated, and documented as required by code. General weather conditions and time of day during the test shall be documented as part of the survey report.

1.2 SURVEY CRITERIA

- A. The required Public Safety Radio Signal Level inside the Owner's facility shall be as required by code, ordinance, AHJ, and as specified.
- B. Survey shall be performed by an FCC licensed technician holding a current General Radiotelephone Operator License (GROL). Where required by the local AHJ, the licensed operator shall be registered with the AHJ as an ERRC Special Inspector (or equivalent designation given by the AHJ) with in-building emergency radio system certification issued by a nationally recognized organization, school, or the emergency radio system manufacturer of the equipment being tested where an existing ERRCES is being tested, or certification by the ERRCES if a new ERRCES is specified elsewhere to be installed as part of the contract documents.

1.3 REGULATIONS

- A. Codes, regulations, and standards shall be the latest published standards. The latest national published standards listed below shall supersede any local standard unless doing so would violate the intent of the local code requirements.
1. NFPA 1 – Fire Code
 2. NFPA 70 – National Electrical Code
 3. IFC 510- Emergency Responder Radio Coverage
 4. NFPA 101, Life Safety Code, and all local amendments and requirements.
 5. NFPA 72 National Fire Alarm and Signaling Code
 6. FCC 47 CFR Telecommunications
 7. FCC 47 CFR 90.219 Use of Signal Boosters
 8. IFC - International Fire Code
 9. Local or State Fire Codes
 10. ADA "Americans with Disabilities Act" and any local or state or local accessibility standards and amendments.
 11. FCC's OET 65 Standards "Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields"
 12. FCC Rules Part 22 Public Mobile Services, Part 90 and Part 101
 13. NFPA 1221- Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems
 14. IBC - International Building Code
 15. UL 2524 - Standard for In-building 2-Way Emergency Radio Communication Enhancement Systems
 16. NFPA 3000 (PS) - Standard for an Active Shooter/Hostile Event Response (ASHER) Program and if present, Owner's specific ASHER Program. Note:

Although currently considered by the NFPA as a Provisional Standard (PS), the issued NFPA 3000 shall be considered part of this specifications as if it were a fully accredited document to NFPA standards. If the building Owner has established an ASHER Program, it too shall be considered part of this specification section requirements.

1.4 DEFINITIONS

A. Definitions:

1. Area: A enclosed space in a building consisting floor to ceiling walls with doors.
2. ASHER Program: Active Shooter Hostile Event Response Program. Program elements developed by the building's Owner to determine the necessary functions and actions related to preparedness, response, and recovery from an active shooter/hostile event response.
3. BDA: Bi-Directional Amplifier. A device used to amplify band-selective or multi-band RF signals in the uplink, to the base station and in the downlink from the base station to subscriber devices for enhanced signals and improved coverage.
4. BER: Bit Error Rate is the number of bit errors per unit time
5. DAS: Distributed Antenna System
6. ERRCES / ERRCS: Emergency Responder Radio Coverage Enhancement System / Emergency Responder Radio Coverage System. A two-way radio communication system installed to assure the effective operation of radio communications systems for fire, emergency medical services, or law enforcement agencies within a building or structure. A system used by firefighters, police, and other emergency services personnel.
7. FCC: Federal Communications Commission
8. Grid or test grid: The individual specified and/or code required imaginary spaces inside the building used for radio coverage testing. Typically a grid space consist of a square space with equal or almost equal side dimensions where the radio signal levels are measured at the center of each grid space to verify radio coverage. Grid spaces can consist of individual areas or rooms meeting the maximum size requirements.
9. GROL- FCC General Radiotelephone Operators License
10. OET 65 Standards: FCC's Bulletin 65 provides Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.
11. Public Safety/First Responder: Public Safety or First Responder agencies that are charged with the responsibility of responding to emergency situations. These include, but are not limited to law enforcement departments, fire departments, and emergency medical companies. Typically, there may be multiple agencies for each type of responder, including those administered by the building Owner.
12. RSSI: Received signal strength indicator RSSI is a relative measurement of the power present in a received radio signal.
13. Zone: The individual partitioned grid specified and/or code required imaginary space(s) inside large buildings. Typically, each zone shall be no more than 50,000 square feet and shall be contiguous on the same building floor. Zones are further sub-divided into smaller grid spaces so that radio signal levels can be measured at the center of each grid space to verify radio coverage. A zone can be an individual wing of a building or separate floors of a building that do not exceed 50,000 square feet each. Zones can be created for separate test report areas to ensure individual grid test spaces are not excessive in physical area size and detrimental to the accuracy and resolution of the test data measurement point

locations. Each zone must pass the radio coverage test for the entire building to pass the test. Zones can exceed 50,000 square feet as long as the maximum allowable grid space size is not exceeded.

PART 3 – EXECUTION

3.1 EXECUTION

- A. Testing Procedures and Parameters
1. The test shall be conducted using a calibrated portable radio authorized by the local AHJ, and of the latest brand and model used by the agency talking through the agency's radio communication system.
 2. Testing shall include all critical areas required by the NFPA 1221 and others included in the list below. Critical areas shall be provided with a minimum 99-percent floor area radio coverage in each specific area. Critical areas include but are not limited to the following areas:
 - a. Fire command centers
 - b. Fire pump rooms
 - c. Exit stairs
 - d. Exit passageways
 - e. Elevator lobbies
 - f. Areas of rescue or refuge
 - g. Areas with or spaces adjacent to standpipe cabinets
 - h. Areas with or spaces adjacent to sprinkler sectional valve locations
 - i. Areas with or spaces adjacent to bleeding control kits.
 - j. Areas with or spaces adjacent to Automatic External Defibrillators (AEDs) for public use.
 - k. Areas designated for persons with special needs or areas for specifically designated for persons who are not ambulatory including those in wheelchairs but require physical assistance by others to evacuate the building.
 - l. Specific bullet resistant areas or spaces designated by the Owner or designated in the Owner's ASHER Program as a bullet resistant panic and safe room/areas or spaces.
 - m. Front lobby areas and/or building administrative areas with direct wired microphone or wired telephone handset access to the building's mass notification or building wide communication system when such system is existing or to be installed as part of this project.
 - n. Areas and/or building administrative areas with public safety radio base stations used for direct communications with Owner's police or security personnel.
 - o. Other areas deemed critical by the AHJ.
 3. Testing grid spaces, areas, and zones shall be as required by the local AHJ and/or as specified in this specification. The more stringent requirements of the local code, AHJ, or those specified or indicated elsewhere in the contract documents shall apply. Specific requirement for the test grids, areas, and zones shall be follows:
 - a. Testing shall be based on a minimum of 20 approximately equal size grid spaces per floor or zone with a maximum of 2,500 square foot per test space. Failure of more than one test space shall be considered a test failure.
 - b. In the event that only two test spaces fail the 20-space grid test above, the same floor/zone shall be divided into 40 approximately equal size

- grid spaces or a maximum of 1,250 square feet per space and re-tested. Failure of only one or only two nonadjacent test spaces on that floor or zone shall result in a non-failure for that floor or zone. Failure of three or more spaces shall result in a test failure for that floor or zone. Failure of two adjacent test spaces shall result in a test failure of that floor or zone.
4. If there is an existing ERRCES and there are grid space test failures resulting in a failed test, notify the Owner in writing immediately about the failed spaces after the completed test and identify the specific areas of the building that are not compliant. The final test result formal submittal data may be submitted at a later date as specified. Contractor may provide recommendations for alterations or modifications to the existing system to the Owner/Architect/Engineer so that the deficiencies can be addressed by the Owner as soon as possible and corrective measures taken by the Owner. Make corrective measures or modifications to the existing system only if specifically instructed by the Owner in writing.
 5. Two-way radio communications shall be verified by testing the two-way communication to and from the outside of the building from a single point approximately at the center of each test grid space or room area. Retesting from a different point inside the same grid space or room area is prohibited if the first point selected fails the test. The initial failure shall be recorded as a failed test grid space or area.
 6. Signal strength for a non-failure shall be sufficient to meet the requirements of the applications being utilized by public safety for emergency operations through the coverage area as required by the AHJ.
 7. The minimum inbound signal strength shall be sufficient to provide usable voice communications throughout the coverage area as required by the AHJ. The inbound signal level shall be sufficient to provide not less than -95 dBm for analog systems or a Delivered Audio Quality (DAQ) of 3.0 for digital systems or an equivalent Signal-to-Interference-Plus-Noise-Ratio (SINR) applicable to the technology of either analog or digital signals.
 - 8.. The minimum outbound signal strength shall be sufficient to provide usable voice communications throughout the coverage area as required by the AHJ. The outbound signal level shall be sufficient to provide not less than -95 dBm for analog systems or a Delivered Audio Quality (DAQ) of 3.0 for digital systems or an equivalent Signal-to-Interference-Plus-Noise-Ratio (SINR) applicable to the technology of either analog or digital signals.
 9. Buildings with existing ERRCES: Verify the following, include the requested information report deficiencies to the Owner as part of the ERRC report.
 - a. Verify the existing ERRCES is fully monitored by the building fire alarm system as required by NFPA 1221 and NFPA 72.
 - b. If there is an existing remote ERRCES annunciator, verify all annunciators and indicators required by NFPA 1221 are operational and functioning properly.
 - c. The gain values of all existing ERRCES amplifiers shall be measured and documented for comparison for future annual testing of the ERRCES.
 - d. A spectrum analyzer or other suitable test equipment shall be used to verify spurious oscillations are not being generated by existing signal booster(s).
 - e. Verify that the isolation between the donor antenna and all inside antennas is maintained to a minimum of 20dB above system gain.

3.2 SURVEY REPORT SUBMITTALS

- A. Submit summary findings and detailed test report data within 14-days of notice to proceed.
- B. Buildings not in compliance with the ERRC testing: Indicate areas of the building deficient in ERRC. Provide general recommendations of the necessary equipment and means required to bring the building into full ERRC compliance for Owner review in the summary findings. This specification section is only intended for survey, report, and recommendation information only and is not intended for detailed design, modification, or corrective measures. The report data submittal shall be complete in such that it would be useful to assist in a detailed design of a ERRCES. Submit additional report data as indicated below.
- C. Building in compliance with required ERRC: Include a copy of the inspection report to be issued to the AHJ(s) in the format required by the AHJ(s) and submit the report to the AHJ(s) as part of the building permitting process.
- D. Report data submittals shall include but are not be limited the following:
 1. Include a copy of survey contractor's AHJ and FCC required licenses to perform the survey.
 2. Where there is an existing ERRCES, include an updated ERRCES technical document and yearly report which the Owner shall keep on file as required by NFPA 1221. Technical documents shall in include but may not be limited to the following information typically provided by the AHJ(s):
 - a. Frequencies required by the AHJ(s) for the existing in-building enhancement system (EERCES).
 - b. Location and effective radiated power (ERP) of radio sites used by the public safety radio enhancement system (ERRCES).
 - c. Maximum propagation delay in microseconds.
 - d. List of specifically approved ERRCES components.
 - e. Other supporting technical information necessary for the existing system maintenance, or future modifications.
 3. Confirmation that the ERRC for the building that is subject of the report has been determined to meet the minimum coverage requirement as defined by the IBC/IFC, this survey specification section's requirements, and the local AHJ requirements.
 4. Include a scaled drawing of the building with RF measurements of each floor or zone of the building which indicates relative RF field strength for each frequency band of interest. Minimum drawing size 11x17-inch, maximum 30x42-inch.
 5. The drawings shall indicate clearly the areas that have passed or failed based on the more restrictive of the above parameters or those specifically required by the AHJ.
 6. When required by the AHJ, inspection reports by AHJ approved third-party inspector in the format required by the AHJ.

END OF SECTION

**SECTION 28 60 00
DISTRICT RADIO COMMUNICATIONS EQUIPMENT**

PART 1 - GENERAL

1.1 DESIGN AND CONSTRUCTION REQUIREMENTS

- A. Provide a complete and tested Radio Communications System, consisting of an Emergency Radio system and a Radio Repeater system.
- B. Contractor Requirements:
 - 1. Contractor shall provide five years of experience in the installation of radio frequency communications equipment and be a factory authorized dealer and installer for Kenwood equipment. Installation and programming shall be performed by FCC licensed technicians for this type of equipment. The following contractors have been pre-approved by CFISD; other contractors to provide documentation and certification prior to being awarded job.
 - a. Northwest Communications 281-890-4724 (Rick Wright, Don Cameron)
 - b. Texas Bigfoot Communications 713-462-2929 (Rick Cogar)
- C. Submittals (Required):
 - 1. Product Literature: Complete manufacturer's product literature showing electrical characteristics and connection requirements.
 - 2. Wiring Diagram: Indicate system wiring diagram showing each device and wiring connection. Indicate partition layout.
 - 3. Operation and Maintenance Data: Submit manufacturer's standard operating and maintenance instructions.

1.2 WARRANTY

- A. One year from date of substantial completion

PART 2 - PRODUCTS AND MATERIALS

- A. The Emergency Radio system shall include:
 - 1. UHF base station radio supporting the district wide emergency frequency.
 - 2. Mounting antenna in area to provide optimum performance for internal and external communications.
 - 3. Emergency radio and associated equipment shall be installed in mechanical area with the radio repeater.
 - 4. Accessory devices and power supply.
 - 5. Installation of equipment and cabling between antenna and emergency radio.
 - 6. Tone Remotes shall be installed in principal secretary's office and front reception.
 - 7. System setup, frequency programming and testing per CFISD Radio Communications Division requirements.
 - 8. Training shall include demonstration and instructing school staff on operation.
 - 9. Contractor responsible for cable and termination between IDA 24-66M VOIP Remote w/DeskMic and Network.
 - 10. Contractor is responsible for cable and termination between Emergency Radio and network.
 - 11. Equipment:
 - a. Radio: Kenwood NX-5800-K UHF, 45 watts, 450-520 MHz, 1024 channels/128 zones.
 - b. Mounting Case: Control Station mounting case for KPS-15 power supply and NX-5800-K radio
 - c. Power Supply: Kenwood KPS-15 power supply

- d. Telephone Style Remove Control: IDA 24-66M VOIP Remote w/DeskMic
 - e. Remote Termination Panel: IDA 20-28 VOIP Remote Adapter.
 - f. Antenna: Antenex Model FG4603, 3db gain UHF 460-470 MHz omni antenna with mounting bracket
- B. Radio Repeater (Repeater set-up required for ES, MS, HS, Transportation Centers, Stadiums & Multifunction Centers):
- 1. The Radio Repeater system shall include:
 - a. Radio repeater supporting the campus wide communication.
 - b. Mounting antenna in area to provide optimum performance for campus or facility communications.
 - c. Radio repeater and associated equipment to be installed in mechanical area.
 - d. System setup, frequency programming and testing per CFISD Radio Communications Division requirements.
 - e. Contractor responsible for cable and termination between network adapter and network.
 - f. Contractor is responsible for cable and termination between Kenwood KTI-3 network interface and network.
 - g. 4 post enclosed rack, duplexer, network adapter, and UPS.
 - 2. Equipment:
 - a. Repeater: Kenwood NXR-810K UHF, 1-40W, 450-520 MHz. Operational as analog 25 KHz or 12.5 KHz, or digital 12.5 KHz or true 6.25 KHz
 - b. FCC Licensing: Frequency coordination and acquisition for repeater
 - c. Antenna: CommScope DB404, 450-470 MHz 3.28/5dB gain
 - d. Duplexer: 633-6A-2N, UHF Duplexer 450-470 MHz
 - e. Network Adapter: Kenwood KTI-3 network interface
 - f. Rack: Tripp Lite SR25UB Smart Rack standard-depth half-height server rack enclosure, doors, and side panels
 - g. Power Supply: Minuteman ED2000RTXL2U power supply
 - h. Installation Materials: Connectors, lightning protection, mounting brackets, 5' antenna mast and all other required installation materials for a complete and operational set-up.
- C. Cabling:
- 1. Provide and install Times LMR-400-LLPL black low loss, plenum rated, indoor/outdoor coax antenna cable with connectors.
 - 2. Provide and install Cat 6 for 24-66M VOIP Remote w/DeskMic in principal secretary's office and front reception to network. Reference Division 27 10 00.
 - 3. Provide and install Cat 6 for IDA 20-28 VOIP Remote Adapter at the emergency radio to the network. Reference Division 27 10 00.
 - 4. Provide and install Cat 6 cable for Kenwood KTI-3 network interface at the radio repeater to the network. Reference Division 27 10 00.

PART 3 - EXECUTION

- A. Demonstration and Training:
 - 1. 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.
 - a. Contractor shall demonstrate system operation to DVISD security personnel and project manager.

- b. Contractor shall provide one hour of instruction each for two of owner's personnel, to be conducted on site with the manufacturer's representative.

END OF SECTION

SECTION 31 00 00 - EARTHWORK UNDER BUILDING PAD

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. Protecting and preserving trees and vegetation to remain.
- B. Clearing, stripping, and grubbing of portions of sites which are below the building pads.
- C. Stockpiling stripped topsoil in approved locations.
- D. Excavating for and otherwise providing stable and compact subgrade below the building pads.
- E. Placing and compaction of select fill under improved areas to conform to elevations indicated on the drawings.
- F. Filling and finish grading of area around buildings and other improvements using imported topsoil per section 2.1,D.
- G. Coordinating Work of other Sections affecting or affected by Work of this Section.

1.2 INSPECTION OF SITE

- A. By making a proposal on the Project, the Contractor acknowledges:
 - 1. That the Owner and Architect do not guarantee the accuracy, completeness, or suitability of the contents of the Geotechnical Report or Topographic Survey.
 - 2. That he/she has visited the site to investigate the conditions affecting the Work and has satisfied himself/herself of the character, quality and quantity of surface and subsurface materials or obstacles to be encountered.
- B. The Contractor will be required to establish, maintain and be responsible for all reference points, hubs, grades, elevations, lines, and surface measurements. If any discrepancies in the documents are found, the Contractor shall promptly notify the Architect and await instructions before proceeding.

1.3 QUALITY ASSURANCE

- A. Inspection and Testing Laboratory Services: Test results shall meet or exceed the standards referenced.

1.4 REFERENCES

- A. ASTM International (ASTM)
 - 1. D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft³ (600 kN-m/m³) – Test for Moisture Unit Weight Relations of Soils and Soil Aggregate.
 - 2. D2922, Tests for Density of Soil and Soil Aggregate in place by Nuclear Methods.

1.5 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13- Project Management and Coordination.

PART 2 - MATERIALS

2.1 MATERIALS

- A. Structural Fill: Sandy clay soils free of organic or other deleterious materials, and have a maximum clay lump size of less than three (3) inches. See Construction Documents for Liquid Limit and Plasticity Index per soils report.
- B. Earth Fill: Shall be excavated material approved by Architect prior to its use as earth fill around building and landscaped areas, but not under building.
- C. Stabilization Materials: Refer to stabilization section(s) in Division 31.
- D. Topsoil: Shall be imported, and shall be free from clay, vegetation, debris, stumps, roots, stones larger than 3/4 inch diameter, or other objectionable matter.

PART 3 - EXECUTION

3.1 GENERAL

- A. Unknown Utilities and Obstacles:
 - 1. If any unknown or uncharted utilities or objects are encountered during excavation, promptly notify the Architect before proceeding. Arrange with utility and telephone companies for removal and relocation of their equipment, and capping of pipes and wiring as required.
- B. Protection of Vegetation:
 - 1. Rope or fence off areas of the site that are designated to remain with vegetation to prevent vehicular traffic and construction damage.
 - 2. Provide wood barricades around trees and shrubs at their drip line in traffic areas to protect them from construction operations until Substantial Completion, or until barricade removal is directed by Architect.
 - 3. Replace damaged trees and vegetation designated to remain with vegetation of equal kind and size. Follow supplier's recommended procedures for planting necessary replacement vegetation.
- C. Clearing, Stripping and Grubbing (General):
 - 1. Remove brush, vegetation, debris, and surplus materials from the jobsite. Removal of other remaining impediments as may be necessary to properly execute the scope of this contract shall be included herein. Adhere to State and

- local code requirements for the disposal of trees and shrubs removed from the site.
2. Do not remove trees or shrubs without the specific approval of the Architect. Vegetation damaged, removed, killed, or constricted from normal growth patterns shall be replaced with a comparable item, or the full replacement amount credited to the Owner.
- D. Drainage, Pumping and Grading:
1. Proper drainage of site shall be maintained during construction so that ponding of surface runoff does not occur and cause construction delays and/or inhibit access to the site.
 2. Contractor shall control the grading around building so that ground is pitched to prevent water from running into the excavated areas of building or damaging other structures.
 3. Provide pumping required to keep excavated spaces clear of water during construction.
 4. If any subgrade is damaged due to flooding, damaged area shall be removed and filled with select fill. Placement and compaction of select fill shall meet the requirements for placing and compacting select fill as specified below.
 5. If the subgrade, due to any reason or cause, lose the required stability, density, or finish before the foundation structure is placed, it shall be re-compacted and refinished at the sole expense of the Contractor.

3.2 BUILDING FOUNDATION (PAD) PREPARATION

- A. Site preparation area at buildings with and without adjacent sidewalks shall extend beyond the limits of the foundation area. See Construction Documents for Site Preparation limits.
- B. Existing fill material, top soil vegetation, roots, debris, organic material and other miscellaneous debris shall be removed to a depth of 9 inches and legally disposed of. Actual removal depth may vary and will be determined at time of construction.
- C. Over excavate the in-situ soils as required to allow the minimum amount of select structural fill to be placed beneath the slab to achieve the desired elevation. See Construction Documents for amount of select structural fill required per soils report.
- D. After stripping, and excavating to the desired grade as indicated above, the exposed soil shall be proof-rolled to locate all soft or loose areas. Soils, which are observed to rut or deflect excessively under the moving load, shall be undercut and replaced with properly compacted structural fill. The proof-rolling and undercutting activities shall be witnessed by a representative of the geotechnical engineer and shall be performed during a period of dry weather.
- E. Subsequent to proof-rolling, and just prior to placement of fill, the exposed subgrade within the construction areas shall be evaluated for moisture and density. The subgrade soils shall be at or above the optimum moisture content, and have an in-place dry density of at least 95 percent of the standard effort (ASTM D698) maximum dry density of the in-situ soils. If the moisture or density does not meet the above criteria, the subgrade shall be scarified to a minimum depth of 6 inches, and moisture adjusted to meet the requirements per the soils report as indicated on the Construction Documents.

- F. If remediation is required, Contractor shall have any of the following remediation options:
1. Disking and drying with natural means (if the construction schedule allows).
 2. Dry the surface soils by chemically treatment.
 3. Remove the unsuitably wet soils and replace the wet soil with select fill having an acceptable moisture content.

The option will be entirely up to the Contractor and no extra will be paid by the Owner.

- G. After proof-rolling and undercutting has been completed, and the subgrade tested and adjusted as necessary, fill placement may begin. The first layer of fill shall be placed in a relatively uniform horizontal lift and be adequately keyed into the stripped subgrade soils.
- H. Refer to construction drawings for information regarding lime-stablized subgrade treatment.

3.3 FILL PLACEMENT

- A. Structural fill materials shall be as specified in Paragraph 2.1, A above. Structural fill shall be placed in maximum lifts of eight (8) inches of loose material and shall have a moisture content as indicated on the Construction Documents. If water must be added, it shall be uniformly applied and thoroughly mixed into the soil by disking or scarifying. Each lift of structural fill shall be tested by a representative of the geotechnical engineer prior to placement of subsequent lifts.
- B. Each lift of structural fill shall be compacted as required per the soils report and as indicated on the Construction Documents. Care shall be taken to apply compactive effort throughout the fill and fill scope areas. The moisture content and the degree of compaction of the structural fill soils shall be maintained until the construction of structures above them.
- C. Contractor shall be responsible for damage caused to structure because of over excavation or excavations left open during inclement weather. Should the subgrade, for any reason or cause, lose the required stability, density, or finish before the foundation structure is placed, it shall be re-compacted and refinished at the sole expense of the Contractor.

3.4 GRADING

- A. Rough Grading: Contractor shall control the grading around building so that ground is pitched to prevent water from running into the excavated areas or damaging other structures. Furnish pumping required to keep excavated spaces clear of water during construction. If a foundation excavation must remain empty through a shut-down period, cover with boards and building paper and clean out immediately when work resumes. If any subgrade should be damaged due to flooding, damaged area shall be removed and filled with select fill.
- B. Finish Grading:

1. After rough grading is completed, provide and place imported top soil in the amounts required to bring the rough grade to within two (2) inches of finish grade. This earth fill shall be placed in lifts not to exceed 12 inches after compaction and shall be compacted to a dry density of at least 95 percent of the ASTM D698 maximum dry density.
 2. Assure bonding of layers of fill material in compliance with the specifications.
 3. Final and fine grading shall be done using a tractor pulled landscape rake and hand raking removing all debris immediately prior to landscaping. The final graded ground surface shall be relatively smooth, free of organic material and in suitable condition to commence landscaping work.
- C. Topsoil:
1. Contractor shall furnish all topsoil that may be required to provide finish elevations. Topsoil material shall meet requirements of Paragraph 2.1 of this Section. Spread minimum two (2) inches of topsoil over graded areas after rough grading has been completed.
 2. At the completion of finish grading, ground surface shall be relatively smooth, free of organic material and in suitable condition to commence landscaping work.

3.5 INSPECTION AND TESTING LABORATORY SERVICES

- A. Refer to Section 01 45 23, Inspection and Testing Laboratory Services for laboratory services to determine the liquid limit, plastic limit and plasticity index for soils and in-place density tests for compacted material.
- B. The Contractor shall cooperate with the inspection and testing laboratory in all matters pertaining to the work.

END OF SECTION 31 00 00

SECTION 31 00 01

EARTHWORK

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Operations required for the excavation of materials on site.
 - 1. Operations required for the excavation of borrow material from approved sources.
 - 2. Compaction of natural subgrades.
 - 3. Placement and compaction of embankments to grade.
 - 4. Finish grading.
 - 5. Disposal of excess or unsuitable materials.
 - 6. Other required operations.
 - 7. Earthwork must conform with dimensions and typical sections shown, and within lines and grades established on the Drawings.
- B. The Contractor shall inform and satisfy himself as to character, quantity and distribution of material to be excavated.

1.2 EXISTING UTILITIES

- A. The plans show the approximate location of all known underground utility lines and structures. Where pipes, ducts and other structures are encountered in the excavation but are not shown on the plans, immediately notify the Owner's Representative.

1.3 CLASSIFICATIONS

- A. Top Soil: Top 6 inches of natural surface soil possessing the characteristics of representative soils on the site that produce growths of grass or other vegetation. Topsoil includes grasses and other vegetation.
- B. Subgrade: Consists of that portion of the surface on which a compacted embankment or pavement is constructed.
- C. Compacted Embankment: Earth fill placed and compacted between subgrade and underside of pavement and fill areas adjacent to paving.
- D. Borrow: Material taken from approved sources to make up any deficit of excavated material. The borrow shall have a measured plasticity index of between 7 and 20, and shall be free of organic matter and excess silt.
- E. Finish Grading: Operations required for smoothing disturbed areas that are not overlaid with pavement.
- F. Stripping of Ground Surface: All vegetation, all decayed vegetable matter, rubbish and other unsuitable material within the areas to be graded not removed by clearing shall be stripped or otherwise removed to ground level before grading or other earthwork is started. In no case will such material be allowed to remain in or on the areas to be graded.

- G. Excavation: After all necessary stripping has been done, excavation of every description and of whatever substances encountered within the grading limits of the project shall be performed to the lines and grades indicated on the Drawings.
- H. Compaction: Compaction of soil materials shall be measured as a percentage of Standard Proctor density as determined by the AASHTO Standard T 99 procedure.

PART 2 PRODUCTS

2.1 EQUIPMENT

- A. Furnish, operate and maintain such equipment as is necessary to produce uniform layers, section and smoothness of grade for compaction and drainage.
- B. Tamping Rollers:
 - 1. Use tamping rollers with one or more cylindrical drums. Each cylinder must be at least 48 inches long and 40 inches in diameter.
 - 2. The minimum weight per linear foot of drum length must be 1500 pounds weighted and 1000 pounds empty.
 - 3. For tamping rollers with multiple cylinders, each cylinder must rotate independently and the cylinders must be pivoted on the main frame so that the units can adapt to irregularities in the ground surface.
 - 4. Provide approximately 2.7 tamping feet per square foot of drum surface on each cylinder. Stagger the feet uniformly over the cylinder surface. Each foot should have a face area between 5 and 7 square inches and a clear projection from the cylinder surface of 7 to 9 inches. Equip each unit with a device for cleaning the feet as the cylinders rotate.
 - 5. Use a crawler tractor with sufficient power to pull the tamping roller at a speed of approximately 3.0 miles per hour.
- C. Rubber Tire Rollers:
 - 1. Use rubber tire rollers having two axles and not less than a total of nine wheels with pneumatic tires.
 - 2. Mount the wheels so that the rear tires will not follow in the tracks of the forward tires and so the unit will give uniform compaction over the entire width of coverage.
 - 3. Mount the axles in a rigid frame with a loading platform or body suitable for being ballasted to a specified gross weight between 10 and 50 tons loading. The Owner's Representative will specify the tire inflation and gross weight.
 - 4. If the roller is not self propelled, the towing equipment must also have pneumatic tires.
- D. Use tank trucks, pressure distributors or other equipment designed to apply water uniformly and in controlled quantities to variable surface widths.
- E. Scarifiers, disks, spring tooth or spike tooth harrows, earth hauling equipment and other equipment must be suitable for construction of fills.

2.2 EARTH FILL

- A. Obtain embankment fill from required excavation or, if excavated material is not sufficient, from Borrow areas approved by the Owner's Representative.

- B. Use the best material available from excavation or borrow. Suitability of fill material is subject to the approval of the Owner's Representative.
- C. Fill material must be free of excessive silts. Do not use soil containing brush, roots, sod or similar perishable material.
- D. Embankment material must have a plasticity index between 7 and 20 inclusive.

PART 3 EXECUTION

3.1 REMOVAL OF TOPSOIL

- A. Remove topsoil within the limits of the construction areas as shown on the Drawings.
- B. Stockpile the topsoil for future distribution. Protect stockpiled topsoil from other excavated materials.

3.2 EXCAVATION

- A. As shown on the Drawings, excavate to lines, grades and elevations required for subsequent construction of embankments or pavement. Remove materials within the indicated limits and dispose of as directed.
- B. Maintain grades during excavation for complete drainage. When required, install temporary drains or drainage ditches to intercept or divert surface water and prevent interference or delay of the Work.
- C. If at time of excavation it is not possible to place material in the proper section of permanent construction, stockpile the material in approved areas for later use.
- D. Stones or rock fragments larger than 2 inches in their greatest dimension will not be permitted in top 6 inches of subgrade.
- E. Uniformly dress cut and fill slopes to slope, cross section and alignment, as shown.

3.3 SUBGRADE UNDER PAVEMENTS

- A. After excavation is made to subgrade lines under proposed pavements, remove and replace soft or undesirable material with select material as specified for embankments. Stabilize and compact the subgrade as stated in the sections on stabilization of pavement subgrade.

3.4 TREATMENT OF NATURAL SUBGRADE UNDER EMBANKMENTS

- A. After excavation is made to lines under proposed embankments, remove soft or undesirable material to a depth determined by the Owner's Representative. Break down sides or holes or depressions to flatten the slopes.
- B. Fill each depression with the appropriate soil for the materials to be placed on the subgrade. Place the fill in layers moistened and compacted as specified in this section.
- C. After depressions have been filled and immediately before placement of compacted fill in a section of the embankment, thoroughly loosen the foundation material to a depth of 6 inches. Remove roots and debris turned up while loosening the soil.
- D. Compact the surface of the embankment subgrade as specified in the following paragraphs.

- E. Take care to prepare the embankment so that planes of seepage or weakness are not induced. Should the Owner's Representative suspect such a deficiency, the material must be thoroughly broken and recompact before proceeding with construction.

3.5 PLACING EMBANKMENT FILL

- A. Do not place fill on any part of the embankment subgrade until the subgrade preparation has been inspected by the Owner's Representative.
- B. During the dumping and spreading process, remove all roots, stones and debris that are uncovered in the embankment material.
- C. After dumping, spread the material in horizontal layers over the entire fill area. The thickness of each layer before compaction must not exceed 8 inches unless otherwise directed. As soon as possible after placement begins, crown the surface to drain freely and maintain such conditions throughout construction.
- D. If the compacted surface of a layer is too smooth to bond with succeeding layers, loosen the surface by harrowing or other approved method before continuing the work.
- E. Stabilize and compact the top 6 inches of embankment fills under pavement sections as specified in the section on stabilization of pavement subgrade.

3.6 MOISTURE CONTROL

- A. Developing the maximum density obtainable with the natural moisture of the embankment material is preferred. However, the moisture content must be 1 to 3 percentage points wet of optimum, as determined by AASHTO Test Method T 99.
- B. If the moisture content is too high, adjust to within the specified limits by spreading the material and permitting it to dry. Assist the drying process by discing or harrowing if necessary. When the material is too dry, sprinkle each layer with water. Work the moisture into the soil by harrowing or other approved method.

3.7 COMPACTION

- A. Compact each layer of embankment with suitable rollers as necessary to secure at least 95% of the standard Proctor density, within the specified range of the moisture content, according to AASHTO Test Method T 99.

3.8 DISTRIBUTION OF TOPSOIL

- A. Preparation:
 - 1. Prior to placing topsoil, scarify the subgrade to a depth of 2 inches to provide effective bonding of the topsoil with the subgrade. Use a chisel plow with the chisels set 10 inches apart.
 - 2. Shape all areas designated for grading, including cut and fill areas, to receive a minimum of 6 inches of topsoil.
 - 3. In areas that require only blading and dressing, the adequacy of existing topsoil will be determined by the Owner's Representative.
- B. Placement:

1. Do not haul or place wet topsoil. Also prohibited is placement of topsoil on a subgrade that is excessively wet, extremely dry, or in a condition otherwise detrimental to proper grading or proposed planting.
 2. Distribute topsoil uniformly and spread evenly to an average thickness of 6 inches. Do no compact topsoil. Correct irregularities in the surface to prevent formation of depressions where water could stand.
 3. Perform the spreading operation so that planting can proceed with little additional tillage or soil preparation. Leave the area smooth and suitable for lawn planting.
- C. Where any portion of the surface becomes eroded or otherwise damaged, repair the affected area to establish the condition and grade prior to topsoil placement. Replace topsoil.

3.9 MATERIAL DISPOSAL

- A. Remove excess excavated material and excess topsoil from the area before substantial completion. Stockpile materials separately in designated areas. Excess soil, topsoil and strippings shall become property of the Contractor and shall be removed from the site.
- B. Dispose of waste material without causing expense or damage to the Owner.

END OF SECTION

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SECTION 31 06 20.15

CEMENT STABILIZED SAND

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cement stabilized sand.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No payment will be made for cement stabilized sand under this Section unless specifically noted in bid documents. Include payment for cement stabilized sand in unit price for applicable utility or structure installation section.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ASTM C 33 - Standard Specification for Concrete Aggregates (Fine Aggregate).
- B. ASTM C 40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
- C. ASTM C 42 - Standard Test Methods for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- D. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.
- E. ASTM C 123 - Standard Test Method for Lightweight Particles in Aggregate.
- F. ASTM C 142 - Standard Test Method for Clay Lumps and Friable Particles in Aggregates.
- G. ASTM C 150 - Specification for Portland Cement.
- H. ASTM D 558 - Standard Test Method for Moisture-Density Relations of Soil Cement-Mixtures.
- I. ASTM D 1632 - Standard Practice for Making and Curing Soil-Cement Compression and Flexure Test Specimens in the Laboratory.
- J. ASTM D 1633 - Standard Test Method for Compressive Strength of Molded Soil-Cement Cylinders.
- K. ASTM D 2487 - Standard Test Method for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
- L. ASTM D2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- M. ASTM D 3665 - Standard Practice for Random Sampling of Construction Materials.

- N. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit proposed target cement content and production data for sand-cement mixture in accordance with requirements of Paragraph 2.03, Materials Qualifications.

1.5 DESIGN REQUIREMENTS

- A. Use sand-cement mixture producing minimum unconfined compressive strength of 100 pounds per square inch (psi) in 48 hours.
 - 1. 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.
 - 2. Determine minimum cement content from production data and statistical history. Provide no less than 1.5 sacks of cement per ton of dry sand.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Cement: Type I Portland cement conforming to ASTM C 150.
- B. Sand: Clean, durable sand meeting grading requirements for fine aggregates of ASTM C 33, or requirements for bank run sand of Division 2 and the following requirements:
 - 1. Classified as SW, SP, SW-SM, SP-SM, or SM by Unified Soil Classification System of ASTM D 2487.
 - 2. Deleterious materials:
 - a. Clay lumps, ASTM C 142 - less than 0.5 percent.
 - b. Lightweight pieces, ASTM C 123; less than 5.0 percent.
 - c. Organic impurities, ASTM C 40, color no darker than standard color.
 - 3. Plasticity index of 4 or less when tested in accordance with ASTM D 4318.
- C. Water: Potable water, free of oils, acids, alkalis, organic matter or other deleterious substances, meeting requirements of ASTM C 94.

2.2 MIXING MATERIALS

- A. Add required amount of water and mix thoroughly in pugmill-type mixer.
- B. Stamp batch ticket at plant with time of loading. Reject material not placed and compacted within 4 hours after mixing.

2.3 MATERIAL QUALIFICATION

- A. Determine target cement content of material as follows:
 - 1. Obtain samples of sand-cement mixtures at production facility representing range of cement content consisting of at least three points.
 - 2. Complete molding of samples within 4 hours after addition of water.
 - 3. Perform strength tests (average of two specimens) at 48 hours and 7 days.
 - 4. Perform cement content tests on each sample.

5. Perform moisture content tests on each sample.
 6. Plot average 48-hour strength vs. cement content.
 7. Record scale calibration date, sample date, sample time, molding time, cement feed dial settings, and silo pressure (if applicable).
- B. Test raw sand for following properties at point of entry into pug-mill:
1. Gradation
 2. Plasticity index
 3. Organic impurities
 4. Clay lumps and friable particles
 5. Lightweight pieces
 6. Moisture content
 7. Classification
- C. Present data obtained in format similar to that provided in sample data form attached to this Section.
- D. The target content may be adjusted when statistical history so indicates. For determination of minimum product performance use formula: $f_c\% \frac{1}{2}$ standard deviation

PART 3 EXECUTION

3.1 PLACING

- A. Place sand-cement mixture in maximum 12-inch-thick loose lifts and compact to 95 percent of maximum density as determined in accordance with ASTM D 558, unless otherwise specified. Refer to related specifications for thickness of lifts in other applications. Target moisture content during compaction is +3 percent of optimum. Perform and complete compaction of sand-cement mixture within 4 hours after addition of water to mix at plant.
- B. Do not place or compact sand-cement mixture in standing or free water.

3.2 FIELD QUALITY CONTROL

- A. Testing will be performed under provisions of Division 1.
- B. One sample of cement stabilized sand shall be obtained for each 150 tons of material placed per day with no less than one sample per day of production. Random samples of delivered cement stabilized sand shall be taken in the field at point of delivery in accordance with ASTM 3665. Obtain three individual samples of approximately 12 to 15 lb each from the first, middle, and last third of the truck and composite them into one sample for test purpose.
- C. Prepare and mold four specimens (for each sample obtained) in accordance with ASTM D 558, Method A, without adjusting moisture content. Samples will be molded at approximately same time material is being used, but no later than 4 hours after water is added to mix.
- D. After molding, specimens will be removed from molds and cured in accordance with ASTM D 1632.
- E. Specimens will be tested for compressive strength in accordance with ASTM D 1633, Method A. Two specimens will be tested at 48 hours plus or minus 2 hours and two specimens will be tested at 7 days plus or minus 4 hours.

- F. A strength test will be average of strengths of two specimens molded from same sample of material and tested at same age. Average daily strength will be average of strengths of all specimens molded during one day's production and tested at same age.
- G. Precision and Bias: Test results shall meet recommended guideline for precision in ASTM D 1633 Section 9.
- H. Reporting: Test reports shall contain, as a minimum, the following information:
 - 1. Supplier and plant number
 - 2. Time material was batched
 - 3. Time material was sampled
 - 4. Test age (exact hours)
 - 5. Average 48-hour strength
 - 6. Average 7-day strength
 - 7. Specification section number
 - 8. Indication of compliance / non-compliance
 - 9. Mixture identification 3
 - 10. Truck and ticket numbers
 - 11. The time of molding
 - 12. Moisture content at time of molding
 - 13. Required strength
 - 14. Test method designations
 - 15. Compressive strength data as required by ASTM D 1633
 - 16. Supplier mixture identification
 - 17. Specimen diameter and height, in.
 - 18. Specimen cross-sectional area, sq. in.

3.3 ACCEPTANCE

- A. Strength level of material will be considered satisfactory if:
 - 1. The average 48-hour strength is greater than 100 psi with no individual strength test below 70 psi.
 - 2. All 7-day individual strength tests (average of two specimens) are greater than or equal to 100 psi.
- B. Material will be considered deficient when 7-day individual strength test (average of two specimens) is less than 100 psi but greater than 70 psi. See Paragraph 3.04 Adjustment for Deficient Strength.
- C. The material will be considered unacceptable and subject to removal and replacement at Contractor's expense when individual strength test (average of two specimens) has 7-day strength less than 70 psi.
- D. When moving average of three daily 48-hour averages falls below 100 psi, discontinue shipment to project until plant is capable of producing material, which exceeds 100 psi at 48 hours. Five 48-hour strength tests shall be made in this determination with no individual strength tests less than 100 psi.
- E. Testing laboratory shall notify Contractor, Owner's Representative, and material supplier by facsimile of tests indicating results falling below specified strength requirements within 24 hours.
- F. If any strength test of laboratory cured specimens falls below the specified strength, Contractor may, at his own expense, request test of cores drilled from the area in question in accordance

with ASTM C42. In such cases, three (3) cores shall be taken for each strength test that falls below the values given in 3.03.A.

- G. Cement stabilized sand in an area represented by core tests shall be considered satisfactory if the average of three (3) cores is equal to at least 100 psi and if no single core is less than 70 psi. Additional testing of cores extracted from locations represented by erratic core strength results will be permitted.

3.4 ADJUSTMENT FOR DEFICIENT STRENGTH

- A. When mixture produces 7-day compressive strength greater than or equal to 100 psi, then material will be considered satisfactory and bid price will be paid in full.
- B. When mixture produces 7-day compressive strength less than 100 pounds per square inch, then remove and replace cement-sand mixture and paving and other necessary work at no cost to Owner.

END OF SECTION

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SECTION 31 06 20.17

UTILITY BACKFILL MATERIALS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Material Classifications.
- B. Utility Backfill Materials:
 - 1. Concrete sand
 - 2. Gem sand
 - 3. Pea gravel
 - 4. Crushed stone
 - 5. Crushed concrete
 - 6. Bank run sand
 - 7. Select backfill
 - 8. Random backfill
- C. Material Handling and Quality Control Requirements.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No payment will be made for backfill material unless specifically listed in the bid documents. Include payment in unit price for applicable utility installation.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 DEFINITIONS

- A. Unsuitable Material:
 - 1. Materials classified as ML, CL-ML, MH, PT, OH, and OL according to ASTM D 2487.
 - 2. Materials that cannot be compacted to required density due to gradation, plasticity, or moisture content.
 - 3. Materials containing large clods, aggregates, or stones greater than 4 inches in any dimension; debris, vegetation, or waste; or any other deleterious materials.
 - 4. Materials contaminated with hydrocarbons or other chemical contaminants.
- B. Suitable Material:
 - 1. Materials meeting specification requirements.
 - 2. Unsuitable materials meeting specification requirements for suitable soils after treatment with lime or cement.

- C. Foundation Backfill Materials: Natural soil or manufactured aggregate meeting Class I requirements and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill where needed to provide stable support for structure foundation base. Foundation backfill materials may include concrete fill and seal slabs.
- D. Foundation Base: Crushed stone aggregate with filter fabric as required, cement stabilized sand, or concrete seal slab. Foundation base provides smooth, level working surface for construction of concrete foundation.
- E. Backfill Material: Classified soil material meeting specified quality requirements for designated application as embedment or trench zone backfill.
- F. Embedment Material: Soil material placed under controlled conditions within embedment zone extending vertically upward from top of foundation to an elevation 12 inches above top of pipe, and including pipe bedding, haunching and initial backfill.
- G. Trench Zone Backfill: Classified soil material meeting specified quality requirements and placed under controlled conditions in trench zone from top of embedment zone to base course in paved areas or to surface grading material in unpaved areas.
- H. Foundation: Either suitable soil of trench bottom or material placed as backfill of over-excavation for removal and replacement of unsuitable or otherwise unstable soils.
- I. Source: Source selected by Contractor for supply of embedment or trench zone backfill material. Selected source may be project excavation, off-site borrow pits, commercial borrow pits, or sand and aggregate production or manufacturing plants.
- J. Refer to Division 33 for other definitions regarding utility installation by trench construction.

1.4 REFERENCES

- A. ASTM C 33 - Standard Specification for Concrete Aggregate.
- B. ASTM C 40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
- C. ASTM C 123 - Standard Test Method for Lightweight Particles in Aggregate.
- D. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in Los Angeles Machine.
- E. ASTM C 136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- F. ASTM C 142 - Standard Test Method for Clay Lumps and Friable Particles in Aggregates.
- G. ASTM D 1140 - Standard Test Method for Amount of Material in Soils Finer Than No. 200 Sieve.
- H. ASTM D 2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
- I. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

- J. ASTM D 4643 - Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Method.
- K. TxDOT Tex-110-E - Determining Particle Size Analysis of Soils.
- L. TxDOT Tex-460-A - Material Finer Than 75 Fm (No.200) Sieve In Mineral Aggregates (Decantation Test for Concrete Aggregates).

1.5 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit description of source, material classification and product description, production method, and application of backfill materials.
- C. Submit test results for samples of off-site backfill materials. Comply with Paragraph 2.03, Material Testing.
- D. Before stockpiling materials, submit copy of approval from landowner for stockpiling backfill material on private property.
- E. Provide delivery ticket which includes source location for each delivery of material that is obtained from off-site sources or is being paid as specific bid item.

1.6 TESTS

- A. Perform tests of sources for backfill material in accordance with Paragraph 2.03B.
- B. Verification tests of backfill materials may be performed by Owner in accordance with Division 1.

PART 2 PRODUCTS

2.1 MATERIAL CLASSIFICATIONS

- A. Classify materials for backfill for purpose of quality control in accordance with Unified Soil Classification Symbols as defined in ASTM D 2487. Material use and application is defined in utility installation specifications and Drawings either by class, as described in Paragraph 2.01B, or by product descriptions, as given in Paragraph 2.02.
- B. Class Designations Based on Laboratory Testing:
 - 1. Class I: Well-graded gravels and sands, gravel-sand mixtures, crushed well-graded rock, little or no fines (GW, SW):
 - a. Plasticity index: non-plastic.
 - b. Gradation: D60/D10 - greater than 4 percent; amount passing No. 200 sieve - less than or equal to 5 percent.
 - 2. Class II: Poorly graded gravels and sands, silty gravels and sands, little to moderate fines (GM, GP, SP, SM):
 - a. Plasticity index: non-plastic to 4.
 - b. Gradations:
 - 1) Gradation (GP, SP): amount passing No. 200 sieve - less than 5 percent.

- 2) Gradation (GM, SM): amount passing No. 200 sieve - between 12 percent and 50 percent.
 - 3) Borderline gradations with dual classifications (e.g., SP-SM): amount passing No. 200 sieve - between 5 percent and 12 percent.
 3. Class III: Clayey gravels and sands, poorly graded mixtures of gravel, sand, silt, and clay (GC, SC, and dual classifications, e.g., SP-SC):
 - a. Plasticity index: greater than 7.
 - b. Gradation: amount passing No. 200 sieve - between 12 percent and 50 percent.
 4. Class IVA: Lean clays (CL).
 - a. Plasticity Indexes:
 - 1) Plasticity index: greater than 7, and above A line.
 - 2) Borderline plasticity with dual classifications (CL-ML): PI between 4 and 7.
 - b. Liquid limit: less than 50.
 - c. Gradation: amount passing No. 200 sieve - greater than 50 percent.
 - d. Inorganic.
 5. Class IVB: Fat clays (CH)
 - a. Plasticity index: above A line.
 - b. Liquid limit: 50 or greater.
 - c. Gradation: amount passing No. 200 sieve - greater than 50 percent.
 - d. Inorganic.
 6. Use soils with dual class designation according to ASTM D 2487, and which are not defined above, according to more restrictive class.

2.2 PRODUCT DESCRIPTIONS

- A. Soils classified as silt (ML) silty clay (CL-ML with PI of 4 to 7), elastic silt (MH), organic clay and organic silt (OL, OH), and organic matter (PT) are not acceptable as backfill materials. These soils may be used for site grading and restoration in unimproved areas as approved by Owner's Representative. Soils in Class IVB, fat clay (CH) may be used as backfill materials where allowed by applicable backfill installation specification. Refer to Division 31.
- B. Provide backfill material that is free of stones greater than 6 inches, free of roots, waste, debris, trash, organic material, unstable material, non-soil matter, hydrocarbon or other contamination, conforming to following limits for deleterious materials:
 1. Clay lumps: Less than 0.5 percent for Class I, and less than 2.0 percent for Class II, when tested in accordance with ASTM C 142.
 2. Lightweight pieces: Less than 5 percent when tested in accordance with ASTM C 123.
 3. Organic impurities: No color darker than standard color when tested in accordance with ASTM C 40.
- C. Manufactured materials, such as crushed concrete, may be substituted for natural soil or rock products where indicated in product specification, and approved by Owner's Representative, provided that physical property criteria are determined to be satisfactory by testing.
- D. Bank Run Sand: Durable bank run sand classified as SP, SW, or SM by Unified Soil Classification System (ASTM D 2487) meeting following requirements:
 1. Less than 15 percent passing number 200 sieve when tested in accordance with ASTM D 1140. Amount of clay lumps or balls may not exceed 2 percent.

2. Material passing number 40 sieve shall meet the following requirements when tested in accordance with ASTM D 4318: Plasticity index: not exceeding 7.

- E. Concrete Sand: Natural sand, manufactured sand, or combination of natural and manufactured sand conforming to requirements of ASTM C 33 and graded within following limits when tested in accordance with ASTM C 136:

Sieve	Percent Passing
3/8"	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30
No. 100	2 to 10

- F. Gem Sand: Sand conforming to requirements of ASTM C 33 for course aggregates specified for number 8 size and graded within the following limits when tested in accordance with ASTM C 136:

Sieve	Percent Passing
3/8"	95 to 100
No. 4	60 to 80
No. 8	15 to 40

- G. Pea Gravel: Durable particles composed of small, smooth, rounded stones or pebbles and graded within the following limits when tested in accordance with ASTM C 136:

Sieve	Percent Passing
1/2"	100
3/8"	85 to 100
No. 4	10 to 30
No. 8	0 to 10
No. 16	0 to 5

- H. Crushed Aggregates: Crushed aggregates consist of durable particles obtained from an approved source and meeting the following requirements:

1. Materials of one product delivered for same construction activity from single source, unless otherwise approved by Owner's Representative.
2. Non-plastic fines.
3. Los Angeles abrasion test wear not exceeding 45 percent when tested in accordance with ASTM C 131.
4. Crushed aggregate shall have minimum of 90 percent of particles retained on No. 4 sieve with 2 or more crushed faces as determined by Tex-460-A, Part I.
5. Crushed stone: Produced from oversize plant processed stone or gravel, sized by crushing to predominantly angular particles from naturally occurring single source. Uncrushed gravel is not acceptable materials for embedment where crushed stone is shown on applicable utility embedment drawing details.
6. Crushed Concrete: Crushed concrete is an acceptable substitute for crushed stone as utility backfill. Gradation and quality control test requirements are same as crushed stone. Provide crushed concrete produced from normal weight concrete of uniform quality; containing particles of aggregate and cement material, free from other substances such as asphalt, reinforcing steel fragments, soil, waste gypsum (calcium sulfate), or debris.

7. Gradations, as determined in accordance with Tex-110-E.

Sieve	Percent Passing by Weight for Pipe Embedment By Ranges of Nominal Pipes Sizes		
	>15"	15" – 8"	< 8"
1"	95 – 100	100	--
¾"	60 – 90	90 – 100	100
½"	25 – 60	--	90 – 100
3/8"	--	20 – 55	40 – 70
No. 4	0 – 5	0 – 10	0 – 15
No. 8	--	0 – 5	0 – 5

- I. Select Backfill: Class III clayey gravel or sand or Class IV lean clay with plasticity index between 7 and 20 or clayey soils treated with lime in accordance with Division 31 to meet plasticity criteria.
- J. Random Backfill: Any suitable soil or mixture of soils within Classes I, II, III and IV; or fat clay (CH) where allowed by applicable backfill installation specification. Refer to Division 31.
- K. Cement Stabilized Sand: Conform to requirements of Division 31.
- L. Concrete Backfill: Conform to Class B concrete as specified in Division 32.
- M. Flexible Base Course Material: Conform to requirements of applicable portions of Division 33.

2.3 MATERIAL TESTING

- A. Source Qualification. Perform testing to obtain tests by suppliers for selection of material sources and products not from the project site. Test samples of processed materials from current production representing material to be delivered. Use tests to verify that materials meet specification requirements. Repeat qualification test procedures each time source characteristics change or there is planned change in source location or supplier. Include the following qualification tests, as applicable:
 - 1. Gradation. Report complete sieve analyses regardless of specified control sieves from largest particle through No. 200 sieve.
 - 2. Plasticity of material passing No. 40 sieve.
 - 3. Los Angeles abrasion wear of material retained on No. 4 sieve.
 - 4. Clay lumps.
 - 5. Lightweight pieces.
 - 6. Organic impurities.
- B. Production Testing. Provide reports to Owner’s Representative from an independent testing laboratory that backfill materials to be placed in Work meet applicable specification requirements.
- C. Assist Owner’s Representative in obtaining material samples for verification testing at source or at production plant.

PART 3 EXECUTION

3.1 SOURCES

- A. Use of existing material in trench excavations is acceptable, provided applicable specification requirements are satisfied.
- B. Identify off-site sources for backfill materials at least 14 days ahead of intended use so that Owner's Representative may obtain samples for verification testing.
- C. Materials may be subjected to inspection or additional verification testing after delivery. Materials which do not meet requirements of specifications will be rejected. Do not use material which, after approval, has become unsuitable for use due to segregation, mixing with other materials, or by contamination. Once material is approved by Owner's Representative, expense for sampling and testing required to change to different material will be credited to Owner through change order.
- D. Bank run sand, select backfill, and random backfill, if available in project excavation, may be obtained by selective excavation and acceptance testing. Obtain additional quantities of these materials and other materials required to complete work from off-site sources.
- E. Owner does not represent or guarantee that any soil found in excavation work will be suitable and acceptable as backfill material.

3.2 MATERIAL HANDLING

- A. When backfill material is obtained from either commercial or non-commercial borrow pit, open pit to expose vertical faces of various strata for identification and selection of approved material to be used. Excavate selected material by vertical cuts extending through exposed strata to achieve uniformity in product.
- B. Establish temporary stockpile locations for practical material handling, control, and verification testing by Owner's Representative in advance of final placement. Obtain approval from landowner for storage of backfill material on adjacent private property.
- C. When stockpiling backfill material near project site, use appropriate covers to eliminate blowing of materials into adjacent areas and prevent runoff containing sediments from entering drainage system.
- D. Place stockpiles in layers to avoid segregation of processed materials. Load material by making successive vertical cuts through entire depth of stockpile.

3.3 FIELD QUALITY CONTROL

- A. Quality Control
 - 1. The Owner's Representative may sample and test backfill at:
 - a. Sources including borrow pits, production plants and Contractor's designated off-site stockpiles.
 - b. On-site stockpiles.
 - c. Materials placed in Work.

2. The Owner's Representative may re-sample material at any stage of work or location if changes in characteristics are apparent.
- B. Production Verification Testing: Owner's testing laboratory will provide verification testing on backfill materials, as directed by Owner's Representative. Samples may be taken at source or at production plant, as applicable.

END OF SECTION

SECTION 31 11 00

CLEARING AND GRUBBING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Removing surface debris and rubbish.
- B. Clearing site of plant life and grass.
- C. Removing trees and shrubs.
- D. Removing root system of trees and shrubs.
- E. Fence removal.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for clearing and grubbing is on a per Acre basis.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REGULATORY REQUIREMENTS

- A. Conform to applicable codes for disposal of debris.
- B. Coordinate clearing work with utility companies.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify that existing plant life and features designated to remain are identified and tagged.

3.2 PROTECTION

- A. Protect following from damage or displacement:
 - 1. Living trees located 3 feet or more outside of intersection of side slopes and original ground line.
 - 2. Plants other than trees and landscape features designated to remain.
 - 3. Utilities designated to remain.
 - 4. Bench marks, monuments, and existing structures designated to remain.

3.3 CLEARING

- A. Remove stumps, main root ball, and root system to:
 - 1. Depth of 24 inches below finished subgrade elevation in area bounded by lines two feet behind back of curbs.
 - 2. Depth of 24 inches below finished surface of required cross section for other areas.
- B. Clear undergrowth and deadwood without disturbing subsoil.
- C. Remove vegetation from top soil scheduled for reuse.

3.4 REMOVAL

- A. Remove debris, rubbish, and extracted plant material life from site in accordance with requirements of Division 1.
- B. Remove on site fences. Materials generated from removal of fences become property of Contractor. Properly dispose of in accordance with applicable local, state and federal laws.

END OF SECTION

SECTION 31 22 00

GRADING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Removal of topsoil.
- B. Rough grading the site for site structures, building pads, and play fields.
- C. Replacement of topsoil and finish grading for planting.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.3 SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.4 PROJECT CONDITIONS

- A. Protect above- and below-grade utilities that remain.
- B. Protect plants, lawns, rock outcroppings, and other features to remain as a portion of final landscaping.
- C. Protect bench marks survey, control points, existing structures, fences, sidewalks, paving, and curbs from grading equipment and vehicular traffic.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Topsoil - Soil Type: Topsoil excavated on-site.
 - 1. Graded.
 - a. Free of roots, rocks larger than 1/2 inch (12 mm), subsoil, debris, large weeds and foreign matter.
 - b. Provide imported topsoil conforming to the requirements of Division 32 as required.
 - 2. Other Fill Materials: Reference relevant sections of Division 32 and the Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.

3.2 PREPARATION

- A. Identify required lines, leveler contours, and datum.
- B. Stake and flag locations of known utilities.
- C. Locate, identify, and protect utilities that remain, from damage.
- D. Notify utility company to remove and relocate utilities.

3.3 ROUGH GRADING

- A. Remove topsoil from areas to be further excavated, re-landscaped, or degraded, without mixing with foreign materials.
- B. Do not remove topsoil when wet.
- C. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.
- D. Do not remove wet subsoil, unless it is subsequently processed to obtain optimum moisture content.
- E. When excavating through roots, perform work by hand and cut roots with sharp axe.
- F. See Division 31 Specifications for filling procedures.
- G. Benching Slopes: Horizontally bench existing slopes greater than 1:4 to key fill material to slope for firm bearing.
- H. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

3.4 SOIL REMOVAL

- A. Stockpile excavated topsoil on site.
- B. Stockpile excavated subsoil on site.
- C. Stockpiles: Use areas designated on site, pile depth not to exceed 8 feet (2.5 m); protect from erosion.

3.5 FINISH GRADING

- A. Before Finish Grading:
 - 1. Verify building and trench backfilling have been inspected.
 - 2. Verify subgrade has been contoured and compacted.
- B. Remove debris, roots, branches, stones, in excess of 1/2 inch (13 mm) in size. Remove/Break-up soil clumps greater than 1" in size. Remove soil contaminated with petroleum products.
- C. Where topsoil is to be placed, scarify surface to depth of 3 inches (75 mm).
- D. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 3 inches (75 mm).
- E. Place topsoil in areas where seeding is indicated.

- F. Place topsoil where required to level finish grade.
- G. Place topsoil to the following compacted thicknesses:
 - 1. Areas to be Seeded with Grass: 6 inches (150 mm).
 - 2. Areas to be Sodded: 4 inches (100 mm).
- H. Place topsoil during dry weather.
- I. Remove roots, weeds, rocks, and foreign material while spreading.
- J. Near plants spread topsoil manually to prevent damage.
- K. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.
- L. Lightly compact placed topsoil.

3.6 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus 1/10 foot (30 mm) from required elevation.
- B. Top Surface of Finish Grade: Plus or minus 1/2 inch (13 mm).

3.7 FIELD QUALITY CONTROL

- A. See Division 1 and Division 31 for compaction density testing.

3.8 CLEANING AND PROTECTION

- A. Remove unused stockpiled topsoil and subsoil. Grade stockpile area to prevent standing water. Excess topsoil and subsoil to be removed at no additional cost to owner.
- B. Leave site clean and raked, ready to receive landscaping.

END OF SECTION

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SECTION 31 23 00

EXCAVATION AND BACKFILL FOR STRUCTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Excavation, backfilling, and compaction of backfill for structures.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices.
1. No payment will be made for structural excavation and backfill under this Section. Include payment in unit price or lump sum for construction of structures.
 2. Refer to Section 01270 - Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 DEFINITIONS

- A. Unsuitable Material: Unsuitable soil materials are the following:
1. Materials that are classified as ML, CL-ML, MH, PT, OH, and OL according to ASTM D 2487.
 2. Materials that cannot be compacted to required density due to gradation, plasticity, or moisture content.
 3. Materials that contain large clods, aggregates, stones greater than 4 inches in any dimension, debris, vegetation, waste or any other deleterious materials.
 4. Materials that are contaminated with hydrocarbons or other chemical contaminants.
- B. Suitable Material: Suitable soil materials are those meeting specification requirements. Unsuitable soils meeting specification requirements for suitable soils after treatment with lime or cement shall be considered suitable, unless otherwise indicated.
- C. Select Material: Material as defined in Section 02320 - Utility Backfill Materials.
- D. Backfill: Material meeting specified quality requirements, placed and compacted under controlled conditions around structures.
- E. Foundation Backfill Materials: Natural soil or manufactured aggregate meeting Class I requirements and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill where needed to provide stable support for structure foundation base. Foundation backfill materials may include concrete fill and seal slabs.

- F. Foundation Base: For foundation base material, use crushed stone aggregate with filter fabric as required, cement stabilized sand, or concrete seal slab. Foundation base provides smooth, level working surface for construction of concrete foundation.
- G. Foundation Subgrade: Foundation subgrade is surface of natural soil which has been excavated and prepared to support foundation base or foundation backfill, where needed.
- H. Ground Water Control Systems: Installations external to excavation such as well points, eductors, or deep wells. Ground water control includes dewatering to lower ground water, intercepting seepage which would otherwise emerge from side or bottom of excavation, and depressurization to prevent failure or heaving of excavation bottom. Refer to Section 01578 - Control of Ground Water and Surface Water.
- I. Surface Water Control: Diversion and drainage of surface water runoff and rain water away from excavation. Remove rain water and surface water which accidentally enters excavation as part of excavation drainage.
- J. Excavation Drainage: Removal of surface and seepage water in excavation by sump pumping and using French drains surrounding foundation to intercept water.
- K. Over-Excavation and Backfill: Excavation of subgrade soils with unsatisfactory bearing capacity or composed of otherwise unsuitable materials below foundation as shown on Drawings, and backfilled with foundation backfill material.
- L. Shoring System: Structure that supports sides of an excavation to maintain stable soil conditions and prevent cave-ins.

1.4 REFERENCES

- A. ASTM D 698 - Standard Test Methods for Laboratory Compaction of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600kN-m/m³)).
- B. ASTM D 1556 - Standard Test Method for Density of Soil in Place by Sand-Cone Method.
- C. ASTM D 2922 - Standard Test Methods for Density of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
- D. ASTM D 3017 - Standard Test Method for Water Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depths).
- E. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- F. TxDOT Tex-101-E - Preparing Soil and Flexible Base Materials for Testing.
- G. TxDOT Tex-110-E - Particle Size Analysis of Soils.
- H. Federal Regulations, 29 CFR, Part 1926, Standards - Excavation, Occupational Safety and Health Administration (OSHA).

1.5 SUBMITTALS

- A. Conform to requirements of Section 01330 - Submittal Procedures.

- B. Submit work plan for excavation and backfill for each structure with complete written description which identifies details of proposed method of construction and sequence of operations for construction relative to excavation and backfill activities. Use descriptions, with supporting illustrations, sufficiently detailed to demonstrate to Project Manager that procedures meet requirements of Specifications and Drawings.
- C. Submit excavation safety system plan.
 - 1. Submit excavation safety system plan in accordance with applicable OSHA requirements for excavations.
 - 2. Submit excavation safety system plan in accordance with requirements of Section 02260 - Trench Safety System, for excavations that fall under State and Federal trench safety laws.
- D. Submit ground and surface water control plan in accordance with requirements in this Section and Section 01578 - Control of Ground Water and Surface Water.
- E. Submit backfill material sources and product quality information in accordance with requirements of Section 02320 - Utility Backfill Materials.
- F. Submit project record documents under provisions of Section 01785 - Project Record Documents. Record location of utilities, as installed, referenced to survey benchmarks. Include location of utilities encountered or rerouted. Give horizontal dimensions, elevations, inverts and gradients.

1.6 TESTS

- A. Testing and analysis of backfill materials for soil classification and compaction during construction will be performed by an independent laboratory provided by City in accordance with requirements of Section 01454 - Testing Laboratory Services and as specified in this Section.
- B. Perform embedment and backfill material source qualification testing in accordance with requirements of Section 02320- Utility Backfill Materials.

PART 2 PRODUCTS

2.1 EQUIPMENT

- A. Perform excavation with equipment suitable for achieving requirements of this Specification.
- B. Use equipment which will produce degree of compaction specified. Compact backfill within 3 feet of walls with hand operated equipment. Do not use equipment weighing more than 10,000 pounds closer to walls than a horizontal distance equal to depth of fill at that time. Use hand operated power compaction equipment where use of heavier equipment is impractical or restricted due to weight limitations.

2.2 MATERIAL CLASSIFICATIONS

- A. Use backfill materials conforming to classifications and product descriptions of Section 02320 - Utility Backfill Materials. Use classification or product description for backfill applications as shown on Drawings and as specified.

PART 3 EXECUTION

3.1 PREPARATION

- A. Conduct an inspection to determine condition of existing structures and other permanent installations.
- B. Set up necessary street detours and barricades in preparation for excavation if construction will affect traffic. Conform to requirements of Section 01555 - Traffic Control and Regulation. Maintain barricades and warning devices at all times for streets and intersections where work is in progress, or where construction work is considered hazardous to traffic movements.
- C. Perform work in accordance with OSHA standards. Employ an excavation safety system as specified in Section 02260 - Trench Safety Systems.
- D. Remove existing pavements and structures, including sidewalks and driveways, in accordance with requirements of Section 02221 - Removing Existing Pavements and Structures.
- E. Install and operate necessary dewatering and surface water control measures in accordance with requirements of Section 01578 - Control of Ground Water and Surface Water.

3.2 PROTECTION

- A. Protect trees, shrubs, lawns, existing structures, and other permanent objects outside of grading limits and within grading limits as designated on Drawings, and in accordance with requirements of Section 01562 - Tree and Plant Protection.
- B. Protect and support above-grade and below-grade utilities which are to remain.
- C. Restore damaged permanent facilities to pre-construction conditions unless replacement or abandonment of facilities is indicated on Drawings.
- D. Prevent erosion of excavations and backfill. Do not allow water to pond in excavations.
- E. Maintain excavation and backfill areas until start of subsequent work. Repair and recompact slides, washouts, settlements, or areas with loss of density at no additional cost to City.

3.3 EXCAVATION

- A. Perform excavation work so that underground structure can be installed to depths and alignments shown on Drawings. Use caution during excavation work to avoid disturbing surrounding ground and existing facilities and improvements. Keep excavation to absolute minimum necessary. No additional payment will be made for excess excavation not authorized by Project Manager.
- B. Upon discovery of unknown utilities, badly deteriorated utilities not designated for removal, or concealed conditions, discontinue work at that location. Notify Project Manager and obtain instructions before proceeding in such areas.
- C. Immediately notify agency or company owning any line which is damaged, broken or disturbed. Obtain approval from Project Manager and agency for any repairs or relocations, either temporary or permanent.

- D. Avoid settlement of surrounding soil due to equipment operations, excavation procedures, vibration, dewatering, or other construction methods.
- E. Provide surface drainage during construction to protect work and to avoid nuisance to adjoining property. Where required, provide proper dewatering and piezometric pressure control during construction.
- F. Conduct hauling operations so that trucks and other vehicles do not create dirt nuisance in streets. Verify that truck beds are sufficiently tight and loaded in such a manner such that objectionable materials will not spill onto streets. Promptly clear away any dirt, mud, or other materials that spill onto streets or are deposited onto streets by vehicle tires.
- G. Maintain permanent benchmarks, monumentation, and other reference points. Unless otherwise directed, replace those which are damaged or destroyed by Work.
- H. Provide sheeting, shoring, and bracing where required to safely complete Work, to prevent excavation from extending beyond limits indicated on Drawings, and to protect Work and adjacent structures or improvements. Use sheeting, shoring, and bracing to protect workmen and public conforming to requirements of Section 02260 - Trench Safety Systems.
- I. Prevent voids from forming outside of sheeting. Immediately fill voids with grout, cement stabilized sand, or other material approved by Project Manager and compact to 95 percent standard density.
- J. After completion of structure, remove sheeting, shoring, and bracing unless shown on Drawings to remain in place or directed by Project Manager in writing that such temporary structures may remain. Remove sheeting, shoring and bracing in such a manner as to maintain safety during backfilling operations and to prevent damage to Work and adjacent structures or improvements.
- K. Immediately fill and compact voids left or caused by removal of sheeting with cement stabilized sand or other material approved by Project Manager and compact to 95 percent standard density.

3.4 HANDLING EXCAVATED MATERIALS

- A. Classify excavated materials. Place material which is suitable for use as backfill in orderly piles at sufficient distance from excavation to prevent slides or cave-ins.
- B. Provide additional backfill material in accordance with requirements of Section 02319 - Borrow, if adequate quantities of suitable material are not available from excavation and trenching operations at site.

3.5 DEWATERING

- A. Provide ground water control per Section 01 57 23.12 - Control of Ground Water and Surface Water.
- B. Keep ground water surface elevation minimum of 2 feet below bottom of foundation base.
- C. Maintain ground water control as directed by Section 01 57 23.12 - Control of Ground Water and Surface Water and until structure is sufficiently complete to provide required weight to resist hydrostatic uplift with minimum safety factor of 1.2.

3.6 FOUNDATION EXCAVATION

- A. Notify Project Manager at least 48 hours prior to planned completion of foundation excavations. Do not place foundation base until excavation is accepted by Project Manager.
- B. Excavate to elevations shown on Drawings, as needed to provide space for foundation base, forming level undisturbed surface, free of mud or soft material. Remove pockets of soft or otherwise unstable soils and replace with foundation backfill material or material as directed by Project Manager. Prior to placing material over it, recompact subgrade where indicated on Drawings, scarifying as needed, to 95 percent of maximum Standard Dry Density according to ASTM D 698. If specified level of compaction cannot be achieved, moisture condition subgrade and recompact until 95 percent is achieved, over-excavate to provide minimum layer of 24 inches of foundation backfill material, or other means acceptable to Project Manager.
- C. Fill unauthorized excessive excavation with foundation backfill material or other material as directed by Project Manager.
- D. Protect open excavations from rainfall, runoff, freezing groundwater, or excessive drying so as to maintain foundation subgrade in satisfactory, undisturbed condition. Keep excavations free of standing water and completely free of water during concrete placement. E. Remove soils which become unsuitable due to inadequate dewatering or other causes, after initial excavation to required subgrade, and replace with foundation backfill material, as directed by Project Manager, at no additional cost to City.
- E. Place foundation base, or foundation backfill material where needed, over subgrade on same day that excavation is completed to final grade. Where base of excavations are left open for longer periods, protect them with seal slab or cement-stabilized sand.
- F. Use filter fabric as specified in Section 02621 - Geotextile to separate crushed aggregate, and other free draining Class I materials from native soils or select material backfill. Overlap fabric minimum of 12 inches beyond where another material stops contact with soil. H. Place crushed aggregate, and other Class I materials, in uniform layers of 8-inch maximum thickness. Perform compaction by means of at least two passes of vibratory compactor.

3.7 FOUNDATION BASE.

- A. Place foundation base after subgrade is properly prepared, including placement of foundation backfill where needed. Use foundation base consisting of 12-inch layer of crushed stone aggregate or cement stabilized sand. Alternately, seal slab with minimum thickness of 4 inches may be placed. Extend foundation base minimum of 12 inches beyond edge of structure foundation, unless shown otherwise on Drawings.
- B. Where foundation base and foundation backfill are of same material, both can be placed in one operation.

3.8 BACKFILL

- A. Complete backfill to surface of natural ground or to lines and grades shown on Drawings. Remove forms, lumber, trash and debris from structures. Deposit backfill in uniform layers and compact each layer as specified.
 - 1. Unless otherwise shown on Drawings, for structures under pavement or within one foot back of curb, use cement stabilized sand up to the top of the proposed structure. Use suitable on-site material (random backfill) up to 12 inches below pavement base or subgrade. Place minimum of 12 inches of select backfill below pavement base or

subgrade.

2. Unless otherwise shown on Drawings, for structures not under pavement, use random backfill of suitable material up to the surface.
- B. Do not place backfill against concrete walls or similar structures until laboratory test breaks indicate that concrete has reached minimum of 85 percent of specified compressive strength. Where walls are supported by slabs or intermediate walls, do not begin backfill operations until slab or intermediate walls have been placed and concrete has attained sufficient strength.
- C. Remove concrete forms before starting backfill and remove shoring and bracing as work progresses.
- D. Maintain backfill material at no less than 2 percent below nor more than 2 percent above optimum moisture content, unless otherwise approved by Project Manager. Place fill material in uniform 8-inch maximum loose layers. Compact fill to at least 95 percent of maximum Standard Proctor Density according to ASTM D 698 below paved areas. Compact fill to at least 90 percent around structures below unpaved areas.
- E. Where backfill is placed against sloped excavation surface, run compaction equipment across boundary of cut slope and backfill to form compacted slope surface for placement of next layer of backfill.
- F. Place backfill using cement stabilized sand in accordance with Section 02321 – Cement Stabilized Sand.

3.9 FIELD QUALITY CONTROL

- A. Testing will be performed under provisions of Section 01454 - Testing Laboratory Services.
- B. Tests will be performed initially on minimum of one different sample of each material type for plasticity characteristics, in accordance with ASTM D 4318, and for gradation characteristics, in accordance with Tex-101-E and Tex-110-E. Additional classification tests will be performed whenever there is noticeable change in material gradation or plasticity.
- C. In-place density tests of compacted subgrade and backfill will be performed according to ASTM D 1556, or ASTM D 2922 and ASTM D 3017, and at following frequencies and conditions:
 1. Minimum of one test for every 50 to 100 cubic yards of compacted backfill material as directed by Project Manager.
 2. A minimum of three density tests for each full work shift.
 3. Density tests will be performed in all placement areas.
 4. Number of tests will be increased when inspection determines that soil types or moisture contents are not uniform or when compacting effort is variable and not considered sufficient to attain uniform density.
 5. Identify elevation of test with respect to natural ground.
 6. Record approximate depth of lift tested.

- D. At least one test for moisture-density relationships will be initially performed for each type of backfill material in accordance with ASTM D 698. Perform additional moisture-density relationship test once a month or whenever there is noticeable change in material gradation or plasticity.
- E. When tests indicate work does not meet specified compaction requirements, recondition, recompact, and retest at Contractor's expense.

3.10 DISPOSAL OF EXCESS MATERIAL

Dispose of excess materials in accordance with requirements of Section 01576 – Waste Material Disposal.

END OF SECTION

SECTION 31 23 16.14

TRENCH SAFETY SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Trench Safety System for the construction of trench excavations.
- B. Trench Safety System for structural excavations that fall under provisions of State and Federal trench safety laws.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for Trench Safety is on a Linear Foot Basis.
- B. Stipulated Price (Lump Sum). The Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.3 DEFINITIONS

- A. A trench shall be defined as a narrow excavation (in relation to its depth) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet.
- B. The Trench Safety System requirements will apply to larger open excavations if the erection of structures or other installations limits the space between the excavation slope and the installation to dimensions equivalent of a trench as defined.
- C. Trench Safety Systems include but are not limited to sloping, sheeting, trench boxes or trench shields, sheet piling, cribbing, bracing, shoring, dewatering or diversion of water to provide adequate drainage.

1.4 SUBMITTALS

- A. Submittals shall conform to requirements of Division 1.
- B. Submit a safety program specifically for the construction of trench excavation. Design the Trench Safety Program to be in accordance with OSHA 29 CFR standards governing the presence and activities of individuals working in and around trench excavations.
- C. Construction and shop drawings containing deviations from OSHA standards or special designs shall be sealed by a licensed Engineer retained and paid by Contractor.
- D. Review of the safety program by the Engineer will only be in regard to compliance with this specification and will not constitute approval by the Engineer nor relieve Contractor of obligations under State and Federal trench safety laws.

1.5 REGULATORY REQUIREMENTS

- A. Install and maintain Trench Safety Systems in accordance with the detail specifications set out in the provision of Excavations, Trenching, and Shoring, Federal Occupation Safety and Health Administration (OSHA) Standards, 29 CFR, Part 1926, Subpart P, as amended, including Final Rule, published in the Federal Register Vol. 54, No. 209 on Tuesday, October 31, 1989. The sections that are incorporated into these specifications by reference include Sections 1926-650 through 1926-652.
- B. The Contractor is responsible for obtaining a copy of OSHA standards included in "Subpart P - Excavations" from the Federal Register Vol. 54, No. 209.
- C. Legislation that has been enacted by the Texas Legislature with regard to trench safety systems is hereby incorporated, by reference, into these specifications. Refer to Texas Health and Safety Code Ann., § 756.021 (Vernon 1991).
- D. Reference materials, if developed for a specific project, will be issued with the Bid Documents.

1.6 INDEMNIFICATION

- A. Contractor shall indemnify and hold harmless the Owner, its employees and agents, from any and all damages, costs (including, without limitation, legal fees, court costs, and the cost of investigation), judgments or claims by anyone for injury or death of persons resulting from the collapse or failure of trenches constructed under this Contract.
- B. Contractor acknowledges and agrees that this indemnity provision provides indemnity for the Owner in case the Owner is negligent either by act or omission in providing for trench safety, including, but not limited to safety program and design reviews, inspections, failures to issue stop work orders, and the hiring of the Contractor.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install and maintain Trench Safety Systems in accordance with provisions of OSHA 29 CFR.
- B. Install specially designed Trench Safety Systems in accordance with the Contractor's trench excavation safety program for the locations and conditions identified in the program.
- C. A competent person, as identified in the Contractor's trench safety program, shall verify that trench boxes and other premanufactured systems are certified for the actual installation conditions.

3.2 INSPECTION

- A. Contractor, or Contractor's independently retained consultant, shall make daily inspections of the Trench Safety Systems to ensure that the installed systems and operations meet OSHA 29 CFR and other personnel protection regulations requirements.

- B. If evidence of possible cave-ins or slides is apparent, Contractor shall immediately stop work in the trench and move personnel to safe locations until necessary precautions have been taken by Contractor to safeguard personnel entering the trench.
- C. Maintain a permanent record of daily inspections.

3.3 FIELD QUALITY CONTROL

- A. Contractor shall verify specific applicability of the selected or specially designed Trench Safety Systems to each field condition encountered on the project.

END OF SECTION

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SECTION 31 23 33

TRENCHING AND BACKFILLING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Excavation, trenching, foundation, embedment, and backfill for installation of utilities, including manholes and other pipeline structures.

1.2 MEASUREMENT AND PAYMENT

- A. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 DEFINITIONS

- A. Pipe Foundation: Suitable and stable native soils that are exposed at trench subgrade after excavation to depth of bottom of bedding as shown on Drawings, or foundation backfill material placed and compacted in over-excavations.
- B. Pipe Bedding: Portion of trench backfill that extends vertically from top of foundation up to level line at bottom of pipe, and horizontally from one trench sidewall to opposite sidewall.
- C. Haunching: Material placed on either side of pipe from top of bedding up to springline of pipe and horizontally from one trench sidewall to opposite sidewall.
- D. Initial Backfill: Portion of trench backfill that extends vertically from springline of pipe (top of haunching) up to level line 12 inches above top of pipe, and horizontally from one trench sidewall to opposite sidewall.
- E. Pipe Embedment: Portion of trench backfill that consists of bedding, haunching and initial backfill.
- F. Trench Zone: Portion of trench backfill that extends vertically from top of pipe embedment up to pavement subgrade or up to final grade when not beneath pavement.
- G. Unsuitable Material: Unsuitable soil materials are the following:
 - 1. Materials that are classified as ML, CL-ML, MH, PT, OH, and OL according to ASTM D 2487.
 - 2. Materials that cannot be compacted to required density due to gradation, plasticity, or moisture content.
 - 3. Materials that contain large clods, aggregates, stones greater than 4 inches in any dimension, debris, vegetation, waste or any other deleterious materials.
 - 4. Materials that are contaminated with hydrocarbons or other chemical contaminants.
- H. Suitable Material: Suitable soil materials are those meeting specification requirements. Materials mixed with lime or cement that can be compacted to required density and meeting requirements for suitable materials may be considered suitable materials, unless otherwise indicated.
- I. Backfill: Suitable material meeting specified quality requirements placed and compacted under controlled conditions.

- J. Ground Water Control Systems: Installations external to trench, such as well points, eductors, or deep wells. Ground water control includes dewatering to lower ground water, intercepting seepage which would otherwise emerge from side or bottom of trench excavation, and depressurization to prevent failure or heaving of excavation bottom. Refer to Division 1.
- K. Surface Water Control: Diversion and drainage of surface water runoff and rain water away from trench excavation. Rain water and surface water accidentally entering trench shall be controlled and removed as part of excavation drainage.
- L. Excavation Drainage: Removal of surface and seepage water in trench by sump pumping and using drainage layer, as defined in ASTM D 2321, placed on foundation beneath pipe bedding or thickened bedding layer of Class I material.
- M. Trench Conditions are defined with regard to stability of trench bottom and trench walls of pipe embedment zone. Maintain trench conditions that provide for effective placement and compaction of embedment material directly on or against undisturbed soils or foundation backfill, except where structural trench support is necessary.
 - 1. Dry Stable Trench: Stable and substantially dry trench conditions exist in pipe embedment zone as result of typically dry soils or achieved by ground water control (dewatering or depressurization) for trenches extending below ground water level.
 - 2. Stable Trench with Seepage: Stable trench in which ground water seepage is controlled by excavation drainage.
 - a. Stable Trench with Seepage in Clayey Soils: Excavation drainage is provided in lieu of or to supplement ground water control systems to control seepage and provide stable trench subgrade in predominately clayey soils prior to bedding placement.
 - b. Stable Wet Trench in Sandy Soils: Excavation drainage is provided in embedment zone in combination with ground water control in predominately sandy or silty soils.
 - c. Unstable Trench: Unstable trench conditions exist in pipe embedment zone if ground water inflow or high water content causes soil disturbances, such as sloughing, sliding, boiling, heaving or loss of density.
- N. Sub-trench: Sub-trench is special case of benched excavation. Sub-trench excavation below trench shields or shoring installations may be used to allow placement and compaction of foundation or embedment materials directly against undisturbed soils. Depth of sub-trench depends upon trench stability and safety as determined by Contractor.
- O. Trench Dam: Placement of low permeability material in pipe embedment zone or foundation to prohibit ground water flow along trench.
- P. Over-excavation and Backfill: Excavation of subgrade soils with unsatisfactory bearing capacity or composed of otherwise unsuitable materials below top of foundation as shown on Drawings, and backfilled with foundation backfill material.
- Q. Foundation Backfill Materials: Natural soil or manufactured aggregate of controlled gradation, and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill to provide stable support for bedding. Foundation backfill materials may include concrete seal slabs.
- R. Trench Safety Systems include both protective systems and shoring systems as defined in Division 31.
- S. Trench Shield (Trench Box): Portable worker safety structure moved along trench as work proceeds, used as protective system and designed to withstand forces imposed on it by cave-in,

thereby protecting persons within trench. Trench shields may be stacked if so designed or placed in series depending on depth and length of excavation to be protected.

- T. Shoring System: Structure that supports sides of an excavation to maintain stable soil conditions and prevent cave-ins, or to prevent movement of ground affecting adjacent installations or improvements.
- U. Special Shoring: Shoring system meeting special shoring as specified in Paragraph 1.08, Special Shoring Design Requirements, for locations identified on Drawings.

1.4 REFERENCES

- A. ASTM C 12 - Standard Practice for Installing Vitrified Clay Pipe Lines.
- B. ASTM D 558 - Standard Test Methods for Moisture-Density Relations of Soil Cement Mixtures.
- C. ASTM D 698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft).
- D. ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.
- E. ASTM D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications.
- F. ASTM D 2487 - Standard Classification of Soils for Engineering Purposes.
- G. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- H. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
- I. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- J. TxDOT Tex-101-E - Preparing Soil and Flexible Base Materials for Testing.
- K. TxDOT Tex-110-E - Particle Size Analysis of Soils.
- L. Federal Regulations, 29 CFR Part 1926, Standards-Excavation, Occupational Safety and Health Administration (OSHA).

1.5 SCHEDULING

- A. Schedule work so that pipe embedment can be completed on same day that acceptable foundation has been achieved for each section of pipe installation, manhole, or other structures.

1.6 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit planned typical method of excavation, backfill placement and compaction including:
 - 1. Trench widths.

2. Procedures for foundation and pipe zone bedding placement, and trench backfill compaction.
 3. Procedures for assuring compaction against undisturbed soil when pre-manufactured trench safety systems are proposed.
- C. Notify owner prior to beginning trenching work and allow sufficient time for owner to locate area.
 - D. Submit backfill material sources and product quality information in accordance with requirements of Division 31.
 - E. Submit trench excavation safety program in accordance with requirements of Division 31. Include designs for special shoring meeting requirements defined in Paragraph 1.08, Special Shoring Design Requirements contained herein.
 - F. Submit record of location of utilities as installed, referenced to survey control points. Include locations of utilities encountered or rerouted. Give stations, horizontal dimensions, elevations, inverts, and gradients.
 - G. Submit 11 inch by 17 inch or 12 inch by 18 inch copy of Drawing with plotted utility or obstruction location titled "Critical Location Report" to Owner's Representative.

1.7 TESTS

- A. Testing and analysis of backfill materials for soil classification and compaction during construction will be performed by an independent laboratory provided by Owner in accordance with requirements of Division 1 and as specified in this Section.
- B. Perform backfill material source qualification testing in accordance with requirements of Division 31.

1.8 SPECIAL SHORING DESIGN REQUIREMENTS

- A. Have special shoring designed or selected by Contractor's Professional Engineer to provide support for sides of excavations, including soils and hydrostatic ground water pressures as applicable, and to prevent ground movements affecting adjacent installations or improvements such as structures, pavements and utilities. Special shoring may be a pre-manufactured system selected by Contractor's Professional Engineer to meet project site requirements based on manufacturer's standard design.

PART 2 PRODUCTS

2.1 EQUIPMENT

- A. Perform excavation with hydraulic excavator or other equipment suitable for achieving requirements of this Section.
- B. Use only hand-operated tamping equipment until minimum cover of 12 inches is obtained over pipes, conduits, and ducts. Do not use heavy compacting equipment until adequate cover is attained to prevent damage to pipes, conduits, or ducts.
- C. Use trench shields or other protective systems or shoring systems which are designed and operated to achieve placement and compaction of backfill directly against undisturbed native soil.

- D. Use special shoring systems where required which may consist of braced sheeting, braced soldier piles and lagging, slide rail systems, or other systems meeting requirements as specified in Paragraph 1.08, Special Shoring Design Requirements.

2.2 MATERIAL CLASSIFICATIONS

- A. Embedment and Trench Zone Backfill Materials: Conform to classifications and product descriptions of Division 31.
- B. Concrete Backfill: Conform to requirements for Class B concrete as specified in Division 31.
- C. Geotextile (Filter Fabric): Conform to requirements of Division 1.
- D. Concrete for Trench Dams: Concrete backfill or 3 sack premixed (bag) concrete.
- E. Timber Shoring Left in Place: Untreated oak.

PART 3 EXECUTION

3.1 STANDARD PRACTICE

- A. Install flexible pipe, including "semi-rigid" pipe, to conform to standard practice described in ASTM D 2321, and as described in this Section. Where an apparent conflict occurs between standard practice and requirements of this Section, this Section governs.
- B. Install rigid pipe to conform to standard practice described in ASTM C 12, and as described in this Section. Where an apparent conflict occurs between standard practice and requirements of this Section, this Section governs.
- C. Classification of material will be determined by Owner's Representative.

3.2 PREPARATION

- A. Establish traffic control to conform to requirements of Division 1. Maintain barricades and warning lights for streets and intersections affected by Work, and are considered hazardous to traffic movements.
- B. Perform work to conform to applicable safety standards and regulations. Employ trench safety system as specified in Division 31.
- C. Immediately notify agency or company owning any existing utility line which is damaged, broken, or disturbed. Obtain approval from Owner's Representative and agency for any repairs or relocations, either temporary or permanent.
- D. Remove existing pavements and structures, including sidewalks and driveways, to conform to requirements of Division 2, as applicable.
- E. Install and operate necessary dewatering and surface-water control measures to conform to Division 1. Provide stable trench to allow installation in accordance with Specifications.
- F. Maintain permanent benchmarks, monumentation, and other reference points. Unless otherwise directed in writing, replace those which are damaged or destroyed in accordance with Division 1.

3.3 CRITICAL LOCATION INVESTIGATION

- A. Horizontal and vertical location of various underground lines shown on Drawings, including but not limited to water lines, gas lines, storm sewers, sanitary sewers, telecommunication lines, electric lines or power ducts, pipelines, concrete and debris, are based on best information available but are only approximate locations. At Critical Locations shown on Drawings, field verify horizontal and vertical locations of such lines within zone 2 feet vertically and 4 feet horizontally of proposed work.
 - 1. Verify location of existing utilities minimum of 7 working days in advance of pipe laying activities based on daily pipe laying rate. Use extreme caution and care when uncovering these lines.
 - 2. Notify Owner's Representative in writing immediately upon identification of obstruction. In event of failure to identify obstruction in minimum of 7 days, Contractor will not be entitled to extra cost for downtime including, but not limited to, payroll, equipment, overhead, demobilization and remobilization, until 7 days has passed from time Owner's Representative is notified of obstruction.
- B. Notify involved utility companies of date and time that investigation excavation will occur and request that their respective utility lines be marked in field. Comply with utility or pipeline company requirements that their representative be present during excavation. Provide Owner's Representative with 48 hours notice prior to field excavation or related work.
- C. Survey vertical and horizontal locations of obstructions relative to project baseline and datum and plot on 12 inch by 18 inch copy of Drawings. For large diameter water lines, submit to Owner's Representative for approval, horizontal and vertical alignment dimensions for connections to existing lines, tied into project baseline, signed and sealed by R.P.L.S.

3.4 PROTECTION

- A. Protect trees, shrubs, lawns, existing structures, and other permanent objects outside of grading limits and within grading limits as designated on Drawings, and in accordance with requirements of Division 1.
- B. Protect and support above-grade and below-grade utilities which are to remain.
- C. Restore damaged permanent facilities to pre-construction conditions unless replacement or abandonment of facilities is indicated on Drawings.
- D. Take measures to minimize erosion of trenches. Do not allow water to pond in trenches. Where slides, washouts, settlements, or areas with loss of density or pavement failures or potholes occur, repair, recompact, and pave those areas at no additional cost to the Owner.

3.5 EXCAVATION

- A. Except as otherwise specified or shown on Drawings, install underground utilities in open cut trenches with vertical sides.
- B. Perform excavation work so that pipe, conduit, and ducts can be installed to depths and alignments shown on Drawings. Avoid disturbing surrounding ground and existing facilities and improvements.
- C. Determine trench excavation widths using following schedule as related to pipe outside diameter (O.D.).

Nominal Pipe Size, Inches	Minimum Trench Width, Inches
Less than 18	O.D. + 24
18 to 30	O.D. + 24
36 to 42	O.D. + 36
<u>Greater than 42</u>	<u>O.D. + 48</u>

- D. Use sufficient trench width or benches above embedment zone for installation of well point headers or manifolds and pumps where depth of trench makes it uneconomical or impractical to pump from surface elevation. Provide sufficient space between shoring cross braces to permit equipment operations and handling of forms, pipe, embedment and backfill, and other materials.

- E. Upon discovery of unknown utilities, badly deteriorated utilities not designated for removal, or concealed conditions, discontinue work at that location. Notify Owner’s Representative and obtain instructions before proceeding.

- F. Shoring of Trench Walls.
 - 1. Install Special Shoring in advance of trench excavation or simultaneously with trench excavation, so that soils within full height of trench excavation walls will remain laterally supported at all times.
 - 2. For all types of shoring, support trench walls in pipe embedment zone throughout installation. Provide trench wall supports sufficiently tight to prevent washing trench wall soil out from behind trench wall support.
 - 3. Leave sheeting driven into or below pipe embedment zone in place to preclude loss of support of foundation and embedment materials, unless otherwise directed by Owner’s Representative. Leave rangers, walers, and braces in place as long as required to support sheeting, which has been cut off, and trench wall in vicinity of pipe zone.
 - 4. Employ special methods for maintaining integrity of embedment or foundation material. Before moving supports, place and compact embedment to sufficient depths to provide protection of pipe and stability of trench walls. As supports are moved, finish placing and compacting embedment.
 - 5. If sheeting or other shoring is used below top of pipe embedment zone, do not disturb pipe foundation and embedment materials by subsequent removal. Maximum thickness of removable sheeting extending into embedment zone shall be equivalent of 1-inch-thick steel plate. As sheeting is removed, fill in voids left with grouting material.

- G. Use of Trench Shields. When trench shield (trench box) is used as worker safety device, the following requirements apply:
 - 1. Make trench excavations of sufficient width to allow shield to be lifted or pulled freely, without damage to trench sidewalls.
 - 2. Move trench shields so that pipe, and backfill materials, after placement and compaction, are not damaged nor disturbed, nor degree of compaction reduced. Re-compact after shield is moved if soil is disturbed.

3. When required, place, spread, and compact pipe foundation and bedding materials beneath shield. For backfill above bedding, lift shield as each layer of backfill is placed and spread. Place and compact backfill materials against undisturbed trench walls and foundation.
 4. Maintain trench shield in position to allow sampling and testing to be performed in safe manner.
 5. Conform to applicable Government regulations.
- H. Voids under or damages to paving area outside shield caused by Contractor's work will require removal of pavement, consolidation and replacement of pavement in accordance with Contract Documents. Repair damage resulting from failure to provide adequate supports. Contractor is responsible for all cost associated with the repairs.
- I. Place sand or soil behind shoring or trench shield to prevent soil outside shoring from collapsing and causing voids under pavement. Immediately pack suitable material in outside voids following excavation to avoid caving of trench walls.
- J. Coordinate excavation within 15 feet of pipeline with company's representative. Support pipeline with methods agreed to by pipeline company's representative. Use small, rubber-tired excavator, such as backhoe, to do exploratory excavation. Bucket that is used to dig in close proximity to pipelines shall not have teeth or shall have guard installed over teeth to approximate bucket without teeth. Excavate by hand within 1 foot of Pipeline Company's line. Do not use larger excavation equipment than normally used to dig trench in vicinity of pipeline until pipelines have been uncovered and fully exposed. Do not place large excavation and hauling equipment directly over pipelines unless approved by Pipeline Company's representative.
- K. When, during excavation to uncover pipeline company's pipelines, screwed collar or an oxy-acetylene weld is exposed, immediately notify Owner's Representative. Provide supports for collar or welds. Discuss with Pipeline Company's representative and determine methods of supporting collar or weld during excavation and later backfilling operations. When collar is exposed, request Pipeline Company to provide welder in a timely manner to weld ends of collar prior to backfilling of excavation.

3.6 HANDLING EXCAVATED MATERIALS

- A. Use only excavated materials, which are suitable as defined in this Section and conforming to Division 31. Place material suitable for backfilling in stockpiles at distance from trench to prevent slides or cave-ins.
- B. When required, provide additional backfill material conforming to requirements of Division 31.
- C. Do not place stockpiles of excess excavated materials on streets and adjacent properties. Protect backfill material to be used on site. Maintain site conditions in accordance with Division 1. Excavate trench so that pipe is centered in trench. Do not obstruct sight distance for vehicles utilizing roadway or detours with stockpiled materials.

3.7 TRENCH FOUNDATION

- A. Excavate bottom of trench to uniform grade to achieve stable trench conditions and satisfactory compaction of foundation or bedding materials.

- B. When wet soil is encountered on trench bottom and dewatering system is not required, over excavate an additional 6 inches with approval by Owner's Representative. Place non-woven geotextile fabric and then compact 12 inches of crushed stone in one lift on top of fabric. Compact crushed stone with four passes of vibratory-type compaction equipment.
- C. Perform over excavation, if directed by Owner's Representative, in accordance with Paragraph 3.07B above. Removal of unstable or unsuitable material may be required if approved by Owner's Representative:
 - 1. Even though Contractor has not determined material to be unsuitable, or
 - 2. If unstable trench bottom is encountered and an adequate ground water control system is installed and operating according to Division 1.
- D. Place trench dams in Class I foundations in line segments longer than 100 feet between manholes and not less than one in every 500 feet of pipe placed. Install additional dams as needed to achieve workable construction conditions. Do not place trench dams closer than 5 feet from manholes.

3.8 PIPE EMBEDMENT, PLACEMENT, AND COMPACTION

- A. Remove loose, sloughing, caving, or otherwise unsuitable soil from bottoms and sidewalls of trenches immediately prior to placement of embedment materials.
- B. Place embedment including bedding, haunching, and initial backfill as shown on Drawings.
- C. For pipe installation, manually spread embedment materials around pipe to provide uniform bearing and side support when compacted. Protect flexible pipe from damage during placing of pipe zone bedding material. Perform placement and compaction directly against undisturbed soils in trench sidewalls, or against sheeting which is to remain in place.
- D. Do not place trench shields or shoring within height of embedment zone unless means to maintain density of compacted embedment material are used. If moveable supports are used in embedment zone, lift supports incrementally to allow placement and compaction of material against undisturbed soil.
- E. Place geotextile to prevent particle migration from in-situ soil into open-graded (Class I) embedment materials or drainage layers.
- F. Do not damage coatings or wrappings of pipes during backfilling and compacting operations. When embedding coated or wrapped pipes, do not use crushed stone or other sharp, angular aggregates.
- G. Place haunching material manually around pipe and compact it to provide uniform bearing and side support. If necessary, hold small-diameter or lightweight pipe in place during compaction of haunch areas and placement beside pipe with sand bags or other suitable means.
- H. Place electrical conduit, if used, directly on foundation without bedding.
- I. Shovel in-place and compact embedment material using pneumatic tampers in restricted areas, and vibratory-plate compactors or engine-powered jumping jacks in unrestricted areas. Compact each lift before proceeding with placement of next lift. Water tamping is not allowed.

- J. For water lines construction embedment, use bank run sand, concrete sand, gem sand, pea gravel, or crushed limestone as specified in Division 31. For water lines adhere to the following subparagraph numbers 1 and 2; for utility installation other than water, adhere to numbers 3 and 4 below:
1. Class I, II and III Embedment Materials:
 - a. Maximum 6 inches compacted lift thickness.
 - b. Compact to achieve minimum of 95 percent of maximum dry density as determined according to ASTM D 698.
 - c. Moisture content to be within -3 percent to +5 percent of optimum as determined according to ASTM D 698, unless otherwise approved by Owner's Representative.
 2. Cement Stabilized Sand (where required for special installations):
 - a. Maximum 6 inches compacted thickness.
 - b. Compact to achieve minimum of 95 percent of maximum dry density as determined according to ASTM D 698.
 - c. Moisture content to be on dry side of optimum as determined according to ASTM D 698 but sufficient for effective hydration.
 3. Class I Embedment Materials.
 - a. Maximum 6-inches compacted lift thickness.
 - b. Systematic compaction by at least two passes of vibrating equipment. Increase compaction effort as necessary to effectively embed pipe to meet deflection test criteria.
 - c. Moisture content as determined by Contractor for effective compaction without softening soil of trench bottom, foundation or trench walls.
 4. Class II Embedment and Cement Stabilized Sand.
 - a. Maximum 6-inches compacted thickness.
 - b. Compaction by methods determined by Contractor to achieve minimum of 95 percent of maximum dry density as determined according to ASTM D 698 for Class II materials and according to ASTM D 558 for cement stabilized materials.
 - c. Moisture content of Class II materials within 3 percent of optimum as determined according to ASTM D 698. Moisture content of cement stabilized sands on dry side of optimum as determined according to ASTM D 558 but sufficient for effective hydration.
- K. Place trench dams in Class I embedment in line segments longer than 100 feet between manholes, and not less than one in every 500 feet of pipe placed. Install additional dams as needed to achieve workable construction conditions. Do not place trench dams closer than 5 feet from manholes.

3.9 TRENCH ZONE BACKFILL PLACEMENT AND COMPACTION

- A. Place backfill for pipe or conduits and restore surface as soon as practicable. Leave only minimum length of trench open as necessary for construction.
- B. For water lines, backfill in trench zone, including auger pits, intermediate and site pits, with bank run sand, select fill, or random backfill material as specified in Division 31.
- C. For sewer pipes, use backfill materials described by trench limits. For "trench zone backfill" under pavement and to within one foot back of curb, use cement stabilized sand to level 12 inches below the pavement. For sewer pipes under natural ground backfill from 12 inches above top of pipe to 6" inches below finish grade with suitable on-site material or select backfill. Use select backfill for rigid pavements or flexible base material for asphalt pavements for 12- inch backfill directly under pavement. Use topsoil for 6-inch backfill directly under natural grade. For backfill materials reference Division 31.

- D. Where damage to completed pipe installation work is likely to result from withdrawal of sheeting, leave sheeting in place. Cut off sheeting 1.5 feet or more above crown of pipe. Remove trench supports within 5 feet from ground surface.
- E. When shown on Drawings, random backfill of suitable material may be used in trench zone for trench excavations outside pavements.
- F. Place trench zone backfill in lifts and compact. Fully compact each lift before placement of next lift.
 - 1. Class I, II, III or IV or combination thereof (Random Backfill):
 - a. Maximum 9-inches compacted lift thickness.
 - b. Compact by vibratory equipment to minimum of 95 percent of maximum dry density determined according to ASTM D 698.
 - c. Moisture content within zero percent to +5 percent of optimum determined according to ASTM D 698, unless otherwise approved by Owner's Representative.
 - 2. Cement-Stabilized Sand:
 - a. Maximum lift thickness determined by Contractor to achieve uniform placement and required compaction, but do not exceed 12 inches.
 - b. Compact by vibratory equipment to minimum of 95 percent of maximum dry density determined according to ASTM D 558.
 - c. Moisture content on dry side of optimum determined according to ASTM D 558 but sufficient for cement hydration.
 - 3. Select Backfill:
 - a. Place in maximum 8-inch loose layers.
 - b. Compaction by equipment providing tamping or kneading impact to minimum of 95 percent of maximum dry density determined according to ASTM D 698.
 - c. Moisture content within 2 percent below or 5 percent above optimum determined according to ASTM D 698, unless approved by Owner's Representative.
- G. Unless otherwise shown on Drawings, for trench excavations not under pavement, random backfill of suitable material may be used in trench zone.
 - 1. Fat clays (CH) may be used as trench zone backfill outside paved areas at Contractor's option. When required density is not achieved, at no additional cost to Owner, rework, dry out, use lime stabilization or other approved methods to achieve compaction requirements, or use different suitable material.
 - 2. Maximum 9-inch compacted lift thickness for clayey soils and maximum 12-inch lift thickness for granular soils.
 - 3. Compact to minimum of 90 percent of maximum dry density determined according to ASTM D 698.
 - 4. Moisture content as necessary to achieve density.
- H. For electric conduits, remove form work used for construction of conduits before placing trench zone backfill.

3.10 MANHOLES, INLETS, JUNCTION BOXES AND OTHER PIPELINE STRUCTURES

- A. Meet requirements of adjoining utility installations for backfill of pipeline structures, as shown on Drawings.

- B. Below paved areas, encapsulate structure with cement stabilized sand; minimum of 1 foot below base, minimum 2 foot around walls, up to within 12 inches of pavement subgrade. Compact in accordance with Paragraph 3.9.F.2 of this Section. Use select backfill for rigid pavements or flexible base material for asphalt pavements for 12- inch backfill directly under pavement.
- C. In unpaved areas, encapsulate structure with cement stabilized sand; minimum of 1 foot below base, minimum 2 foot around walls, up to within 12 inches of finish grade. Compact in accordance with Paragraph 3.9.F.2 of this Section. Use suitable on-site material and topsoil for the 12-inch backfill directly under natural ground.

3.11 FIELD QUALITY CONTROL.

- A. Test for material source qualifications as defined in Division 1.
- B. Provide excavation and trench safety systems at locations and to depths required for testing and retesting during construction at no additional cost to Owner.
- C. Tests will be performed on minimum of three different samples of each material type for plasticity characteristics, in accordance with ASTM D 4318, and for gradation characteristics, in accordance with Tex-101-E and Tex-110-E. Additional classification tests will be performed whenever there is noticeable change in material gradation or plasticity, or when requested by Owner's Representative.
- D. At least three tests for moisture-density relationships will be performed initially for backfill materials in accordance with ASTM D 698, and for cement- stabilized sand in accordance with ASTM D 558. Perform additional moisture-density relationship tests once a month or whenever there is noticeable change in material gradation or plasticity.
- E. In-place density tests of compacted pipe foundation, embedment and trench zone backfill soil materials will be performed according to ASTM D 1556, or ASTM D 2922 and ASTM D 3017, and at following frequencies and conditions.
 - 1. For open cut construction projects and auger pits: Unless otherwise approved by Owner's Representative, successful compaction to be measured by one test per 40 linear feet measured along pipe for compacted embedment and two tests per 40 linear feet measured along pipe for compacted trench zone backfill material. Length of auger pits to be measured to arrive at 40 linear feet.
 - 2. A minimum of three density tests for each full shift of Work.
 - 3. Density tests will be distributed among placement areas. Placement areas are: foundation, bedding, haunching, initial backfill and trench zone.
 - 4. The number of tests will be increased if inspection determines that soil type or moisture content are not uniform or if compacting effort is variable and not considered sufficient to attain uniform density, as specified.
 - 5. Density tests may be performed at various depths below fill surface by pit excavation. Material in previously placed lifts may therefore be subject to acceptance/rejection.
 - 6. Two verification tests will be performed adjacent to in-place tests showing density less than acceptance criteria. Placement will be rejected unless both verification tests show acceptable results.
 - 7. Recompact placement will be retested at same frequency as first test series, including verification tests.
 - 8. Identify elevation of test with respect to natural ground or pavement.
- F. Recondition, recompact, and retest at Contractor's expense if tests indicate Work does not meet specified compaction requirements. For hardened soil cement with nonconforming density, core and test for compressive strength at Contractor's expense.

- G. Acceptability of crushed rock compaction will be determined by inspection.

3.12 DISPOSAL OF EXCESS MATERIAL

- A. Dispose of excess materials in accordance with requirements of Division 1.

END OF SECTION

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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.

END OF SECTION 31 50 00

31 50 00 - 5 EXCAVATION SUPPORT AND PROTECTION

SECTION 31 63 29 - DRILLED CONCRETE PIERS AND SHAFTS

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. Dry-installed drilled piers.
 - 2. Slurry displacement-installed drilled piers.
 - 3. Dry-installed or slurry displacement-installed drilled piers at Contractor's choice.

1.3 UNIT PRICES

- A. Unit prices are included in Section 01 22 00 "Unit Prices."
- B. Drilled Piers: Actual net volume of drilled piers in place and approved. Actual length, shaft diameter, and bell diameter if applicable, may vary, to coincide with elevations where satisfactory bearing strata are encountered. These dimensions may also vary with actual bearing value of bearing strata determined by an independent testing and inspecting agency. Adjustments will be made on net variation of total quantities, based on design dimensions for shafts and bells.
 - 1. Base bids on indicated number of drilled piers and, for each pier, the design length from top elevation to bottom of shaft, extended through the bell, if applicable, and the diameter of shaft and bell.
 - 2. Unit prices include labor, materials, tools, equipment, and incidentals required for excavation, trimming, shoring, casings, dewatering, reinforcement, concrete fill, testing and inspecting, and other items for complete drilled-pier installation.
- C. Trial Drilled Pier: Unit price as indicated for drilled pier, including backfilling.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Shop Drawings: For concrete reinforcement detailing fabricating, bending, supporting, and placing.

- D. Material Certificates: For the following, from manufacturer:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Steel reinforcement and accessories.
- E. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
- F. Field quality-control reports.
- G. Other Informational Submittals:
 - 1. Record drawings.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer that has specialized in drilled-pier work.
- B. Testing Agency Qualifications: Qualified according to ASTM C 1077, ASTM D 3740, and ASTM E 329 for testing indicated.
- C. Drilled-Pier Standard: Comply with ACI 336.1 unless modified in this Section.

1.6 PROJECT CONDITIONS

- A. Existing Utilities: Locate existing underground utilities before excavating drilled piers. If utilities are to remain in place, provide protection from damage during drilled-pier operations.
 - 1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, adapt drilling procedure if necessary to prevent damage to utilities. Cooperate with Owner and utility companies in keeping services and facilities in operation without interruption. Repair damaged utilities to satisfaction of utility owner.
- B. Interruption of Existing Utilities: Do not interrupt any utility to 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 affected 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.
- C. 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 this data.
 - 1. Make additional test borings and conduct other exploratory operations necessary for drilled piers.
 - 2. The geotechnical report is referenced elsewhere in the Project Manual.
- D. Survey Work: Engage a qualified land surveyor or professional engineer to perform surveys, layouts, and measurements for drilled piers. Before excavating, lay out each drilled pier to lines

and levels required. Record actual measurements of each drilled pier's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.

1. Record and maintain information pertinent to each drilled pier and cooperate with Owner's testing and inspecting agency to provide data for required reports.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Refer Section 03 20 00.

2.2 CONCRETE MATERIALS

- A. Refer Section 03 30 00 and Structural General Notes.

2.3 STEEL CASINGS

- A. Steel Pipe Casings: ASTM A 283, Grade C, or ASTM A 36, carbon-steel plate, with joints full-penetration welded according to AWS D1.1.
- B. Corrugated-Steel Pipe Casings: ASTM A 929, steel sheet, zinc coated.

2.4 CONCRETE MIXTURES

- 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.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland cement according to ACI 301 limits as if concrete were exposed to deicing chemicals.
- C. Proportion normal-weight concrete mixture as follows:
 1. As indicated in Structural General Notes.

2.5 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.6 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, 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 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled-pier operations.

3.2 EXCAVATION

- A. **Unclassified Excavation:** Excavate to bearing elevations regardless of character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions.
 - 1. **Obstructions:** Unclassified excavation may include removal of unanticipated boulders, concrete, masonry, or other subsurface obstructions. No changes in the Contract Sum or the Contract Time will be authorized for removal of obstructions.
 - 2. **Obstructions:** Unclassified excavated materials may include removal of unanticipated boulders, concrete, masonry, or other subsurface obstructions. Payment for removing obstructions that cannot be removed by conventional augers fitted with soil or rock teeth, drilling buckets, or underreaming tools attached to drilling equipment of size, power, torque, and downthrust necessary for the Work will be according to Contract provisions for changes in the Work.
- B. Prevent surface water from entering excavated shafts. Conduct water to site drainage facilities.
- C. Excavate shafts for drilled piers to indicated elevations. Remove loose material from bottom of excavation.
 - 1. Excavate bottom of drilled piers to level plane within 1:12 tolerance.
 - 2. Remove water from excavated shafts before concreting.
- D. Notify and allow testing and inspecting agency to test and inspect bottom of excavation. If unsuitable bearing stratum is encountered, make adjustments to drilled piers as determined by Architect.
 - 1. Do not excavate shafts deeper than elevations indicated unless approved by Architect.
 - 2. Payment for additional authorized excavation will be according to Contract provisions for changes in the Work.
- E. Excavate shafts for closely spaced drilled piers and for drilled piers occurring in fragile or sand strata only after adjacent drilled piers are filled with concrete and allowed to set.
- F. **Temporary Casings:** Install watertight steel casings of sufficient length and thickness to prevent water seepage into shaft; to withstand compressive, displacement, and withdrawal stresses; and to maintain stability of shaft walls.
 - 1. Remove temporary casings, maintained in plumb position, during concrete placement and before initial set of concrete.
- G. **Bells:** Excavate bells for drilled piers to shape, base thickness, and slope angle indicated. Excavate bottom of bells to level plane and remove loose material before placing concrete.
- H. **Tolerances:** Construct drilled piers to remain within ACI 336.1 tolerances.

1. If location or out-of-plumb tolerances are exceeded, provide corrective construction. Submit design and construction proposals to Architect for review before proceeding.

3.3 STEEL REINFORCEMENT

- A. Comply with recommendations in CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with concrete.
- C. Fabricate and install reinforcing cages symmetrically about axis of shafts in a single unit.
- D. Accurately position, support, and secure reinforcement against displacement during concreting. Maintain minimum cover over reinforcement.
- E. Use templates to set anchor bolts, leveling plates, and other accessories furnished in work of other Sections. Provide blocking and holding devices to maintain required position during final concrete placement.
- F. Protect exposed ends of extended reinforcement, dowels, or anchor bolts from mechanical damage and exposure to weather.

3.4 CONCRETE PLACEMENT

- A. Place concrete in continuous operation and without segregation immediately after inspection and approval of shaft by Owner's independent testing and inspecting agency.
 1. Construct a construction joint if concrete placement is delayed more than one hour. Level top surface of concrete. Before placing remainder of concrete, clean surface laitance, roughen, and slush concrete with commercial bonding agent or with sand-cement grout mixed at ratio of 1:1.
- B. Dry Method: Place concrete to fall vertically down the center of drilled pier without striking sides of shaft or steel reinforcement.
 1. Where concrete cannot be directed down shaft without striking reinforcement, place concrete with chutes, tremies, or pumps.
 2. Vibrate top 60 inches of concrete.
- C. Coordinate withdrawal of temporary casings with concrete placement to maintain at least a 60-inch head of concrete above bottom of casing.
 1. Vibrate top 60 inches of concrete after withdrawal of temporary casing.
- D. Screed concrete at cutoff elevation level and apply scoured, rough finish. Where cutoff elevation is above the ground elevation, form top section above grade and extend shaft to required elevation.
- E. Protect concrete work, according to ACI 301, from frost, freezing, or low temperatures that could cause physical damage or reduced strength.

1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 2. Do not use calcium chloride, salt, or other mineral-containing antifreeze agents or chemical accelerators.
- F. If hot-weather conditions exist that would seriously impair quality and strength of concrete, place concrete according to ACI 301 to maintain delivered temperature of concrete at no more than 90 deg F.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
1. Drilled piers.
 2. Excavation.
 3. Concrete.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Drilled-Pier Tests and Inspections: For each drilled pier, before concrete placement.
1. Soil Testing: Bottom elevations, bearing capacities, and lengths of drilled piers indicated have been estimated from available soil data. Actual elevations and drilled-pier lengths and bearing capacities will be determined by testing and inspecting agency. Final evaluations and approval of data will be determined by Architect.
- D. Concrete Tests and Inspections: ASTM C 172 except modified for slump to comply with ASTM C 94.
1. Slump: ASTM C 143; one test at point of placement for each compressive-strength test but no fewer than one test for each concrete load.
 2. Concrete Temperature: ASTM C 1064; 1 test hourly when air temperature is 40 deg F and below and 80 deg F and above, and 1 test for each set of compressive-strength specimens.
 3. Compression Test Specimens: ASTM C 31; one set of four standard 6-inch x 12-inch cylinders for each compressive-strength test unless otherwise indicated. Mold and store cylinders for laboratory-cured test specimens unless field-cured test specimens are required.
 4. Compressive-Strength Tests: ASTM C 39; one set for each drilled pier but not more than one set for each truck load. One specimen will be tested at 7 days, 2 specimens will be tested at 28 days, and 1 specimen will be retained in reserve for later testing if required.
 5. If frequency of testing will provide fewer than five strength tests for a given class of concrete, testing will be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 6. If strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

8. Report test results in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. List Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests in reports of compressive-strength tests.
 9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 10. Additional Tests: Testing and inspecting agency will make additional tests of concrete if test results indicate that slump, compressive strengths, or other requirements have not been met, as directed by Architect.
 - a. Continuous coring of drilled piers may be required, at Contractor's expense, if temporary casings have not been withdrawn within specified time limits or if observations of placement operations indicate deficient concrete quality, presence of voids, segregation, or other possible defects.
 11. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.
 12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- E. An excavation, concrete, or a drilled pier will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports for each drilled pier as follows:
1. Actual top and bottom elevations.
 2. Actual drilled-pier diameter at top, bottom, and bell.
 3. Top of rock elevation.
 4. Description of soil materials.
 5. Description, location, and dimensions of obstructions.
 6. Final top centerline location and deviations from requirements.
 7. Variation of shaft from plumb.
 8. Shaft excavating method.
 9. Design and tested bearing capacity of bottom.
 10. Levelness of bottom and adequacy of cleanout.
 11. Ground-water conditions and water-infiltration rate, depth, and pumping.
 12. Description, purpose, length, wall thickness, diameter, tip, and top and bottom elevations of temporary or permanent casings. Include anchorage and sealing methods used and condition and weather tightness of splices if any.
 13. Description of soil or water movement, sidewall stability, loss of ground, and means of control.
 14. Bell dimensions and variations from original design.
 15. Date and time of starting and completing excavation.
 16. Inspection report.
 17. Condition of reinforcing steel and splices.
 18. Position of reinforcing steel.
 19. Concrete placing method, including elevation of consolidation and delays.
 20. Elevation of concrete during removal of casings.
 21. Locations of construction joints.
 22. Concrete volume.
 23. Concrete testing results.

24. Remarks, unusual conditions encountered, and deviations from requirements.

3.6 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 31 63 29

SECTION 32 11 13.13

LIME-TREATED SUBGRADES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Foundation course of lime stabilized natural subgrade material.

1.2 MEASUREMENT AND PAYMENT

- A. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ASTM D698 - Tests for Moisture-Density Relations of Soils and Soil-Aggregate Mixture Using 5.5 lb Rammer and 12 inch Drop.
- B. ASTM D1140 - Method of Test for Amount of Material in Soils Finer than the No. 200 Sieve.
- C. ASTM D1556 - Density of Soil in Place by the Sand-Cone Method.
- D. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- E. ASTM D3017 - Test Method for Moisture Content of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth).
- F. ASTM D4318 - Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- G. TxDOT Tex-600-J - Lime Testing Procedure.
- H. Geotechnical Engineering Soils Report.

1.4 SUBMITTALS

- A. Submittals shall conform to requirements of Division 1.
- B. Submit certificates stating that hydrated lime, quicklime, or commercial lime slurry complies with these specifications.
- C. Submit weight tickets, certified by supplier, with each bulk delivery of lime to work site.
- D. Submit manufacturer's description and characteristics for rotary speed mixer and compaction equipment for approval.

1.5 TESTS

- A. Testing will be performed under provisions of Section - Testing Laboratory Services.
- B. Tests and analysis of soil materials will be performed in accordance with ASTM D4318.

- C. Sampling and testing of lime slurry shall be in accordance with Tex-600-J.
- D. Sample mixtures of hydrated lime or quicklime in slurry form will be tested to establish compliance with specifications.
- E. Soil will be evaluated to establish percent of hydrated lime, quicklime, or lime slurry to be applied to sub grade material.
- F. Moisture-density relationship will be established on material sample from roadway, after stabilization with lime, in accordance with ASTM D698.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Bagged lime shall bear manufacturer's name, product identification, and certified weight. Bags varying more than 5 percent of certified weight may be rejected; average weight of 50 random bags in each shipment shall not be less than certified weight.
- B. Store lime in weatherproof enclosures. Protect lime from ground dampness.
- C. Quicklime can be dangerous; exercise extreme caution if used for the Work. Contractor shall become informed about recommended precautions in the handling, storage and use of quicklime.

PART 2 PRODUCTS

2.1 WATER

- A. Water shall be clean; clear; and free from oil, acids, alkali, or vegetable matter.

2.2 LIME

- A. Type A - Hydrated lime: Dry material consisting essentially of calcium hydroxide or mixture of calcium hydroxide and an allowable percentage of calcium oxide and magnesium hydroxide.
- B. Type B - Commercial lime slurry: Liquid mixture consisting essentially of lime solids and water in slurry form. Water or liquid portion shall not contain dissolved material in sufficient quantity to be injurious or objectionable for purpose intended.
- C. Type C - Quicklime: Dry material consisting essentially of calcium oxide. Furnish quicklime in either of the following grades:
 - 1. Grade DS: Pebble quicklime of a gradation suitable for use in the preparation of a slurry for wet placing.
 - 2. Grade S: Finely-graded quicklime for use in the preparation of slurry for wet placing. Do not use grade S quicklime for dry placing.
- D. Lime shall conform to requirements of Item 260 of the 1993 Texas Department of Transportation Standard Specifications.
- E. Lime slurry may be delivered to the job site as commercial lime, or may be prepared at the job site by using hydrated lime or quicklime. The slurry shall be free of liquids other than water and shall be of a consistency that can be handled and uniformly applied without difficulty.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify compacted sub grade is ready to support imposed loads.
- B. Verify sub grade lines and grades are correct.

3.2 PREPARATION

- A. Complete backfill of new utilities below future grade.
- B. Cut material to bottom of sub grade using an approved cutting and pulverizing machine meeting following requirements:
 - 1. Cutters accurately provide a smooth surface over entire width of cut to plane of secondary grade.
 - 2. Visible indication that cut is to proper depth.
- C. Alternatively, scarify or excavate to bottom of stabilized sub grade. Remove material or windrow to expose secondary grade. Correct wet or unstable material below secondary grade by scarifying, adding lime, and compacting. Obtain uniform stability.

3.3 LIME SLURRY APPLICATION

- A. Mix hydrated lime or quicklime with water to form a slurry of the solids content specified. Commercial lime slurry shall have dry solids content as specified. Conform to cautionary requirements of Paragraph 1.06C concerning use of quicklime.
- B. Apply slurry with a distributor truck equipped with an agitator to keep lime and water in a consistent mixture. Make successive passes over measured section of roadway to attain proper moisture and lime content. Limit spreading to an area where preliminary mixing operations can be completed on the same working day.
- C. Apply so that dry sub grade will contain a minimum lime content of 7 percent by weight of dry sub grade unless otherwise instructed by Testing Laboratory.

3.4 PRELIMINARY MIXING

- A. Do not mix and place material when temperature is below 40 degrees F and falling. Base may be placed when temperature taken in shade and away from artificial heat is above 35 degrees F and rising.
- B. Use approved single-pass or multiple-pass rotary speed mixers to mix soil, lime, and water to required depth. Obtain a homogeneous friable mixture free of clods and lumps.
- C. Shape mixed sub grade to final lines and grades.
- D. Eliminate following operations and final mixing if pulverization requirements of Paragraph 3.05C can be met during preliminary mixing:
 - 1. Seal sub grade as a precaution against heavy rainfall by rolling lightly with light pneumatic rollers.
 - 2. Cure soil-lime material for 1 to 4 days. Keep sub grade moist during cure.

3.5 FINAL MIXING

- A. Use approved single-pass or multiple-pass rotary speed mixers to uniformly mix cured soil and lime to required depth.
- B. Add water to bring moisture content of soil mixture to a minimum of optimum or above.
- C. Mix and pulverize until all material passes a 1-3/4-inch sieve; a minimum of 85 percent, excluding nonslacking fractions, passes a 3/4-inch sieve; and a minimum of 60 percent excluding nonslacking fractions passes a No. 4 sieve.
- D. Shape mixed sub grade to final lines and grades.
- E. Do not expose hydrated lime to open air for 6 hours or more during interval between application and mixing. Avoid excessive hydrated lime loss due to washing or blowing.

3.6 COMPACTION

- A. Aerate or sprinkle to attain optimum moisture content as determined by Testing Laboratory. Remove and reconstruct sections where average moisture content exceeds ranges specified at time of final compaction.
- B. Start compaction immediately after final mixing, unless approved by Engineer.
- C. Spread and compact in two or more approximately equal layers where total compacted thickness is to be greater than 8 inches.
- D. Compact with approved heavy pneumatic or vibrating rollers, or a combination of tamping rollers and light pneumatic rollers. Begin compaction at the bottom and continue until entire depth is uniformly compacted.
- E. Do not allow stabilized base to mix with underlying material. Correct irregularities or weak spots immediately by replacing material and recompacting.
- F. Compact to following minimum densities at a moisture content of optimum to 3 percent above optimum as determined by ASTM D698, unless otherwise indicated on the Drawings:
 - 1. Areas to receive pavement without subsequent base course: Minimum density of 98 percent of maximum dry density.
 - 2. Areas to receive subsequent base course: Minimum density of 95 percent of maximum dry density.
- G. Seal with approved light pneumatic tired rollers: Prevent surface hair line cracking. Rework and recompact at areas where hair line cracking develops.

3.7 CURING

- A. Moist cure for a minimum of 3 days before placing base or surface course, or opening to traffic. Time may be adjusted as approved by Engineer. Sub grade may be opened to traffic after 2 days if adequate strength has been attained to prevent damage. Restrict traffic to light pneumatic rollers or vehicles weighing less than 10 tons.
- B. Keep sub grade surface damp by sprinkling. Roll with light pneumatic roller to keep surface knit together.
- C. Place base, surface, or seal course within 14 days after final mixing and compaction unless prior approval is obtained from the Engineer.

3.8 TOLERANCES

- A. Completed surface shall be smooth and conform to typical section and established lines and grades.
- B. Top of compacted surface: Plus or minus 1/4 inch in cross section or in 16 foot length.

3.9 FIELD QUALITY CONTROL

- A. Testing will be performed under provisions of Section - Testing Laboratory Services.
- B. A minimum of one phenolphthalein test will be made at random locations per 1000 linear feet per lane of roadway or 500 square yards of base to determine in-place depth.
- C. Contractor may, at his own expense, request additional cores in the vicinity of cores indicating nonconforming in-place depths. If the average of the tests falls below the required depth, place and compact additional material at no cost to the Owner.
 - 1. Compaction Testing will be performed in accordance with ASTM D1556 or ASTM D2922 and ASTM D3017 at random locations near depth determination tests. Rework and recompact areas that do not conform to compaction requirements at no cost to the Owner.
- D. Fill test sections with new compacted lime stabilized sub grade.

3.10 PROTECTION

- A. Maintain stabilized sub grade to lines and grades and in good condition until placement of base or surface course. Protect the asphalt membrane, if used, from being picked up by traffic.
- B. Repair defects immediately by replacing material to full depth.

END OF SECTION

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SECTION 32 11 29.13

LIME-FLY ASH-TREATED BASE COURSES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Foundation course of lime/fly ash stabilized sub grade material.
 - 1. Application of lime slurry and fly ash to sub grade.
 - 2. Mixing, compaction, and curing of lime, slurry, fly ash, water and sub grade into a stabilized foundation.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Measurement for lime stabilized subgrade, when included in the Bid Form, is on a square yard basis. Separate measurement will be made for each different required thickness of base course.
 - 2. Measurement for hydrated lime and quicklime, when included in the Bid Form, is by the ton of 2,000 pounds dry-weight basis.
 - 3. Measurement for commercial lime slurry, when included in the Bid Form, is by the ton of 2,000 pounds of lime calculated on the percentage by weight of dry solids for the grade of slurry.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.3 DEFINITIONS

- A. Moist Cure: Curing soil lime/fly ash material to obtain optimum hydration.
- B. 1000-Foot Roadway Section: 1000 feet per lane width or approximately 500 square yards of compacted sub grade for other than full-lane-width roadway sections.

1.4 REFERENCES

- A. ASTM C 618 - Standard Specification for Coal Fly Ash and Raw or Calcinated Natural Pozzolan for use as Mineral Admixture in Portland Cement Concrete.

1.5 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit certification that fly ash, hydrated lime, quicklime, or commercial lime slurry complies with these specifications.
- C. Submit weight tickets, certified by supplier, with each bulk delivery of materials to work site.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Conform to requirements of Division 2.
- B. Quicklime can be dangerous; exercise extreme caution if used for Work. Become informed about recommended precautions in handling, storage and use of quicklime.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Water: clean, clear and free from oil, acids, alkali, or vegetable matter.
- B. Conform to requirements of City of Houston Standard Specifications Section 02336 – Lime Stabilized Subgrade for Type A hydrated lime, Type C quicklime, and Type B commercial lime slurry.
- C. Fly ash: Residue or ash remaining after burning finely pulverized coal at high temperatures conforming to requirements of ASTM C 618, Type ‘C’ or ‘F’ and following:
 - 1. Minimum CaO content of 20 percent
 - 2. Loss on ignition not to exceed 3 percent
 - 3. Contain no lignite ash
- D. Asphaltic Seal Cure: Conform to requirements of Division 32.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Conform to City of Houston Standard Specifications Section 32 11 13.13 – Lime Stabilized Subgrade with following exceptions:
 - 1. Include fly ash in percentage amounts in lime or lime slurry as established from geotechnical evaluation for application, mixing, and compaction.
 - 2. Apply lime/fly ash as single mix, single pass over lower PI soils.
 - 3. Conduct operations to minimize elapsed time between mixing and compacting lime/fly ash stabilized subgrade in order to take advantage of rapid initial set characteristics. Complete compaction within 2 hours of commencing compaction and not more than 6 hours after adding and mixing last stabilizing agent.

3.2 QUALITY CONTROL

- A. Testing will be performed under provisions of Division 1.
- B. Soil will be sampled to establish percent of fly ash and hydrated lime, quicklime, or lime slurry to be applied to sub grade material.
- C. Testing will be in accordance with Division 1.

END OF SECTION

SECTION 32 13 13

CONCRETE PAVING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Portland cement concrete paving.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for concrete paving will be on a square yard basis.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ASTM A 82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
- B. ASTM A 185 - Standard Specifications for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
- C. ASTM A 615 - Standard Specification for Deformed and Plain Billet - Steel Bars for Concrete Reinforcement.
- D. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- E. ASTM C 33 - Standard Specifications for Concrete Aggregates.
- F. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- G. ASTM C 40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
- H. ASTM C 42 - Standard Test Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- I. ASTM C 78 - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third Point Loading).
- J. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.
- K. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- L. ASTM C 136 - Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
- M. ASTM C 138 - Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
- N. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.

- O. ASTM C 150 - Standard Specification for Portland Cement.
- P. ASTM C 174 - Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores.
- Q. ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- R. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.
- S. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete.
- T. ASTM C 618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete.
- U. TxDOT Tex-203-F - Sand Equivalent Test.
- V. TxDOT Tex-406-A - Material Finer than 75 Fm (No. 200) Sieve In Mineral Aggregates (Decantation Test for Cement Aggregates).

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit proposed mix design and test data for each type and strength of concrete in Work. Include proportions and actual flexural strength obtained from design mixes at required test ages.
- C. Submit for approval manufacturer's description and characteristics for mixing equipment, and for traveling form paver, when proposed for use.
- D. Submit manufacturer's certificates giving properties of reinforcing steel. Include certificate of compliance with ASTM A 82. Provide specimens for testing when required by Owner's Representative.
- E. CHPS Submittals:
 - 1. Product Data for Credit ME 4.1: For structural steel products (including reinforcing steel), documentation indicating percentages by weight of post-consumer recycled content. Project requirement is a minimum 67% post-consumer recycled content for all structural steel.

1.5 HANDLING AND STORAGE

- A. Do not mix different classes of aggregate without written permission of Owner's Representative.
- B. Class of aggregate being used may be changed before or during Work with written permission of Owner's Representative. Comply new class with specifications.
- C. Reject segregated aggregate. Before using aggregate whose particles are separated by size, mix them uniformly to grading requirements.
- D. Reject aggregates mixed with dirt, weeds, or foreign matter.
- E. Do not dump or store aggregate in roadbed.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Portland Cement:
 - 1. Sample and test cement to verify compliance with Standards of ASTM C 150, Type I or Type III.
 - 2. Bulk cement which meets referenced standards may be used when method of handling is approved by Owner’s Representative. When using bulk cement, provide satisfactory weighing devices.
 - 3. Fly ash which meets standards of ASTM C 618 may be used as mineral fill when method of handling is approved by Owner’s Representative.
- B. Water: Conform to requirements for water in ASTM C 94.
- C. Coarse Aggregate: Crushed stone, gravel, or combination thereof, which is clean, hard, and durable, conforms to requirements of ASTM C 33, and has abrasion loss not more than 45 percent by weight when subjected to Los Angeles Abrasion Test (ASTM C 131).
 - 1. Maximum percentage by weight of deleterious substances shall not exceed following values:

<u>Item</u>	<u>Percent by Weight of Total Sample Maximum</u>
Clay lumps and friable particles	3.0
Material finer than 75-um (No. 200) sieve:	
Concrete subject to abrasion	3.0*
All other concrete	5.0*
Coal and lignite:	
Where surface appearance of concrete is of importance	0.5
All other concrete	1.0

* In case of manufactured sand, when material finer than 75-µm (No. 200) sieve consists of dust of fracture, essentially free from clay or shale, these limits may be increased to 5 and 7 percent, respectively.

- 2. Conform coarse aggregate (size 1 1/2 inch to No. 4 sieve) to requirements of ASTM C 33. Use gradation within following limits when graded in accordance with ASTM C 136:

<u>Sieve Designation (Square Openings)</u>	<u>Percentage by Weight</u>
Retained on 1¾” sieve	0
Retained on 1½” sieve	0 to 5
Retained on ¾” sieve	30 to 65
Retained on 3/8” sieve	70 to 90
Retained on No. 4 sieve	95 to 100
Loss by Decantation Test	
*Method Tex-406-A	1.0 maximum

* In case of aggregates made primarily from crushing of stone, when material finer than 200 sieve is dust of fracture essentially free from clay or shale as established by Part III of TxDOT Tex-406-A, percent may be increased to 1.5.

- D. Fine Aggregate: Sand, manufactured sand, or combination thereof, composed of clean, hard, durable, uncoated grains, free from loams or other injurious foreign matter. Conform fine aggregate for concrete to requirements of ASTM C 33. Use gradation within following limits when graded in accordance with ASTM C 136:

<u>Sieve Designation (Square Openings)</u>	<u>Percentage by Weight</u>
Retained on 3/8" sieve	0
Retained on No. 4 sieve	0 to 5
Retained on No. 8 sieve	0 to 20
Retained on No. 16 sieve	15 to 50
Retained on No. 30 sieve	35 to 75
Retained on No. 50 sieve	65 to 90
Retained on No. 100 sieve	90 to 100
Retained on No. 200 sieve	97 to 100

1. When subjected to color test for organic impurities (ASTM C 40), fine aggregate shall not show color darker than standard color. Fine aggregate shall be subjected to Sand Equivalent Test (Tex-203-F). Sand equivalent value shall not be less than 80, unless higher value is shown on Drawings.
- E. Mineral Filler: Type "C" or Type "F" fly ash of acceptable quality and meeting requirements of ASTM C 618 may be used as mineral admixture in concrete mixture as approved by the Engineer. When fly ash mineral filler is used, store and inspect in accordance with ASTM C 618. Do not use fly ash in amounts to exceed 25 percent by weight of cementitious material in mix design. Cement content may be reduced when strength requirements can be met. Note: When fly ash is used, term "cement" is defined as cement plus fly ash.
- F. Air Entraining Agent: Furnish air entraining agent conforming to requirements of ASTM C 260.
- G. Water Reducer: Water reducing admixture conforming to requirements of ASTM C 494 may be used when required to improve workability of concrete. Amount and type of admixture is subject to approval by Owner's Representative.
- H. Reinforcing Steel:
1. Provide new billet steel manufactured by open hearth process and conforming to ASTM A 615, Grade 60. Store steel to protect it from mechanical injury and rust. At time of placement, steel shall be free from dirt, scale, rust, paint, oil, or other injurious materials.
 2. Cold bend reinforcing steel to shapes shown. Once steel has been bent, it may not be rebent.
 3. Provide wire fabric conforming to ASTM A 82. Use fabric in which longitudinal and transverse wires have been electrically welded at points of intersection. Welds shall have sufficient strength not to be broken during handling or placing. Conform welding and fabrication of fabric sheets to ASTM A 185.

2.2 EQUIPMENT

- A. Conform Equipment to requirements of ASTM C 94.

2.3 MIXING

- A. Flexural strength shall be as specified using test specimens prepared in accordance with ASTM C 31 and tested in accordance with ASTM C 78 (using simple beam with third-point loading). Compressive strength shall be as specified using test specimens prepared in accordance with ASTM C 31 and tested in accordance with ASTM C 39. Determine and measure batch quantity of each ingredient, including water for batch designs and all concrete produced for Work. Mix shall conform to these specifications and other requirements indicated on Drawings.

- B. Mix design to produce concrete which will have minimum compressive strength of 3,000 psi at 7 days and 3,500 psi at 28 days. Slump of concrete shall be at least 2 inches but no more than 6 inches, when tested in accordance with ASTM C 143.
 - 1. Concrete pavement coordinate with curb and gutter spec section 32 16 13, including curb, curb and gutter, and saw-tooth curb, shall contain at least 5 1/2 sacks (94 pounds per sack) of cement per cubic yard, with not more than 6.5 gallons of water, net, per sack of cement (water-cement ratio maximum 0.57). Determine cement content in accordance with ASTM C 138. Addition of mineral filler may be used to improve workability or plasticity of concrete to limits specified.
 - 2. Coarse dry aggregate shall not exceed 85 percent of loose volume of concrete.
 - 3. Add air-entraining admixture to ensure uniform distribution of agent throughout batch. Base air content of freshly mixed air-entrained concrete upon trial mixes with materials to be used in Work, adjusted to produce concrete of required plasticity and workability. Percentage of air entrainment in mix shall be 4 1/2 percent plus or minus 1 1/2 percent. Determine air content by testing in accordance with ASTM C 231.
 - 4. Use retardant when temperature exceeds 90 degrees F. Proportion as recommended by manufacturer. Use same brand as used for air-entraining agent. Add and batch material using same methods as used for air-entraining agent.
- C. Use high early strength concrete pavement to limits shown on Drawings. Design to meet following:
 - 1. Concrete Mix: Flexural strength greater than or equal to 500 psi at 72 hours.
 - 2. Cement: Minimum of 7 sacks of cement per cubic yard of concrete.
 - 3. Water-Cement Ratio maximum of 0.45. Slump of concrete shall a maximum of 5 inches, when tested in accordance with ASTM C 143.
 - 4. Other requirements for proportioning, mixing, execution, testing, etc., shall be in accordance with this Division 32.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify compacted base is ready to support imposed loads and meets compaction requirements.
- B. Verify lines and grades are correct.

3.2 PREPARATION

- A. Properly prepare, shape and compact each section of subgrade before placing forms, reinforcing steel or concrete. After forms have been set to proper grade and alignment, use subgrade planer to shape subgrade to its final cross section. Check contour of subgrade with template.
- B. Remove subgrade that will not support loaded form. Replace and compact subgrade to required density.

3.3 EQUIPMENT

- A. Alternate equipment and methods, other than those required by this Section, may be used provided equal or better results will be obtained. Maintain equipment for preparing subgrade and for finishing and compacting concrete in good working order.
- B. Subgrade Planer and Template:
 - 1. Use subgrade planer with adjustable cutting blades to trim subgrade to exact section shown on Drawings. Select planer mounted on visible rollers which ride on forms. Planer frame must have sufficient weight so that it will remain on form, and have strength and rigidity that, under

- tests made by changing support from wheels to center, planer will not develop deflection of more than 1/8 inch. Tractors used to pull planer shall not produce ruts or indentations in subgrade. When slip form method of paving is used, operate subgrade planer on prepared track grade or have it controlled by electronic sensor system operated from string line to establish horizontal alignment and elevation of subbase.
2. Provide template for checking contour of subgrade. Template shall be long enough to rest upon side forms and have strength and rigidity that, when supported at center, maximum deflection shall not exceed 1/8 inch. Fit template with accurately adjustable rods projecting downward at 1 foot intervals. Adjust these rods to gauge cross sections of slab bottom when template is resting on side forms.
- C. Machine Finisher: Provide power-driven, transverse finishing machine designed and operated to strike off and consolidate concrete. Machine shall have two screeds accurately adjusted to crown of pavement and with frame equipped to ride on forms. Use finishing machine with rubber tires when it operates on concrete pavement.
- D. Hand Finishing:
1. Provide mechanical strike and tamping template 2 feet longer than width of pavement to be finished. Shape template to pavement section.
 2. Provide two bridges to ride on forms and span pavement for finishing expansion and dummy joints. Provide floats and necessary edging and finishing tools.
- E. Burlap Drag or transverse broom for Finishing Slab: Furnish four plies of 10 ounce burlap material fastened to bridge to form continuous strip of burlap full width of pavement. Maintain contact 3 foot width of burlap material with pavement surface. Keep burlap drags clean and free of encrusted mortar.
- F. Vibrators: Furnish mechanically-operated, synchronized vibrators mounted on tamping bar which rides on forms and hand-manipulated mechanical vibrators. Furnish vibrators with frequency of vibration to provide maximum consolidation of concrete without segregation.
- G. Traveling Form Paver: Approved traveling form paver may be used in lieu of construction methods employing forms, consolidating, finishing and floating equipment. Meet requirements of this specification for subgrade, pavement tolerances, pavement depth, alignments, consolidation, finishing and workmanship. When traveling form paver does not provide concrete paving that meets compaction, finish, and tolerance requirements of this Specification, immediately discontinue its use and use conventional methods.
1. Equip traveling paver with longitudinal transangular finishing float adjustable to crown and grade. Use float long enough to extend across pavement to side forms or edge of slab.
 2. Ensure that continuous deposit of concrete can be made at paver to minimize starting and stopping. Use conventional means of paving locations inaccessible to traveling paver, or having horizontal or vertical curvature that traveling paver cannot negotiate.
 3. Where Drawings require tie bars for adjacent paving, securely tie and support bars to prevent displacement. Tie bars may be installed with approved mechanical bar inserter mounted on traveling-form paver. Replace pavement in which tie bars assume final position other than that shown on Drawings.

3.4 FORMS

- A. Side Forms: Use forms of approved shape and section. Form depth shall be equal to required edge thickness of pavement. Forms with depths greater or than required edge thickness of pavement will be permitted, provided difference between form depth and edge thickness when not greater than 1 inch. Length of form sections shall be not less than 10 feet and each section shall provide for staking in position with not less than 3 pins. Flexible or curved forms of wood or metal of proper radius shall be used for curves of 200 foot radius or less. Forms shall have ample strength and shall be provided

with adequate devices for secure setting so that when in-place they will withstand, without visible springing or settlement, impact and vibration of finishing machine. Forms shall be free from warp, bends or kinks and shall be sufficiently true to provide straight edge on concrete. Top of each form section, when tested with straight edge, shall conform to requirements specified for surface of completed pavement. Provide sufficient forms for satisfactory placement of concrete. For short radius curves, forms less than 10 feet in length or curved forms may be used.

- B. Form Setting:
1. Rest forms directly on subgrade. Do not shim with pebbles or dirt. Accurately set forms to required grade and alignment and, during entire operation of placing, compacting and finishing of concrete, do not deviate from this grade and alignment more than 1/8 inch in 10 feet of length. Do not remove forms for at least 8 hours after completion of finishing operations. Provide supply of forms that will be adequate for orderly and continuous placing of concrete. Set forms and check grade for at least 300 feet ahead of mixer or as approved by Owner's Representative.
 2. Adjacent slabs may be used instead of forms, provided that concrete is well protected from possible damage by finishing equipment. Do not use adjacent slabs for forms until concrete has aged at least 7 days.

3.5 REINFORCING STEEL AND JOINT ASSEMBLIES

- A. Place reinforcing steel and joint assemblies and position securely as indicated on Drawings. Wire reinforcing bars securely together at intersections and splices. Bars and coatings shall be free of rust, dirt or other foreign matter when concrete is placed. Secure reinforcing steel to chairs.
- B. Position pavement joint assemblies at required locations and elevations, and rigidly secure in position. Install dowel bars in joint assemblies, each parallel to pavement surface and to center line of pavement, as shown.
- C. Cut header boards, joint filler, and other material used for forming joints to receive each dowel bar.
- D. Secure in required position to prevent displacement during placing and finishing of concrete.
- E. Drill dowels into existing pavement, secure with epoxy, and provide paving headers as required to provide rigid pavement sections.
- F. Use sufficient number of chairs for steel reinforcement bars to maintain position of bars within allowable tolerances. Place reinforcement as shown on Drawings. In plane of steel parallel to nearest surface of concrete, bars shall not vary from plan placement by more than 1/12 of spacing between bars. In plane of steel perpendicular to nearest surface of concrete, bars shall not vary from plan placement by more than 1/4 inch.

3.6 FIBROUS REINFORCING

- A. Do not use fibrous reinforcing to replace structural, load-bearing, or moment-reinforcing steel.

3.7 PLACEMENT

- A. Place concrete when air temperature taken in shade and away from artificial heat is above 35 degrees F and rising. Do not place concrete when temperature is below 40 degrees F and falling.
- B. Place concrete within 90 minutes after initial water had been added. Remove and dispose of concrete not placed within this period.
- C. Concrete slump during placement shall be 2 to 6 inches, except when using traveling-form paver, slump shall be maximum of 2 inches.

- D. Deposit concrete continuously in successive batches. Distribute concrete in manner that will require as little rehandling as possible. Where hand spreading is necessary, distribute concrete with shovels or by other approved methods. Use only concrete rakes in handling concrete. At placement interruption of more than 30 minutes, place transverse construction joint at stopping point. Remove and replace sections less than 10 feet long.
- E. Take special care in placing and spading concrete against forms and at longitudinal and transverse joints to prevent honeycombing. Voids in edge of finished pavement will be cause for rejection.

3.8 COMPACTION

- A. Consolidate concrete using mechanical vibrators as specified herein. Extend vibratory unit across pavement, not quite touching side forms. Space individual vibrators at close enough intervals to vibrate and consolidate entire width of pavement uniformly. Mount mechanical vibrators to avoid contact with forms, reinforcement, transverse or longitudinal joints.
- B. Furnish enough hand-manipulated mechanical vibrators for proper consolidation of concrete along forms, at joints and in areas not covered by mechanically controlled vibrators.

3.9 FINISHING

- A. Finish concrete pavement with power-driven transverse finishing machines or by hand finishing methods.
 - 1. Hand finish with mechanical strike and tamping template in same width as pavement to be finished. Shape template to pavement section shown on Drawings. Move strike template forward in direction of placement, maintaining slight excess of material in front of cutting edge. Make minimum of two trips over each area. Screed pavement surface to required section. Work screed with combined transverse and longitudinal motion in direction work is progressing. Maintain screed in contact with forms. Use longitudinal float to level surface.
- B. On narrow strips and transitions, finish concrete pavement by hand. Thoroughly work concrete around reinforcement and embedded fixtures. Strike off concrete with strike-off screed. Move strike-off screed forward with combined transverse and longitudinal motion in direction work is progressing, maintaining screed in contact with forms, and maintaining slight excess of materials in front of cutting edge. Tamp concrete with tamping template. Use longitudinal float to level surface.
- C. After completion of straightedge operation, make first pass of burlap drag or transverse broom as soon as construction operations permit and before water sheen has disappeared from surface. Follow with as many passes as required to produce desired texture depth. Permit no unnecessary delays between passes. Keep drag wet, clean and free from encrusted mortar during use.

3.10 JOINTS AND JOINT SEALING

- A. Conform to requirements of Division 32.

3.11 CONCRETE CURING

- A. Conform to requirements of Division 32.

3.12 TOLERANCES

- A. Test entire surface before initial set and correct irregularities or undulations. Bring surface within requirements of following test and then finish. Place 10 foot straightedge parallel to center of roadway to bridge depressions and touch high spots. Do not permit ordinates measured from face of straight edge to surface of pavement to exceed 1/16 inch per foot from nearest point of contact.

Maximum ordinate with 10 foot straightedge shall not exceed 1/8 inch. Grind spots in excess of required tolerances to meet surface test requirements. Restore texture by grooving concrete to meet surface finishing specifications.

3.13 FIELD QUALITY CONTROL

- A. Perform testing under provisions of Division 1.
- B. Compressive Strength Test Specimens: Make four test specimens for compressive strength test in accordance with ASTM C 31 for each 150 cubic yards or less of pavement that is placed in one day. Test one specimen at 7 days or at number of hours as directed by the Owner's Representative for high early strength concrete. Test two specimens at 28 days. Test remaining specimens at 56 days, if required. Test specimens in accordance with ASTM C 39. Minimum compressive strength shall be 3000 pounds per square inch for first two specimens and 3500 pounds per square inch at 28 days.
- C. When compressive test indicates failure, perform yield test in accordance with ASTM C 138 for cement content per cubic yard of concrete. When cement content is found to be less than that specified per cubic yard, increase batch weights until amount of cement per cubic yard of concrete conforms to requirements.
- D. Minimum of one 4 inch core will be taken at random locations per 375 feet per 12 feet lane or 500 square yards of pavement to measure in-place depth. Measure depth in accordance with ASTM C 174. Each core may be tested for 28 day compressive strength according to methods of ASTM C 42. 28 day compressive strength of each core tested shall be a minimum of 3000 pounds per square inch.
- E. Request, at option, three additional cores in vicinity of cores indicating nonconforming in-place depths at no cost to Owner. In-place depth at these locations shall be average depth of four cores.
- F. Fill cores and density test sections with new concrete paving or non shrink grout.

3.14 NONCONFORMING PAVEMENT

- A. Remove and replace areas of pavement found deficient in thickness, or that fail compressive strength tests, with concrete of thickness shown on Drawings.
- B. When measurement of any core is less than specified thickness, actual thickness of pavement in this area will be determined by taking additional cores at 10 foot intervals parallel to centerline in each direction from deficient core until, in each direction, core is taken which is not deficient by more than 10 percent. Exploratory cores for deficient thickness will not be used in averages for adjusted unit price. Exploratory cores are to be used only to determine length of pavement in unit that is to be removed and replaced. Replace nonconforming pavement sections at no additional cost to Owner.

3.15 PAVEMENT MARKINGS

- A. Restore pavement markings to match those existing in accordance with the applicable governmental standard specifications and details and Owner's Representative's requirements.

3.16 PROTECTION

- A. Barricade pavement section to prevent use until concrete has attained minimum design strength. Cure barricade pavement section for minimum 72 hours before use. Do not open pavement to traffic until concrete is at least 10 days old. Pavement may be open to traffic earlier provided Contractor pays for testing and additional specimen once 7 day specified strength is obtained. Pavement may be opened when high early strength concrete is used meeting specified 72 hour strength.

- B. High early strength concrete may be used to provide access at driveways, street intersections, esplanades and other locations approved by Owner's Representative.
- C. On those sections of pavement to be opened to traffic, seal joints, clean pavement, and place earth against pavement edges before permitting use by traffic. Opening of pavement to traffic shall not relieve responsibility for Work.
- D. Maintain concrete paving in good condition until completion of Work.
- E. Repair defects by replacing concrete to full depth.

END OF SECTION

SECTION 32 13 13.10

CONCRETE PAVEMENT CURING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Curing of Portland cement concrete paving.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for concrete curing shall be incidental to concrete paving.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ASTM C 156 - Standard Test Method for Water Retention by Concrete Curing Materials.
- B. ASTM C 171 - Standard Specifications for Sheet Materials for Curing Concrete.
- C. ASTM C 309 - Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit manufacturer's product data for cover materials and liquid membrane-forming compounds.

PART 2 PRODUCTS

2.1 COVER MATERIALS FOR CURING

- A. Conform curing materials to one of the following:
 - 1. Polyethylene Film: Opaque pigmented white film conforming to requirements of ASTM C 171.
 - 2. Waterproofed Paper: Paper conforming to requirements of ASTM C 171.
 - 3. Cotton Mats: Single layer of cotton filler completely enclosed in cover of cotton cloth. Mats shall contain not less than 3/4 of a pound of uniformly distributed cotton filler per square yard of mat. Cotton cloth used for covering materials shall weigh not less than 6 ounces per square yard. Stitch mats so that mat will contact surface of pavement at all points when saturated with water.

2.2 LIQUID MEMBRANE-FORMING COMPOUNDS

- A. Conform liquid membrane-forming compounds to ASTM C 309. Membrane shall restrict loss of water to not more than 0.55 kg/m² in 72 hours using test method ASTM C 156.

PART 3 EXECUTION

3.1 CURING REQUIREMENT

- A. Cure concrete pavement by protecting against loss of moisture for period of not less than 72 hours immediately upon completion of finishing operations. Do not use membrane curing for concrete pavement to be overlaid by asphalt concrete.
- B. Failure to provide sufficient cover material shall be cause for immediate suspension of concreting operations.

3.2 POLYETHYLENE FILM CURING

- A. Immediately after finishing surface, and after concrete has taken its initial set, apply water in form of fine spray. Cover surface with polyethylene film so film will remain in direct contact with surface during specified curing period.
- B. Cover entire surface and both edges of pavement slab. Overlap joints in film sheets minimum of 12 inches. Immediately repair tears or holes occurring during curing period by placing acceptable moisture-proof patches or replacing.

3.3 WATERPROOFED PAPER CURING

- A. Immediately after finishing surface, and after concrete has taken its initial set, apply water in form of fine spray. Cover surface with waterproofed paper so paper will remain in direct contact with surface during specified curing period.
- B. Prepare waterproofed paper to form blankets of sufficient width to cover entire surface and both edges of pavement slab, and not be more than 60 feet in length. Overlap joints in blankets caused by joining paper sheets not less than 5 inches and securely seal with asphalt cement having melting point of approximately 180 degrees F. Place blankets to secure overlap of at least 12 inches. Immediately repair tears or holes appearing in paper during curing period by cementing patches over defects.

3.4 COTTON MAT CURING

- A. Immediately after finishing surface, and after concrete has taken its initial set, completely cover surface with cotton mats, thoroughly saturated before application, maintaining contact with surface of pavement equally at all points.
- B. Keep mats on pavement for specified curing period. Keep mats saturated so that, when lightly compressed, water will drip freely from them. Keep banked earth or cotton mat covering edges saturated.

3.5 LIQUID MEMBRANE-FORMING COMPOUNDS

- A. Immediately after free surface moisture, and after concrete has dispersed, apply liquid membrane-forming compound in accordance with manufacturer's instructions.
- B. Moisten concrete by water fogging prior to application of membrane when surface has become dry.
- C. Seal concrete surface with single coat at rate of coverage recommended by manufacturer and directed by Owner's Representative, but not less than one gallon per 200 square feet of surface area.

3.6 TESTING MEMBRANE

- A. Treated areas will be visually inspected for areas of lighter color of dry concrete as compared to dump concrete. Test suspected areas by placing few drops of water on surface. Membrane passes test when water stands in rounded beads or small pools which can be blown along surface of concrete without wetting surface.
- B. Re-Apply membrane compound immediately at no cost to Owner when membrane fails above test.

END OF SECTION

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SECTION 32 13 13.25

CONCRETE SIDEWALKS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Reinforced concrete sidewalks.
- B. Wheelchair ramps.
- C. Reinforced slope paving.

1.2 MEASUREMENT AND PAYMENT

- A. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in Field.
- B. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- C. ASTM C 42 - Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- D. ASTM C 138 - Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
- E. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
- F. ASTM C 172 - Standard Practice for Sampling Freshly Mixed Concrete.
- G. ASTM D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
- H. Texas Accessibility Standards of Architectural Barriers Act, Article 9102, Texas Civil Statutes.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. CHPS Submittals:
 - 1. Product Data for Credit ME 4.1: For structural steel products (including reinforcing steel), documentation indicating percentages by weight of post-consumer recycled content. Project requirement is a minimum 67% post-consumer recycled content for all structural steel.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Concrete: Conform to material and proportion requirements for concrete of Division 32.
- B. Reinforcing Steel: Conform to material requirements of Division 32. Use No. 3 reinforcing bars.
- C. Preformed Expansion Joint Material: Conform to material requirements for preformed expansion joint material of Division 32.
- D. Expansion Joint Filler: Conform to material requirements for expansion joint material of Division 31.
- E. Forms: Use straight, unwarped wood or metal forms with nominal depth equal to or greater than proposed sidewalk thickness. The use of 2 inch by 4 inch lumber as forms will not be allowed.
- F. Sand Bed: Conform to material requirements for bank run sand of Division 31.
- G. Sodding: Conform to material requirements for sodding of Division 31.
- H. Coloring for wheelchair ramps: Conform to material requirements for colored concrete of Division 31. Color shall be Brick Red or as shown on the drawings.

PART 3 EXECUTION

3.1 REPLACEMENT

- A. Replace sidewalks and slope paving which are removed or damaged during construction with thickness and width equivalent to one removed or damaged, unless otherwise shown on Drawings. Finish surface (exposed aggregate, brick pavers, etc.) to match existing sidewalk.
- B. Provide replaced and new sidewalks with wheelchair ramps when sidewalk intersects curb at street or driveway.

3.2 PREPARATION

- A. Identify and protect utilities which are to remain.
- B. Protect living trees, other plant growth, and features designated to remain.
- C. Conduct clearing and grubbing operations in accordance with Division 31.
- D. Excavate subgrade 6 inches beyond outside lines of sidewalk. Shape to line, grade and cross section. For soils with plasticity index above 40 percent, stabilize soil with lime in accordance with Division 31. Compact subgrade to minimum of 90 percent maximum dry density at optimum to 3 percent above optimum moisture content, as determined by ASTM D 698.
- E. Immediately after subgrade is prepared, begin form work and concrete placement.

3.3 PLACEMENT

- A. Setting Forms: Straight, unwarped wood or metal forms with nominal depth equal to or greater than proposed sidewalk thickness. Use of 2 by 4's as forms will not be allowed. Securely stake forms to line and grade. Maintain position during concrete placement.
- B. Reinforcement:
 - 1. Install reinforcing bars.
 - 2. Install reinforcing steel as shown on the drawings. Lay longitudinal bars in walk continuously, except through expansion joints.
 - 3. Use sufficient number of chairs to support reinforcement in manner to maintain reinforcement in center of slab vertically during placement.
 - 4. Drill dowels into existing paving, sidewalk and driveways, secure with epoxy, and provide headers as required.
 - 5. Use sufficient number of chairs for steel reinforcement bars to maintain position of bars within allowable tolerances. Place reinforcement as shown on Drawings. In plane of steel parallel to nearest surface of concrete, bars shall not vary from plan placement by more than 1/12 of spacing between bars. In plane of steel perpendicular to nearest surface of concrete, bars shall not vary from plan placement by more than 1/4 inch.
- C. Expansion Joints: Install expansion joints with load transfer units in accordance with Division 32.
- D. Place concrete in forms to specified depth and tamp thoroughly with "jitterbug" tamp, or other acceptable method. Bring mortar to surface.
- E. Strike off to smooth finish with wood strike board. Finish smoothly with wood hand float. Brush across sidewalk lightly with fine-haired brush.
- F. Apply coating to wheelchair ramp with contrasting color in accordance with Division 32.
- G. Unless otherwise indicated on Drawings, mark off sidewalk joints 1/8 inch deep, at spacing equal to width of walk. Use joint tool equal in width to edging tool.
- H. Finish edges with tool having 1/4 inch radius.
- I. After concrete has set sufficiently, refill space along sides of sidewalk to one-inch from top of walk with suitable material. Tamp until firm and solid, place sod as applicable. Dispose of excess material in accordance with Division 1. Repair driveways and parking lots damaged by sidewalk excavation in accordance with Division 32.

3.4 CURING

- A. Conform to requirements of Division 32.

3.5 FIELD QUALITY CONTROL

- A. Testing will be performed under provisions of Division 1.
- B. Compressive Strength Test Specimens: Four test specimens for compressive strength test will be made in accordance with ASTM C 31 for each 30 cubic yards or less of sidewalk that is placed in one day. Two specimens will be tested at 7 days. Remaining two specimens will be tested at 28 days. An additional test specimen performed at 56 days, if required. Specimens

will be tested in accordance with ASTM C 39. Minimum compressive strength: 2500 psi at 7 days and 3000 psi at 28 days.

- C. Yield test for cement content per cubic yard of concrete will be made in accordance with ASTM C 138. When cement content is found to be less than that specified per cubic yard, reduce batch weights until amount of cement per cubic yard of concrete conforms to requirements.
- D. If the Contractor places concrete without notifying the laboratory, the Owner will have the concrete tested by means of core test as specified in ASTM C 42. When concrete does not meet specification, cost of test will be deducted from payment.
- E. Sampling of fresh concrete shall be in accordance with ASTM C 172.
- F. Take slump tests when cylinders are made and when concrete slump appears excessive.
- G. Concrete shall be acceptable when average of two 28 day compression tests is equal to or greater than minimum 28 day strength specified.
- H. If either of two tests on field samples is less than average of two tests by more than 10 percent, that entire test shall be considered erratic and not indicative of concrete strength. Core samples will be required of in-place concrete in question.
- I. If 28 day laboratory test indicates that concrete of low strength has been placed, test concrete in question by taking cores as directed by Owner's Representative. Take and test at least three representative cores as specified in ASTM C 42 and deduct cost from payment due.

3.6 NONCONFORMING CONCRETE

- A. Remove and replace areas that fail compressive strength tests, with concrete of thickness shown on Drawings.
- B. Replace nonconforming sections at no additional cost to Owner.

3.7 PROTECTION

- A. Maintain newly place concrete in good condition until completion of Work.
- B. Replace damaged areas.

END OF SECTION

SECTION 32 13 73

CONCRETE PAVING JOINTING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Joints for concrete paving; concrete sidewalks, concrete driveways, curbs, and curb and gutters.
- B. Saw-cutting existing concrete or asphalt pavements for new joints.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No separate payment for street pavement expansion joints. Include cost for work in unit price bid for related work.
 - 2. No separate payment for saw-cutting existing concrete or asphalt pavement for new joints. Include cost for work in unit price bid for related work.
 - 3. No separate payment will be made for formed or sawed street pavement contraction joints and longitudinal weakened plane joints. Include cost for work in unit price bid for related work.
 - 4. No separate payment will be made for joints for curb, curb and gutter, concrete sidewalks, and concrete driveways. Include cost for work in unit price bid for related work.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- B. ASTM D 994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
- C. ASTM D 1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- D. ASTM D 3405 - Standard Specification for Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements.
- E. TxDOT Tex-525-C - Tests for Asphalt and Concrete Joint Sealers.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit product data for joint sealing compound and proposed sealing equipment for approval.
- C. Submit samples of dowel cup, metal supports, and deformed metal strip for approval. Submit manufacturer's recommendation for placing sealant(s).

PART 2 PRODUCTS

2.1 BOARD EXPANSION JOINT MATERIAL

- A. Filler board of selected stock. Use wood of density and type as follows:
 - 1. Clear, all-heart cypress weighing no more than 40 pounds per cubic foot, after being oven dried to constant weight.
 - 2. Clear, all-heart redwood weighing no more than 30 pounds per cubic foot, after being oven dried to constant weight.

2.2 PREFORMED EXPANSION JOINT MATERIAL

- A. Bituminous fiber and bituminous mastic composition material conforming to ASTM D 994 and ASTM D 1751.

2.3 JOINT SEALING COMPOUND

- A. Provide joint sealant as indicated on the drawings.

2.4 LOAD TRANSMISSION DEVICES

- A. Smooth, steel dowel bars conforming to ASTM A 615, Grade 60. When indicated on Drawings, encase one end of dowel bar in approved cap having inside diameter 1/16 inch greater than diameter of dowel bar.
- B. Deformed steel tie bars conforming to ASTM A 615, Grade 60.

2.5 SUPPORTS FOR REINFORCING STEEL AND JOINT ASSEMBLY

- A. Employ supports of approved shape and size that will secure reinforcing steel and joint assembly in correct position during placing and finishing of concrete. Space supports as directed by Owner's Representative.

PART 3 EXECUTION

3.1 PLACEMENT

- A. When new Work is adjacent to existing concrete, place joints at same location as existing joints in adjacent pavement.
- B. If limit of removal of existing concrete or asphalt pavement does not fall on existing joint, saw cut existing pavement minimum of 2 inches deep to provide straight, smooth joint surface without chipping, spalling, or cracks.

3.2 CONSTRUCTION JOINTS

- A. Place transverse construction joint wherever concrete placement must be stopped for more than 30 minutes. Place longitudinal construction joints at interior edges of pavement lanes using No. 6 deformed tie bars, 30 inches long and spaced 18 inches on centers.

3.3 EXPANSION JOINTS

- A. Place 3/4 inch expansion joints at radius points of curb returns for cross street intersections, or as located in adjacent pavement but no further than 80 feet apart or as shown on the drawings. Use no boards shorter than 6 feet. When pavement is 24 feet or narrower, use not more than 2 lengths of board. Secure pieces to form straight joint. Shape board filler accurately to cross section of concrete slab. Use load transmission devices of type and size shown on Drawings unless otherwise specified or shown as "No Load Transfer Device." Seal with joint sealing compound.

3.4 CONTRACTION JOINTS

- A. Place contraction joints at same locations as in adjacent pavement or at spaces indicated on Drawings. Place smoothed, painted and oiled dowels accurately and normal to joint. Seal groove with joint sealing compound.

3.5 LONGITUDINAL WEAKENED PLANE JOINTS

- A. Place longitudinal weakened plane joints at spaces indicated on Drawings. If more than 15 feet in width is poured, longitudinal joint must be saw cut. Seal groove with joint sealing compound.

3.6 SAWED JOINTS

- A. Use sawed joints as alternate to contraction and weakened plane joints. Use circular cutter capable of cutting straight line groove minimum of 1/4 inch wide. Maintain depth of one quarter of pavement thickness. Commence sawing as soon as concrete has hardened sufficiently to permit cutting without chipping, spalling or tearing and prior to initiation of cracks. Once sawing has commenced, continue until completed. Make saw cut with one pass. Complete sawing within 24 hours of concrete placement. Saw joints at required spacing consecutively in sequence of concrete placement.
- B. Concrete Saw: Provide sawing equipment adequate in power to complete sawing to required dimensions and within required time. Maintain ample supply of saw blades at work site during sawing operations. Maintain sawing equipment on job during concrete placement.

3.7 JOINTS FOR CURB, CURB AND GUTTER

- A. Place 3/4 inch preformed expansion joints through curb and gutters at locations of expansion and contraction joints in pavement, at end of radius returns at street intersections and driveways, and at curb inlets. Maximum spacing shall be 120-foot centers.

3.8 JOINTS FOR CONCRETE SIDEWALKS

- A. Provide 3/4 inch expansion joints conforming to ASTM A 1751 along and across sidewalk at back of curbs, at intersections with driveways, steps, and walls; and across walk at intervals not to exceed 40 feet.

3.9 JOINTS FOR CONCRETE DRIVEWAYS

- A. Provide 3/4-inch expansion joints conforming to ASTM D 1751 across driveway in line with street face of sidewalks, at existing concrete driveways, and along intersections with sidewalks and other structures. Extend expansion joint material full depth of slab.

3.10 JOINT SEALING

- A. Seal joints only when surface and joints are dry, ambient temperature is above 50 degrees F and less than 85 degrees F and weather is not foggy or rainy.
- B. Use joint sealing equipment in like new working condition throughout joint sealing operation, and be approved by Owner's Representative. Use concrete grooving machine or power-operated wire brush and other equipment such as plow, brooms, brushes, blowers or hydro or abrasive cleaning as required to produce satisfactory joints.
- C. Clean joints of loose scale, dirt, dust and curing compound. The term joint includes wide joint spaces, expansion joints, dummy groove joints or cracks, either preformed or natural. Remove loose material from concrete surfaces adjacent to joints.
- D. Fill joints neatly with joint sealer to depth shown. Pour sufficient joint sealer into joints so that, upon completion, surface of sealer within joint will be 1/4 inch above level of adjacent surface or at elevation as directed.

3.11 PROTECTION

- A. Maintain joints in good condition until completion of Work.
- B. Replace damaged joints material with new material as required by this Section.

END OF SECTION

SECTION 32 16 13

CURBS AND GUTTERS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Reinforced concrete curb, reinforced monolithic concrete curb and gutter, and mountable curb.
- B. Paving headers and railroad headers poured monolithically with concrete base or pavement.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for reinforced concrete curb, reinforced monolithic concrete curb and gutter, and mountable curb, when included on the bid form, is on a linear foot basis measured along face of curb.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit details of proposed form work for approval.
- C. CHPS Submittals:
 - 1. Product Data for Credit ME 4.1: For structural steel products (including reinforcing steel), documentation indicating percentages by weight of post-consumer recycled content. Project requirement is a minimum 67% post-consumer recycled content for all structural steel.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Concrete: Conform to material and proportion requirements for concrete of Division 32.
- B. Reinforcing Steel: Conform to material requirements for welded wire fabric of Division 32.
- C. Grout: Nonmetallic, nonshrink grout containing no chloride producing agents conforming to following requirements.
 - 1. Compressive strength
 - a. at 7 days: 3500 psi
 - b. at 28 days: 4000 psi
 - 2. Initial set time: 45 minutes
 - 3. Final set time: 1.5 hours
- D. Preformed Expansion Joint Material: Conform to material requirements for preformed expansion joint material of Division 32.

- E. Expansion Joint Filler: Conform to material requirements for expansion joint filler of Division 32.
- F. Mortar: Mortar finish composed of one part Portland cement and 1 1/2 parts of fine aggregate. Use only when approved by Owner's Representative.

PART 3 EXECUTION

3.1 PREPARATION

- A. Prepare subgrade in accordance with applicable portions of sections on excavation and fill, embankment, and sub grade and roadbed.

3.2 PLACEMENT

- A. Guideline: Set to follow top line of curb. Attach indicator to provide constant comparison between top of curb and guideline. Ensure flow lines for monolithic curb and gutters conform to slopes indicated on Drawings.
- B. Forms: Brace to maintain position during pour. Use metal templates cut to section shown on Drawings.
- C. Reinforcement: Secure in position so that steel will remain in place throughout placement. Reinforcing steel shall remain at approximate center of base or pavement as indicated on Drawings.
- D. Joints: Place in accordance with Division 32. Place dummy groove joints at to match concrete pavement joints at right angles to curb lines. Cut dummy grooves 1/4 inch deep using approved edging tool.
- E. Place concrete in forms to required depth. Consolidate thoroughly. Do not permit rock pockets in form. Entirely cover top surfaces with mortar.

3.3 MANUAL FINISHING

- A. After concrete is in place, remove front curb forms. Form exposed portions of curb, and of curb and gutter, using mule which conforms to curb shape, as shown on Drawings.
- B. Thin coat of mortar may be worked into exposed face of curb using mule and two-handled wooden darby at least 3 feet long.
- C. Before applying final finish move 10 foot straightedge across gutter and up curb to back form of curb. Repeat until curb and gutter are true to grade and section. Lap straightedge every 5 feet.
- D. Steel trowel finish surfaces to smooth, even finish. Make face of finished curb true and straight.
- E. Edge outer edge of gutter with 1/4 inch edger. Finish edges with tool having 1/4 inch radius.
- F. Finish visible surfaces and edges of finished curb and gutter free from blemishes, form marks and tool marks. Finished curb or curb and gutter shall have uniform color, shape and appearance.

3.4 MECHANICAL FINISHING

- A. Mechanical curb forming and finishing machines may be used instead of, or in conjunction with, previously described methods, when approved by Owner's Representative. Use of mechanical methods shall provide specified curb design and finish.

3.5 CURING

- A. Immediately after finishing operations, cure exposed surfaces of curbs and gutters in accordance with Division 32.

3.6 TOLERANCES

- A. Top surfaces of curb and gutter shall have uniform width and shall be free from humps, sags or other irregularities. Surfaces of curb top, curb face and gutter shall not vary more than 1/8 inch from edge of straightedge laid along them, except at grade changes.

3.7 PROTECTION

- A. Maintain curbs and gutters in good condition until completion of Work.
- B. Replace damaged curbs and gutters to comply with this Section.

END OF SECTION

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SECTION 32 17 23

PAVEMENT MARKINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This Section specifies the requirements for providing pavement markings of the following types.

1.2 UNIT PRICES

- A. Measurement and payment for pavement markings is on a lump sum basis.

1.3 QUALITY ASSURANCE

- A. All markings shall comply with the requirements of the SDHPT Standard Specifications for Construction of Highways, Streets and Bridges, the SDHPT Manual on Uniform Traffic Control Devices for Streets and Highways and the applicable regulations and standards of Harris County, Texas, and the City.
- B. Reference Standards Applicable to this Section:
 - 1. SDHPT: Texas State Department of Highways and Public Transportation:
 - a. Standard Specifications for Construction of Highways, Streets and Bridges.
 - b. Texas Manual on Uniform Traffic Control Devices for Streets and Highways (TMUTCD).
 - c. The above referenced SDHPT standards may be obtained from:

State Department of Highways & Public Transportation Highway Building
11th and Brazos Streets
Austin, Texas 78701
Tel: (512) 475-2081
 - 2. Conform to current federal VOC (Volatile Organic Compounds) regulations.

1.4 SUBMITTALS

- A. Certificates:
 - 1. Certificates shall be submitted for each product indicating that the product complies with the requirements of this specification.
- B. Manufacturer's Data:
 - 1. Manufacturer's installation instructions, specifications and recommendations shall be submitted for each pavement marking product.

1.5 JOB CONDITIONS

- A. Markings shall be installed only on clean and dry surfaces. Paint markings shall be applied only when surfaces have the following minimum temperatures:
 - 1. A minimum of 50 degrees F for asphalt and a minimum of 60 degrees F for concrete.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Paint:
 - 1. Marking paint shall be traffic white, yellow, or as designated on the drawings.
 - 2. Fast Drying Alkyd, Low VOC Chlorinated Rubber Traffic Paint.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Surface condition / preparation: Asphalt and concrete surfaces should be cured, clean, dry and sound. Loose and lifting paint should be removed prior to application. Concrete with sealers containing silicone, having a smooth finish, or efflorescence should be removed by etching or abrasive blasting, as these conditions may interfere with adhesion. While new asphalt surfaces vary in length of time required for curing, insufficient curing may result in bleeding. Not recommended for use over asphalt sealers. Regardless of surface condition, a test stripe should be placed inconspicuously to determine if surface is suitable before continuing.
- B. Markings shall be installed, and surfaces prepared in accordance with the requirements of the applicable item in the SDHPT Standard Specifications and the TMUTCD.
- C. Markings shall be protected from vehicular traffic until not subject to damage by such traffic. Contractor shall be responsible for repair and replacement of markings until written acceptance by the Owner.

END OF SECTION

**SECTION 32 18 28
TENNIS COURTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Design, engineering and construction of post-tensioned concrete tennis courts.
- B. Tennis court related fencing and gates.
- C. Wind screens.
- D. Nets, posts and hardware.
- E. Surfacing and court markings.
- F. Court lighting.
- G. The "Work" of this Section is defined to include, but not necessarily to be limited to:
 - 1. Requirements indicated are to establish a minimum standard. Provide tennis court work to meet these standards, but in no case less than those required by the Tennis Court Design Engineer.
 - 2. The scope of this work shall be the construction of the Tennis Courts as on the site plans as a complete and whole construction package including, but not be limited to, the engineered design of the Tennis Courts concrete slab and foundation, and fencing. Further, the scope of work shall include, but not be limited to the furnishing and installation or construction of the Tennis Courts including the concrete footings, concrete slab, reinforcing, pad preparation as recommended by the geotechnical report, all soil stabilization below and five feet outside the perimeter of the slab, fencing, nets, posts, and windscreens. In addition to the court, provide lighting Poles, fixtures, all necessary wiring, electrical panels, transformers, timers, and electrical service to the Tennis Courts from the nearest power service.
 - 3. Tennis Courts shall comply with the latest U.I.L. rules and regulation and be constructed to comply with United States Tennis Association (USTA) Specifications.
 - 4. Entire system including but not limited to, courts, fencing, equipment and lighting along with any other accessory items, shall be designed as a performance specification. A Professional Engineer licensed in the State of Texas shall seal the court designs submitted.
 - 5. A full copy of the geotechnical report has been included in the project manual.

1.02 RELATED REQUIREMENTS

- A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 01 of these Specifications.
- B. Section 00 3132 - Geotechnical Data.
- C. Section 03 3000 - Cast-In-Place Concrete.
- D. Section 03 3800 - Post-Tensioned Concrete.
- E. Section 26 5668 - Tennis Court Lighting

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting two weeks prior to the start of the work of this section; require attendance by all affected installers.
- B. Coordination: Coordinate the installation of court lighting with size, location and installation of service utilities.
- C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product data: Within 15 calendar days after the Contractor has received the Owner's Notice to Proceed, submit the following:
 - 1. Materials list of items proposed to be provided under this Section, and related Sections;
 - 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements; including color samples.
 - 3. Shop drawings requirements for submission to the local AHJ for permitting.
- C. Manufacturer's recommended installation procedures which, when approved by the Architect, will become the basis for accepting or rejecting actual installation procedures used on the Work.
- D. Shop Drawings:
 - 1. Submit sealed design documents and calculations for for submission to the local AHJ for permitting requirements and A/E review.
 - a. Foundation Design
 - b. Dimensioned court layouts
 - c. Equipment locations.
 - d. Fencing calculations and layouts
 - e. Striping width and color.
 - f. Proposed colored graphic or logo.
 - 2. Shop drawing sheets that include engineering information designed by the Contractor's Delegated Design Engineer shall be signed and sealed in accordance with the Texas Engineering Practice Act. Sheets that do not provide information designed by the Contractor's Engineer do not require being signed and sealed. Calculation packages require a signed and sealed cover sheet only. Any submittals requiring to be signed and sealed that are received without the signature and seal will be rejected without review.
 - 3. Submit a copy of the latest U.I.L. rules and regulations verifying compliance.
- E. Samples: Accompanying the submittal described above, submit Samples of each sealant, each backing material, each primer, and each bond breaker proposed to be used.

1.05 QUALITY ASSURANCE

- A. Designer Qualifications: Perform design under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in Texas.
- B. Tennis Court Contractor shall have completed at least ten (10) similar size tennis court projects in the last three years.
- C. Surfacing applicator shall have a minimum of one hundred (100) tennis court applications of proven experience.
- D. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- E. Submission of Substitute Materials:
 - 1. If other than the product specified, submit at least five working days prior to the bid date a complete type written list of all such proposed substitutions together with sufficient data, drawings, samples, literature, and other detailed information as will demonstrate to the satisfaction of the Owner that the proposed substitute material is equal in quality and utility to that originally specified. Under no circumstances will a surfacing system comprised of several products produced or manufactured from different sources be considered.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 6000 - Product Requirements, for transportation, handling, storage and protection procedures.
- B. Do not use material which has exceeded the shelf life recommended by its manufacturer.

1.07 FIELD CONDITIONS

- A. Ambient Conditions: Do not install materials when environmental conditions are outside of the acceptable ranges recommended by the manufacturer.
- B. Weather Limitations: No part of the construction involving the surfacing system may be conducted during rain or when rain is imminent. The air and surface temperature must be at least 50 deg. F. and rising. Do not apply when surface temperature is above 140 deg. F.
- C. Existing Conditions: See subsurface investigation report; see Section 00 3132.

1.08 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide three year manufacturer warranty for windscreens.
- C. System Warranty:
 - 1. Provide a written guarantee warranting the entire system, including all materials, devices, and workmanship to be free of defects for a period of five (5) years from the date of completion, unless otherwise indicated. Any defects in materials, devices, and workmanship which become apparent within the guarantee period shall be repaired or replaced by the contractor at his own expense, and at no additional cost to the Owner.

PART 2 PRODUCTS AND EXECUTION

2.01 GENERAL

- A. The materials and installation of foundations, synthetic surfaces, fences, equipment for tennis courts and tennis court lighting indicated are a part of these specifications are minimum standards but shall be in no case less than those required by the Design Engineer.

2.02 TENNIS COURT POST-TENSIONED SLAB

- A. See Section 03 3800 - Post-Tensioned Concrete.

2.03 TENNIS COURT LIGHTING

- A. See Division 26 - Tennis Court Lighting

2.04 TENNIS COURT COLOR SURFACING

- A. Manufacturers:
 - 1. California Products Corp.; Plexipave System: www.plexipave.com.
 - 2. Hellas Constrction; Model TPS 5000: www.hellasconstruction.com
 - 3. Substitutions: See Section 01 6000 - Product Requirements.
- B. Materials:
 - 1. Patching Mix (California Court Patch Binder) - for use in patching cracks, holes, depressions and other surface imperfections.
 - 2. Crack Filler (Plexipave Crack Filler) - for use in filling fine cracks.
 - 3. Concrete Preparer - specially formulated acid heat for use in neutralizing the concrete in preparation for the Plexipave System.
 - 4. Adhesion Primer - (California TiCoat) - two component water based epoxy primer for uncoated concrete surfaces.
 - 5. Acrylic Filler Course (California Acrylic Resurfacer) - for use as a filler for new or existing concrete surfaces. The 100% acrylic filler shall be blended with approved silica sand at the job site.

6. Acrylic Color Playing Surface (Plexichrome/Plexipave Color Base) - for use as the finish color and texture. Plexichrome and Plexipave Color Base are blended at the job site to achieve the correct surface texture. Factory Fortified Plexipave may be used as an alternative material.
7. Line Paint (California Line Paint) - for use as the line marking on the court/play surface.
8. Water: - for use in dilution/mixing shall be clean and potable.

2.05 TENNIS COURT CHAIN LINK FENCING

- A. Height
 1. Height of fence to match existing.
- B. Fabric
 1. Nine gauge (9 Ga.) black resin clad fabric shall have a polyvinyl chloride coating, minimum wall thickness of .015 inches over a galvanized substrate. The base metal shall have a minimum breaking strength of five hundred fifty pounds (550 lbs.) and a zinc coat weight of .1503 pounds per square foot of uncoated wire surface. Top and bottom salvage of the fabric shall be knuckled with one and three-quarters inch (1 $\frac{3}{4}$ " mesh).
- C. Pipe and Accessories
 1. Method of Manufacturing: Pipe used for fence framework shall be cold rolled and electric-resistance-welded from steel conforming to ASTM A-569 and hot dip galvanized to ASTM A-525 G-90 zinc weight both inside and outside the pipe. The outside then receives a conversion coating and fusion bonded black polyester powder coating. the application of the coating will consist of three (3.0) mils of cured thermosetting polyester powder coatings applied over zinc phosphate pretreatment of galvanized steel.
 2. Posts: All line, and gateposts shall be two and seven-eighths inch outside diameter (2 $\frac{7}{8}$ " O.D.) with a wall thickness of eleven gauge (11 Ga.) and a minimum yield strength of fifty-five thousand pounds per square inch (55,000 psi). Corner posts shall be 4" pipe, outside diameter, 9.1 lbs. per ft.
 3. Rails: Shall be one and five-eighths inch outside diameter (1 $\frac{5}{8}$ " O.D.) pipe with a wall thickness of thirteen gauge (13 Ga.) and a minimum yield strength of fifty five thousand pounds per square inch (55,000 psi) and provided with seven inch (7") long expansion sleeve couplings. Provide top, middle and bottom rails.
 4. Accessories:
 - a. Fabric Ties: Eleven gauge (11 Ga.) galvanized steel tie wire to fasten fabric to framework. Tension wire shall be attached to fabric bottom with heavy galvanized hog rings.
 - b. Tension Wire: Two (2) strands of twelve and half gauge (12.5 Ga.) steel wire twisted together.
 - c. Tension Bands: Beveled edge type with nuts and bolts.
 - d. Line Post Tops: Heavy galvanized cast from eye top fitting.
 - e. Terminal Post Tops: Heavy galvanized iron tops of bullet type construction.
 - f. Coating: All accessories to receive black polyester powder coating.
 5. Gates: Construct gate frames with one and five-eighths inches outside diameter (1 $\frac{5}{8}$ " O.D.) rail material with welded corners. Provide fabric filler same as used in fence and use heavy duty galvanized hardware with lockable latches.
- D. Workmanship: The complete fence shall be plumb, both in line and transverse to the fence, straight and rigid with fabric tightly stretched and held firmly in place. Details of construction not specified, shall be performed in keeping with standard good fencing practices.
- E. Posts: Space all posts not more than eight feet (8') apart and set in concrete, as shown on the drawings.
- F. Rails: Set rails as nearly parallel to the finish grade as possible and at the specified height of the fence.

- G. Fabric Ties: Provide a minimum of six (6) ties for each ten-foot (10') of rail and one tie to each foot of post height. Ties to tension wire shall be made with heavy galvanized hog rings at six (6) per ten foot (10') of tension wire.
- H. Tension Bands: Provide one (1) fastener for each one foot (1') of fabric height.
- I. Gates:
 - 1. Size: Clear opening 3 feet wide by 7 feet high.
 - 2. Provide with transom extending above gate opening to top of fence height indicated.

2.06 TENNIS COURT EQUIPMENT

- A. Manufacturers / Suppliers:
 - 1. E.J. Renner and Associates, Inc., Denver, CO.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.
- B. Tennis Net Posts
 - 1. Model: Vogue 2.5.
 - 2. Internal brass worm-gear take-up, baked-on black polyester powder coating, continuous lacing rod, and galvanized sleeves. Two and half inches (2 ½") square with three-sixteenths inch (3/16") wall thickness.
 - 3. Set in concrete foundations three feet (3') deep by two feet (2') diameter. Net posts to be laid out according to the United States Tennis Court and Track Builders Association specifications.
- C. Nets
 - 1. Model: Edwards 30LS Double Top Net.
 - 2. 3.5 mm double stitched, braided polyethylene (three hundred ten pound – 310 lb. test) body, top six rows of net body are double mesh with extra heavy spun polyester headband.
 - 3. Hung flush with the net posts and thirty-six inches (36") high in the center.
- D. Center Straps
 - 1. Model: TWCS.
 - 2. Two and one-eighth inches (2 1/8") wide, white nylon webbing with adjusting buckle and bottom snap hook.
 - 3. Loop strap around net, hook into anchor, and tighten so that the net is thirty-six inches (36") high in the center.
- E. Center Strap Anchor
 - 1. Model: GAS-30.
 - 2. Anchor is tubular pipe nine inches (9") long by one and seven-eighths inches (1 7/8") diameter with a three-sixteenth inch (3/16") anchoring pin.
 - 3. Set in concrete eight inches by eight inches (8" x 8").
- F. Windscreen Curtain
 - 1. Nine foot (9') high Dacron windscreen fabricated of seven ounce (7 oz.) open mesh polyester with brass grommets every twelve inches (12") along the top, bottom, and sides.
 - 2. The nine foot (9') high curtains shall be accurately measured, fabricated, and attached with nine gauge (9 Ga.) galvanized hog rings and #8 polyrope for the center seam.
- G. Practice Backboards
 - 1. Panels to be green with an integrated white net line.
 - 2. Provide mounting system including all mounting hardware needed for a complete installation.
 - 3. See drawings for size and locations.

PART 3 EXECUTION

3.01 SOIL PREPARATION UNDER THE TENNIS COURTS SLAB

- A. The Contractor's Tennis Court Engineer shall review the geotechnical report(s) and submit proposed soil preparation under the tennis court to the Architect. The soil preparation shall achieve a reduction in the estimated potential vertical movement so that the estimated potential vertical movement is no more than one (1) inch according to the Geotechnical Engineer. The soil preparation shall be in accordance with the recommendations of the Geotechnical Report(s) provided with this Project Manual. If the Geotechnical Engineering report does not provide recommendations for reducing the potential vertical movement to no more than one (1) inch, Proposers shall not assume what will be acceptable but instead shall request information from the Architect at least five (5) days before submitting a proposal. If the Geotechnical Engineering report does not provide recommendations for achieving no more than a one (1) inch estimated potential vertical movement and a request for information is not submitted to the Architect at least five (5) days before Proposals are submitted, and the Proposal is accepted by the Owner, the Contractor shall be responsible for all costs to prepare the soil as recommended by the Geotechnical Engineer to achieve an estimated potential vertical movement of no more than one (1) inch.

3.02 INSTALLATION - TENNIS COURT POST-TENSIONED SLAB

- A. See Section 03 3800 - Post-Tensioned Concrete.

3.03 INSTALLATION - TENNIS COURT LIGHTING

- A. See Division 26 - Tennis Court Lighting

3.04 INSTALLATION - TENNIS COURT COLOR SURFACING

- A. Install in accordance with manufacturer's instructions.
- B. Verify that fencing, drainage, adjacent landscaping, lighting, net posts, center strap anchors, and any curb and gutter work is completed prior to color surfacing.
- C. Surface Preparation: Concrete shall have a wood float or broom finish. **DO NOT STEEL TROWEL CONCRETE. DO NOT ALLOW ANY CURING AGENTS OR HARDENERS TO BE USED.** Concrete must cure for 28 days. Thoroughly remove all dirt, dust, mud, oil, and foreign matter.
- D. The court(s) shall be flooded to check for depressions and irregularities. All depressions ponding water that covers the thickness of a nickel shall be outlined with a construction crayon and filled after acid treating the surface.
- E. Concrete Preparer: Concrete surface must be treated with concrete Preparer solution. After drying, all latent material must be removed from the surface.
- F. All depressions requiring correction shall be filled with Court Patch Binder according to specifications using the following mix:
 - 1. 100 lbs. 60 –80 mesh silica sand (dry).
 - 2. 3 gallons Plexipave court Patch Binder.
 - 3. 1 to 2 gallons Portland Cement (depending on temperature and humidity).
 - 4. Tack Coat – Tack coat is necessary under patches only and shall be as follows:
 - a. Plexipave Court Patch Binder diluted 1 part Court patch Binder to 2 parts water and allowed to dry prior to patching. After patching, the surface shall not vary more than 1/8 inch in 10 ft. measured in any direction.
- G. Primer Coat: Mix and apply California Ti-Coat epoxy primer according to Specification 10.17. NOTE: Plexibond may be used as an alternate for priming concrete courts.
- H. Acrylic Filler Coat: In order to provide a smooth, dense underlayment for the textured color surfacing, one or more applications of California Acrylic Resurfacer shall be applied to the surface according to specifications utilizing the following mix:

1. Acrylic Resurfacer – 55 gallons
 2. Water - 20-40 gallons
 3. Liquid yield = 112-138 gallons
 4. Sand (60 – 80 mesh) 600-900 lbs.
- I. Fortified Plexipave Textured Coats shall be applied by a rubber blade squeegee on the clean, dry surface in 3 applications. To obtain the proper application consistency, the Fortified Plexipave shall be mixed as follows:
1. Plexipave Color Base – 30 gallons
 2. Plexichrome – 20 gallons
 3. Water – 20 gallons
 4. The finished surface shall have a uniform appearance and be free from ridges and tool marks. Colors shall be as selected by the Architect.
- J. Playing Lines – Textured playing lines shall be accurately located, marked and painted with Plexicolor Line Paint, as specified by the U.S. Tennis Association.

3.05 INSTALLATION - TENNIS COURT CHAIN LINK FENCING

- A. Install according to the Chain Link Manufacturers Institute recommendations, these specification or the Design Engineer, whichever is greater.

3.06 INSTALLATION - TENNIS COURT EQUIPMENT

- A. Install according to the manufacturer's recommendation for each component.

3.07 ADJUSTING

- A. Align gates flush with the plane of the fence.

3.08 CLEANING

- A. Upon completion, remove all containers, surplus material and debris, and leave the site in a clean and orderly condition acceptable to the Owner.

END OF SECTION

SECTION 32 31 13
CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fence framework, fabric, and accessories.
- B. Excavation for post bases; concrete foundation for posts.
- C. Manual gates and related hardware.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete anchorage for posts.
- B. Section 08 71 00 - Door Hardware: Gate locking device.

1.03 REFERENCE STANDARDS

- A. ASTM F567 - Standard Practice for Installation of Chain-Link Fence; 2011.
- B. ASTM F668 - Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric; 2011.
- C. ASTM F934- Standard Specification for Standard Colors for Polymer Coated Chain Link Fence Materials.
- D. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework; 2012.
- E. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures; 2010.
- F. ASTM F1234-Standard Terminology Relating to Chain Link Fencing.

1.04 SUBMITTALS

- A. See Section 01 33 00 – Submittal Procedures
- B. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.
- C. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Fence Fabric:
 - 1. Zinc-coated or zinc-5 percent aluminum-mesh metal alloy coated steel core wire; ASTM A392 Class 2, not less than 2 oz/sq ft (610 g/sp m) of uncoated wire surface. Core wire tensile strength 75,000 psi.
 - 2. Size: Helically wound and woven to height of six feet with two inch diamond mesh, with core wire diameter of 0.148 inch (9 gauge) and a break load of 1290 lbf.
 - 3. Selvage shall be knuckled at top and knuckled at bottom.
 - 4. Provide fabric fabricated in one piece widths for fencing in height of 12 feet (3.6m) and less.
 - 5. Comply with CLFMI's "Product Manual".
- B. Fence Framing:
 - 1. Steel Pipe- type I; ASTM F1083, standard weight schedule 40; minimum yield strength of 25,000 psi; sizes as indicated below. Hot dipped galvanized with minimum average 2.0 oz/ft² of coated surface areas.
 - a. Line posts: 1.90 inch o.d. up to 6 feet on center; 2.375 inch o.d. up to 10 feet on center.

- b. Terminal, End, Corner and Pull Posts: 3.0 inch o.d. up to 6 feet on center; 3.975 inch o.d. up to 10 feet on center.
 - c. Rails and Braces: 1.660 inch o.d.
- C. Gate Frames: fabricate chain link swing gates in accordance to ASTM F900 using galvanized tubular members, 2 inches square, weighing 2.60 lb/ft. Fusion or stainless steel welded connections forming rigid one-piece unit.
- 1. Chain Link fence fabric: zinc coated steel wire, ASTM F668, Class 2b, in color, mesh and gauge to match fence. Install fabric with hook bolts and tension bars at all four sides. Attach gate frame at not more than 15 inches on center.
 - 2. Hardware materials: Hot dipped galvanized steel or malleable iron shapes to suit gate size. Field coat moveable parts (i.e. hinges, latch, keeper, and drop bar) with finish provided by manufacturer, to match adjacent finishes.
 - 3. Hinges: Structurally capable of supporting gate leaf and allow opening and closing without binding. Non-lift-off type hinge design shall permit gate to swing 180 degrees inward.
 - 4. Latch: Forked type capable of retaining gate in closed position and have provision for padlock. Latch shall permit operation from either side of gate.
 - 5. Keeper: Provide keeper for each gate leaf over five feet wide. Gate keeper shall consists of mechanical divide for securing free end of gate when in full open position.
 - 6. Double gates: Provide drop rod to hold inactive leaf. Provide gate stop pipe to engage center drop rod. Provide locking device and padlock eyes as an integral part of latch, requiring one padlock for locking both gate leaves.
 - 7. Gate posts: Steel pipe, ASTM F1083, standard weight schedule 40; minimum yield strength of 25,000 psi 2.875 inches in diameter. Hot-dipped galvanized with minimum 1.8 oz/ft² of zinc or respective material finished in accordance with ASTM F1043.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install framework, fabric, accessories and gates in accordance with ASTM F567 and manufacturer's instructions.
- B. Locate terminal post at each fence termination and change in horizontal or vertical direction of 30 degrees or more.
- C. Space line posts uniformly at 10 feet on center.
- D. Concrete fence post footings shall be set in 3000 psi concrete at 28 days.
 - 1. Drill holes in firm, undisturbed or compacted soil. Excavate deeper than specified below as required to adequate support in soft or loose soils, and for posts with heavy lateral loads.
 - 2. Line posts shall be set in 9 inch minimum diameter concrete piers, with a minimum of 33 inches of post embedment in concrete with an additional 3 inch concrete cover at bottom.
 - 3. All end, corner, and pull posts shall be set in minimum 12 inch diameter concrete piers, with a minimum of 33 inches of post embedment in concrete with an additional 3 inch concrete cover at bottom.
 - 4. Place concrete around posts in a continuous pour.
 - 5. Trowel finish around posts. Slope to direct water away from posts.
- E. Check each post for vertical and top alignment, and maintain in position during placement and finishing operations.
- F. Bracing: Install horizontal pipe brace at mid-height for fences six (6) and over, on each side of terminal posts. Firmly attach with fittings. Install diagonal truss rods at these points. Adjust truss rod, ensuring post remain plumb.
- G. Tension wire: Provide tension wire at bottom of fabric. Install tension wire before stretching fabric and attach at each post with ties. Secure tension wire to fabric with 12-1/2 gauge hog rings 24 inches on center.

- H. Top Rail: Install lengths, 21 feet. Connect joints with sleeves for rigid connections for expansion/contraction.
- I. Install gate posts in accordance with manufacturer's instructions.
 - 1. Drill holes in firm, undisturbed or compacted soil. Excavate deeper than specified below as required for adequate support in soft and loose soils and for posts with heavy lateral loads.
 - 2. All gate posts shall be set in minimum 12 inch diameter concrete piers with a minimum of 33 inches of post embedment in concrete with an additional 3 inch concrete cover at bottom.
 - 3. Place concrete around posts in continuous pour.
 - 4. Trowel finish around post. Slope to direct away from posts.
- J. Gate posts and hardware: Set keeper, stops, sleeves into concrete. Check each post for vertical and top alignment, and maintain in position during placement and finishing operations.
- K. Fencing shall be grounded every 1500 feet or within 100 feet of buildings or structures.

END OF SECTION

SECTION 32 31 19
ORNAMENTAL METAL FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Decorative steel fences.

1.02 RELATED REQUIREMENTS

- A. Section 03 33 00 - Cast-in-Place Concrete.
- B. Section 31 23 16 - Excavation.

1.03 REFERENCE STANDARDS

- A. ASTM A283/A283M-13 Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- C. ASTM A787- Standard Specification for Electric-Resistance-Welded Metallic-Coated Carbon Steel Mechanical Tubing.
- D. ASTM F2408 - Ornamental Fences Employing Galvanized Steel Tubular Pickets; 2011.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit 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.
- C. Shop Drawings:
 - 1. Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.
 - 2. Foundation details, concrete design mix and reinforcing schedule for anti-ram barrier system.
- D. Installer's Qualification Statement.
- E. Manufacturer's Warranty.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Installer Qualifications: Experienced with type of construction involved and materials and techniques specified and approved by fence manufacturer.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Store materials in a manner to ensure proper ventilation and drainage. Protect against damage, weather, vandalism and theft.

1.07 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Finish: 15 years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Decorative Metal Fences:
 - 1. Basis of Design: "Estate N" for fence and gates as manufactured by Monumental Iron Works/Master Halco Inc.

2. Basis of Design: "Estate A-1" for double gates as manufactured by Monumental iron Works / Master Halco Inc.

2.02 ORNAMENTAL PICKET FENCE

- A. Pickets: Galvanized square steel tubular members manufactured in accordance with ASTM A787, having a 45,000 psi yield strength and G90 zinc coating, 0.90 oz/ft². Size pickets 3/4 inch by minimum wall thickness 18 gauge. Space pickets 3-15-16 inch maximum face to face. Attach each picket to each rail with 1/4 inch #4 industrial drive rivets.
- B. Rails: 1-1/2 inch x 1-3/8 inch x 1-1/2 inch, 11 gauge thick galvanized steel "U" channel in accordance with ASTM A653 or ASTM A1008, having a 50,000 psi yield strength and G90 zinc coating, 0.90 oz/ft². Punch rails to receive pickets and rivets and attach rails to rail brackets with two each, 1/4 inch #4 industrial drive rivets. Steel for rail produced under ASTM A653.
- C. Posts: Galvanized square steel tubular members manufactured in accordance with ASTM A787 having 45,000 psi yield strength and G90 zinc coating, 0.90oz/ft². Zinc coating is inside and outside. Posts which are zinc coated outside and painted inside are unacceptable. Minimum post size three inches having 12 gauge wall thickness, weighing 4.286 lb/ft.
- D. Accessories: Assembled panels with ornamental accessories attached using industrial drive rivets to prevent removal and vandalism.
- E. Finish: All pickets, channels, posts, fittings and accessories shall be polyester coated individually after drilling and layout, to ensure maximum corrosion protection. All components are given a four stage "Powder Wash" pre-treatment process that cleans and prepares the galvanized surface to assure complete adhesion of the finish coat. All metal is then given a polyester resin based powder coating applied by the electrostatic spray process, to a thickness of 2.5 mils. The finish is then baked in a 450 degrees F (metal temperature) oven for 20 minutes.

2.03 ORNAMENTAL PICKET SWING GATES

- A. Gate Frames: Fabricate ornamental picket swing gates using galvanized steel members ASATM A283, structural quality steel, 45,000 psi tensile strength, with galvanized G90 coating. Frame members welded using stainless steel welded to form rigid one-piece unit (no substitution). Minimum size vertical uprights, two inches square 13 gauge wall thickness.
- B. Ornamental Picket Infill: "U" channel rails, formed from hot rolled, structural steel, 1-3/8 inch wide x 1-1/2 inch deep, 11 gauge wall thickness. Punch rails to receive pickets and weld inside gate frame. Pickets, galvanized steel, 3/4 inch square tube of gauge, spacing and with accessories to match fence. Attach pickets to "U" rails by 1/4 inch industrial drive rivets, size #4.
- C. Bracing: Provide diagonal adjustable length truss rods on gates to prevent sag.
- D. Hardware Materials: Galvanized steel or malleable iron shapes to suite gate size.
- E. Hinges: Structurally capable of supporting gate leaf and allow opening and losing without binding. Non-lift-off type hinge design shall permit gate to swing 180 degrees.
- F. Latch: Capable of retaining gate in closed position and have provision for padlock.
- G. Keeper: Provide keeper for each gate leaf over 5 feet wide. Gate keeper shall consist of mechanical device for securing free end of gate when in full open position.
- H. Double gates: Provide drop rod to hold inactive leaf. Provide gate stop pipe to engage center drop rod. Provide locking device and padlock eyes as an integral part of latch, requiring one padlock for locking both gate leaves.
- I. Gate Posts: Square members, ASTM A787, structural quality steel 45,000 psi tensile strength, with galvanized G90 coating; size as indicated below:

<u>Gate Leaf Single Leaf</u>	<u>Post Size (square)</u>	<u>Post Depth</u>
3 ft to 4 ft	3 inches	36 inches
4 ft to 8 ft	4 inches	42 inches
12 ft to 18 ft	6 inches	48 inches

- J. Polyester Powder Coat Finish: After components have been galvanized to provide maximum corrosion resistance, pre-treat, clean and prepare galvanized surface to assure complete adhesion of finish coat. Apply 2.5 mil thickness of polyester resin based powder coating by electrostatic spray process. Bake finish for 20 minutes at 450 degrees F, metal temperature. Color shall match ornamental picket fence.

2.04 ACCESSORIES

- A. Rail Attachment Brackets- Die cast of zinc (ZAMAK #3 Alloy) in accordance with ASTM B86-83Z 33521. BALL and socket design capable of 30 degree swivel (up/down-left/right) Bracket to fully encapsulate rail end for complete security. (no substitution)
- B. Industrial Drive Rivets: Of sufficient length to attach items in a secure non-rattling position. Rivet to have a maximum of 1100 lbs holding power and a shear strength of 1500 lbs.
- C. Ornamental Picket Fence Accessories: Provide indicated items required to complete fence system. Galvanize each ferrous metal items in accordance with ASTM B695 and finish to match framing.
- D. Post Caps: Formed steel, cast of malleable iron or aluminium allowy, weathertight closure cap. Provide one ball style post cap for each post.
- E. Rings: Cast aluminium. Attach ring to top rail by inserting mounting blocks into top rail and riveting through side of rail using 1/4 inch industrial drive rivet. HOLD bottom of ring in place by dowel that protrudes from ring through pre-drilled hole in bottom rail.
- F. Picket Tops: Flat tops extending above rail.

2.05 SETTING MATERIAL

- A. Concrete: Minimum 28 day compressive strength of 3000 psi.
- B. Flanged Posts: provide flange type base plates with 4 holes for surface mounting of posts where indicated or as required.

PART 3 EXECUTION

3.01 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. Verify areas to receive fencing are completed to final grades and elevations. Ensure property lines and legal boundaries of work are clearly established.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.

3.03 FENCE INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Fence height shall be 8'-0" high unless indicated otherwise.
- C. Space posts uniformly at 7 feet 8-3/4 inches maximum face to face, unless otherwise indicated.
- D. Concrete Set Posts: Drill hole in firm undisturbed or compacted soil. Holes shall have diameter four times greater than nominal outside dimension of post, and depths approximately 6 inches deeper than post bottom. Excavate deeper as required for adequate support in soft and loose soils, and for posts with heavy lateral loads. Set post bottom below surface when in firm, undisturbed soil to depth as indicated in table above. Place concrete around posts in a continuous pour. Trowel finish around posts and slope to direct water away from posts.
1. Gate Posts and Hardware: Set keepers, stops, sleeves and other accessories into concrete. Check each post for vertical and top alignment, and maintain in position during placement and finishing operations.
- E. Surface mount (wall mount) posts with mounting plates where indicated. Fasten with lag bolts and shields.

- F. Check each post for vertical and top alignment, and maintain in position during placement and finishing operation.
- G. Align fence panels between posts. Firmly attach rail brackets to posts with 1/4" (6 mm) bolt and lock nut, ensuring panels and posts remain plumb.

3.04 ORNAMENTAL PICKET GATE FRAMING INSTALLATION

- A. Install gate posts in accordance with manufacturer's instructions
- B. Concrete Set Gate Posts: Drill holes in firm, undisturbed or compacted soil. Holes shall have diameter four times greater than outside dimension of post, and depth approximately 6 inches deeper than post bottom. Excavate deeper as required for adequate support in soft and loose soils, and for posts with heavy lateral loads. Set posts bottom 36 inches below surface when in firm, undisturbed soil. Place concrete around posts in a continuous pour. Trowel finish around post and slope to direct water away from posts.
 - 1. Gate Posts and Hardware: Set keepers, stops, sleeves into concrete. Check each post for vertical and top alignment, and maintain in position during placement and finishing operations.

3.05 GATE INSTALLATION

- A. Gate Height shall be as indicated on drawings.
- B. Install gates plumb, level, and secure for full opening without interference.
- C. Attach hardware by means which will prevent unauthorized removal.
- D. Adjust hardware for smooth operation.

3.06 CLEANING

- A. Leave immediate work area neat at end of each work day.
- B. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.
- C. Clean fence with mild household detergent and clean water rinse well..
- D. Remove mortar from exposed posts and other fencing material using a 10 percent solution of muriatic acid followed immediately by several rinses with clean water.
- E. Touch up scratched surfaces using materials recommended by manufacturer. Match touchup paint color to fence finish.

3.07 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.

END OF SECTION

**SECTION 32 84 10
LANDSCAPE IRRIGATION**

CONDITIONS OF THE CONTRACT, SECTIONS AA THROUGH CB AND DIVISION 1 APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Refer to Section AB – Instructions to Proposers, Section AF – Subcontractor / Manufacturer Prequalification, and Section 01 25 00 – Request for Substitution Procedures.
- B. Scope of Work:
 - 01 Provide a complete underground sprinkler irrigation system in designated areas as indicated on the Drawings.
 - 02 Coordinate with Plumbing contractor for Main stub-out, install all backflow preventers, vacuum breakers and valves required and / or shown on the Drawings.
 - 03 Coordinate with Electrical Contractor for power and connection to irrigation controllers.
 - 04 System shall be complete, including, but not limited to the following:
- C. Section Includes:
 - a. Piping
 - b. Manual valves
 - c. Automatic control valves
 - d. Automatic drain valves
 - e. Sprinklers
 - f. Quick couplers
 - g. Controllers
 - h. Boxes for automatic control valves

1.2 PERFORMANCE REQUIREMENTS

- A. Irrigation zone control shall be automatic operation with controller and automatic control valves.
- B. Intent of Drawings: Sprinkler lines shown on the Drawings are diagrammatic. Locations of all sprinkler heads, valves, piping, wiring, etc. shall be established by the Contractor at the time of construction. Spacing of sprinkler heads and quick coupling valves are shown on the Drawings and shall be exceeded only with the permission of the Owner's authorized representative.
- C. Keep all areas of work clean, neat, and orderly at all times. Keep paved areas clean during installation operations.

1.3 SUBMITTALS

- A. Review and comply with all provisions of section 01 33 00 – Submittal Procedures.
- B. Product Data: For each type of product indicated, provide manufacturer's literature, include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories to demonstrate compliance with the specified requirements.
- C. Wiring Diagrams: For power, signal, and control wiring.

- D. Delegated-Design Submittal: For irrigation systems 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. Zoning Chart: Show each irrigation zone and its control valve.
- F. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.
- G. Field quality-control reports.
- H. Operation and maintenance data for the following:
 - 01 Irrigation controller.
 - 02 Valves and gate valves.
 - 03 Pipe and fittings.
 - 04 Valve boxes.
 - 05 Quick coupling valves.
 - 06 Low voltage wire and connections.
- I. Record Irrigation Drawings:
 - 01 Furnish Record Drawings of complete irrigation system in accordance with the General and Special Conditions.
 - 02 Procure full size, electronic set of Contract Drawings from Landscape Architect.
 - a. Construction Drawings shall be on-site at all times while irrigation system is under construction.
 - b. Make daily record of all work installed each day.
 - c. Actual location of valves and quick couplers and all irrigation and drainage piping shall be shown on prints by dimensions from easily identifiable permanent features, such as buildings, light poles, curbs, fences, walks, or property lines.
 - d. Drawings shall show approved substitutions of material. Include material, manufacturer's name, and catalogue number.
 - e. Drawings shall be to scale and all indications shall be easily understandable, legible, and neat.

1.4 QUALITY ASSURANCE

- A. Requirement of Regulatory Agencies:
 - 01 All work and materials shall be in full accordance with the latest rules and regulations of safety orders of Division of Industrial Safety; the Uniform Plumbing Code and other applicable laws or regulations, including the City of Houston or other local governing body.
 - 02 Nothing in Drawing is to be construed to permit work not conforming to these codes. Should the Contract Documents be at variance with the aforementioned rules and regulations, notify Landscape Architect and get instructions before proceeding with the work.
 - 03 If it is found, and decided by Landscape Architect and the Owner that these plans, details and/or specifications are not being followed or installed correctly by the Irrigation Contractor (IC), requiring additional trips to verify quality or completion of this work, it will be the responsibility of the IC to pay the LA for additional site visits for verification and compliance of this work. Normal billable rates will apply with a three hour minimum including travel one way.
- B. Testing:
 - 01 Preliminary review of completed installation will be made by the Landscape Architect prior to backfilling trenches and during hydrostatic testing.
 - 02 Final review shall be made in conjunction with the final review, shrubs, and tree planting.

03 The contractor is responsible to call the Landscape Architect (LA) and set up a time for the above, 24-48 hours in advance.

C. 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.

1.5 FINAL ACCEPTANCE

A. Work under this Section will be accepted by Landscape Architect upon satisfactory completion of all work. Upon final acceptance, Owner will assume responsibility for maintenance of the work. Said assumption does not relieve Contractor of obligations under Warranty.

1.6 WARRANTY

A. In addition to the manufacturer's guarantees or warranties, all work shall be warranted for one (1) year from the date of Final Acceptance against defects, material, equipment and workmanship by the Contractor. Warranty shall also cover repair of damage to any part of the premises resulting from leaks or other defect in materials, equipment, and workmanship to the satisfaction of the Owner.

B. Contractor shall not be held responsible for failures due to neglect by the Owner, vandalism, etc., during the Warranty or Guarantee period. Report such conditions to the Landscape Architect in writing.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials throughout the system shall be as specified and noted on the Drawings, new and in perfect condition.

B. Submit shop drawings to the Landscape Architect for review prior to installation.

C. Gate Valves: Three inches in size and under, use 125 pound bronze construction, non-rising stem type, sized to line specified on the plan. NIBCO #T113 or approved equal.

D. Sleeves: Control wire and water line sleeves shall be PVC 1120-1220, Schedule 40 pipe.

E. ~~Irrigation Controllers: N/A As shown on Drawings.~~

F. Control Wiring: Solid copper wire, UL approved for direct burial in ground, 14 gauge, type UF with plastic insulation and 600 volt rated. Use 12ga. UF for runs over 1,000 linear feet. Common ground wire shall be white, Red for valves, yellow for tree bubblers, green for mainlines, orange and blue for "extra" valve wire runs.

G. Valve Boxes: These Boxes shall be 14"x19"x12" minimum, injection molded of polymers and fibrous inorganic temperature resistant components. Box shall provide adequate clearance to operate and service valve. Box and lid shall be green in color.

01 Acceptable Manufacturers: NDS, Amtek, Christy, Carson, or approved equal.

02 Valve boxes, Gate Valves, Wire Connector Boxes and Quick Coupler Boxes

03 See details for additional information.

- H. Sprinkler Heads: As shown on Drawings.
- I. Conduit: All conduit for low voltage irrigation control wires shall be 2-inch Schedule 40 PVC. Control wiring may be placed in common sleeve with lateral or main lines under paving when sleeves are larger than 4-inches. Use galvanized steel pipe only under public roads or for high voltage power conductors.
- J. NOTE: Provide a clay dam at piping trenches where piping crosses building perimeter grade beams to prevent water traveling pipes to area below slabs.

2.2 PIPING

- A. General
 - 01 No Class Pipe to be used.
 - 02 Schedule 40 Pipe, continuously and permanently marked with the manufacturer's name or trademark, size, schedule and type of material, working pressure at 73 degrees F., SDR number, ASTM standard number and the NSF (National Sanitation Foundation) seal.
- B. Piping on pressure side of irrigation control valves:
 - 01 Two inch diameter and smaller pipe – ASTM D1785, PVC 1120-1220 compound, Schedule 40.
 - 02 Two to three (2"-3") pipe – ASTM
 - 03 Lay a "tracer wire" in, next to ALL Main Lines installed and back to the controller and labeled for future use. The wire spec is the same as the valve wires, the color shall be green.
- C. Piping on non-pressure side of irrigation control valves:
 - 01 Two inch diameter and smaller – ASTM D1785, PVC 1120-1220 compound, Schedule 40.

2.3 FITTINGS

- A. General
 - 01 PVC pipe and fittings shall be suitable for solvent weld, slip joint ring, tight seal or threaded connections.
 - 02 Pipe on side of Valves shall have a minimum of 18" offset to mainlines or other fittings on either end.
 - 03 Do not use 1-1/4" or 1/2" pipe.
 - 04 Fittings on all mains shall be schedule 80.
 - 05 Fittings on all lateral lines shall be schedule 40, Type 1.
 - 06 All threaded fittings shall be schedule 80, (if any at all).
- B. Fittings for Solvent- Welded Pipe:
 - 01 Schedule 40, polyvinyl chloride, standard weight, as manufactured by "Sloane", "Lasco", or approved equal, to meet ASTM D2466-73 and D-2467-73.
 - 02 Threaded PVC nipples - Schedule 80 PVC.
- C. Fittings for Swing Joints:
 - 01 Use IPS PVC Flex Hose with Weld-On 795 PVC Clear Transparent Glue for standard schedule 40 fittings.
 - 02 No "poly pipe" is to be used anywhere on site.

- 03 Provide Teflon tape on all threaded connections except on the Irrigation head body.
- 04 Size of pipe shall be according to flow requirements and detailed notes.

2.4 PIPING JOINING MATERIALS

- A. Glue and Primer:
 - 01 Pipe Primer: Christy's Purple Primer to be used on all pipe joints, ASTM F656.
 - 02 Pipe Cement: Christy's Red Hot Blue to be used on all pipe joints 3" or smaller, ASTM D2564.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Site Verification of Conditions:
 - 01 Contractor shall be acquainted with all site conditions. Should utilities or other work not shown on the plans be found during site visit or excavations, Irrigation Contractor (IC) shall promptly notify Landscape Architect for instructions prior to further action. Failure to do so will make Contractor liable for any and all damage arising from operations subsequent to discovering of such items or utilities not shown on plans.
 - 02 Contractor shall take necessary precautions to protect site conditions. Should damage be incurred Contractor shall repair damage to its original condition or furnish and install an equal or better replacement.

3.2 LAYOUT

- A. Consideration will not be given to any design changes until after award of contract.
- B. Lay out work as closely to that shown on the Contract Drawings as possible. Contract Drawings are diagrammatic in nature. Adjust layout as necessary to accommodate actual site conditions. Locate pipe and valves shown under paving in adjacent planting areas.
- C. Full and complete coverage is required. Contractor shall make minor adjustments to layout as required to assure full and complete coverage. When such adjustments require exceeding radius limitations shown on irrigation legend, IC shall contact Landscape Architect for direction.
- D. Substitutions for smaller pipe sizes or types will be not be accepted or approved.

3.3 EARTHWORK

- A. After final grading has been performed and accepted, perform excavation as required for installation of work included under this Section, including shoring of earth banks if necessary. Restore all surfaces, existing underground installations, etc., damaged or cut as a result of excavations, to their original condition.
- B. Should utilities not shown on the plans be found during excavation, promptly notify General Contractor and Landscape Architect for instructions as to further action. Failure to do so will make Contractor liable for any and subsequent discovery of such utilities. Indicate such utility crossings on the Record Drawings promptly.
- C. Dig trenches wide enough to allow a minimum of 3-inches of fill between parallel pipe lines. Trenches shall be of sufficient depth of proved minimum cover from finish grade as follows:
 - 01 Over pipe on pressure side of irrigation control valve, control wires and quick coupling valves: 18 inches.

02 Over pipe on non-pressure side of irrigation control valve: 12 inches.

- D. Trenching within the drip-line of existing trees shall be dug by hand only without severing roots which exceed 1-1/2' in diameter. Notify the Landscape Architect immediately if site conditions prohibit such action. Tunnel under or over roots, still at minimum requirements and allowing at least 3" soil space to the root.

3.4 PIPING INSTALLATION

A. General:

- 01 Location and Arrangement: NOTE: Drawings indicate location and arrangement of piping systems. Install piping as indicated unless deviations are approved and initialed by LA on Coordination Drawings.
- 02 Keep all pipes and fittings clean and free of dirt and moisture before assembly using a temporary cardboard or plastic matt.
- 03 Lay piping on solid subbase, uniformly install piping free of sags and depressions. See "snaking" requirements note below.
- 04 Install groups of pipes parallel to each other, spaced to permit dirt layers between main lines, laterals and to allow valve servicing.
- 05 Install fittings for changes in direction and branch connections.
- 06 Install expansion loops, as needed, in valve boxes for plastic piping.
- 07 Install PVC piping in dry weather when temperature is above 40 degrees F. Allow joints to cure at least 24 hours at temperatures above 45 degrees F. before testing.

B. Solvent-Welded Joints for PVC Pipes:

- 01 Use solvents and methods by pipe manufacturer
- 02 Cure joint a minimum of one hour before applying any external stress on the piping and at least twenty four (24) hours before placing the joint under water pressure.

C. Threaded Joints for Plastic Pipes:

- 01 Use Teflon tape on the threaded PVC fittings, ONLY at Main line tie-ins.
- 02 Use strap-type friction wrench only. Do not use metal-jawed wrench.
- 03 When connection is plastic to metal, male adaptors shall be used. The male adaptor shall be hand tightened, plus one turn with a strap wrench. Joint compound shall be Teflon tape or approved equal.

D. Joints for Polyethylene Pipes:

- 01 NO Poly pipe to be used, only flexible PVC, see specs above.

E. Laying of Pipe:

- 01 NOTE: Pipes shall be bedded in at least 2-inches of finely divided material, preferably sand or a sandy loam with no rocks or clods over 1-inch diameter to provide a uniform bearing.
- 02 Pipe shall be "snake" from side-to-side of trench bottom at least every 40 ft. to allow for expansion and contraction along with the „main line trace wire“. One additional foot per 100 feet of pipe is the minimum allowance for snaking.
- 03 Do not lay PVC pipe when there is water in the trench.
- 04 Install plastic pipe in a manner to provide for expansion and contraction as recommended by the manufacturer.
- 05 Cut plastic pipe with PVC pipe cutters to ensure a square cut. Remove any burrs at cut ends prior to installation to ensure that a smooth unobstructed flow will be obtained.
- 06 All plastic-to-plastic joints shall be solvent-weld joints or slip seal joints as specified shall be used. Install plastic pipe and fittings as outlined and instructed by pipe manufacturer. It shall be the Contractor's responsibility to make arrangements with the pipe manufacturer for any field assistance that may be necessary. Contractor shall assume full responsibility for the correct installation.

3.5 EQUIPMENT INSTALLATION

- A. Gate Valves: Group valves together per plan where possible, minimum of two together, no isolated valves by themselves. Box shall be flush with finish grade.

- B. Irrigation Control Valves:
 - 01 Install control valves in valve boxes as shown and group at least two together minimum.
 - 02 Place Valves no closer than two feet from Mainlines, three feet to walk edges, buildings, or walls. Valve boxes shall be flush with finish grade with a strip of sod around the boxes.

- C. Sprinkler Heads:
 - 01 Place all rotary pop-up sprinkler heads in lawn areas on swing joints as Detailed on Drawings with top of heads. Place part-circle rotary pop-up sprinkler heads 6-inches from edge of and flush with top of adjacent walks, header boards, curbs, mowing bands, or paved areas at time of installation. Install rotary sprinklers on a swing joint assembly as detailed.
 - 02 Install spray heads and bubbler heads on a swing joint assembly as detailed on the Drawings.

- D. Quick Coupling Valves: Install quick coupling valves on a swing joint assembly as detailed on the Drawings.

- E. Control Wiring:

Install control wires with sprinkler mains and laterals in common trenches wherever possible. Lay to the side of pipe line. Provide looped slack at valves and snake wires in trench to allow for contraction of wires. Tie wires in bundles at ten (10') foot intervals.

 - 01 Crimp and seal control wire splices at remote control valves with specified splicing materials. Line splices will be allowed only on runs of more than 500 feet. Line splices to be Scotchlok and sealed with Scotchkote sealer.
 - 02 Install a minimum of two, (2) extra control wires, to the control valve located the greatest distance from the controller in BOTH directions, blue on one side and orange in the other direction, label each end blanks.

- F. Closing of Pipe and Flushing of Lines:
 - 01 Cap or plug all openings as soon as lines have been installed to prevent entrance of materials that would obstruct the pipe or heads. Leave in place until removal is necessary for completion of installation.
 - 02 Thoroughly flush out all water lines before installing heads, valves and other hydrants.
 - 03 Test as specified.
 - 04 Upon completion of testing, complete assembly and adjust sprinkler heads for proper distribution.

- 05 All sprinkler heads and quick coupling valves shall be set perpendicular to finished grades unless otherwise designated on the Drawings, or otherwise specified. Sprinkler heads adjacent to existing walls, curbs and other paved areas, shall be set to grade. Sprinkler heads which are to be installed in lawn areas where the turf has not yet been established shall be set 1/2-inch above the proposed finish grade. Heads installed in this manner will be lowered to grade when the turf is sufficiently established to allow walking on it without appreciable destruction. Such lowering of heads shall be done by Contractor as part of the original contract with no additional cost to the Owner.

3.6 BACKFILL AND COMPACTING:

- A. After system is operating and required tests and inspections have been made, backfill excavations and trenches half-way, with clean soil free of debris, then “water-in” soil and tampen to remove air pockets, then repeat this process with the balance of the material.
- B. Backfill for all trenches, regardless of the type of pipe covered, shall be compacted to minimum 95 percent density under pavements, and 85 percent under planted areas.
- C. Compact trenches in areas to be planted by thoroughly flooding backfill. Jetting process may be used in those areas.
- D. Dress off all areas to finish grades.

3.7 WARRANTY

- A. The Contractor shall warrant all materials and workmanship for one (1) year from final acceptance.

3.8 CLEAN UP

- A. Clean up and remove all debris from the entire work area prior to Final Acceptance to satisfaction of Landscape Architect.

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Perform hydrostatic tests when welded PVC joints have cured per manufacturer's instructions.
 - 01 Pressurized Mains:
 - a. Completely install mains, gate valves, and control valves. Do not install laterals.
 - b. Fill all lines with water.
 - c. Pressurize the main with air to 70 psi. Monitor gauge for pressure loss for four (4) hours. Maximum allowable loss over four (4) hour period - 3 psi.
 - d. Leave lines and fittings exposed throughout testing period.
 - e. Leaks resulting from tests shall be repaired and tests repeated until the system passes.
 - f. Test all gate valves for leakage.
 - 02 Non-Pressure Laterals:
 - a. Test piping after laterals and risers are installed and system is fully operational.
 - b. Leave trenches open to detect possible leaks.
- C. Submit written requests for inspections to the Landscape Architect at least forty eight (48) hours prior to anticipated inspection date.
- D. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

- 01 Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.
 - 02 Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Any irrigation product will be considered defective if it does not pass tests and inspections.
 - F. Prepare test and inspection reports, submit to Landscape Architect.

3.10 ADJUSTING

- A. Adjust settings of controllers.
- B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.
- C. Adjust sprinklers and devices, except those intended to be mounted aboveground, so they will be flush with, or not more than 1/2 inch above, finish grade.

END OF SECTION

SECTION 32 91 13.13

TOPSOIL PLACEMENT AND GRADING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnishing and placing topsoil for finish grading and for seeding, sodding, and planting in areas other than designated athletic fields.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for topsoil is on a cubic yard basis.
 - 2. Payment for grading shall be incidental to the project unless included on the bid form.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

PART 2 PRODUCTS

2.1 TOPSOIL

- A. Topsoil shall be fertile, friable, natural sandy loam surface soil obtained from excavation or borrow operations having following characteristics:
 - 1. pH value of between 5.5 and 6.5
 - 2. Liquid limit: 50 or less
 - 3. Plasticity index: 20 or less
 - 4. Gradation: maximum of 10 percent passing No. 200 sieve
- B. Topsoil shall be reasonably free of subsoil, clay lumps, weeds, non-soil materials, and other litter or contamination. Topsoil shall not contain roots, stumps, and stones larger than 2 inches.
- C. Obtain topsoil from naturally well-drained areas where topsoil occurs at minimum depth of 4 inches and has similar characteristics to that found at placement site. Do not obtain topsoil from areas infected with growth of, or reproductive parts of nut grass or other noxious weeds.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Excavate topsoil for esplanades and areas to receive grass or landscaping from areas to be further excavated. Stockpile in area approved by Owner's Representative.
- B. Stockpile topsoil to depth not exceeding 8 feet. Cover to protect from erosion.

3.2 TOPSOIL EXCAVATION

- A. Conform to excavation and stockpiling requirements of Division 31.

3.3 PLACEMENT

- A. Place no topsoil until subgrade has been approved. For areas to be seeded or sodded, scarify or plow existing material to minimum depth of 4 inches, or as indicated on Drawings. Remove vegetation and foreign inorganic material. Place 4 inches of topsoil on loosened material and roll lightly with appropriate lawn roller to consolidate topsoil.
- B. Increase depth of topsoil to 6 inches when placed over sand bedding and backfill materials specified in Division 31.
- C. For areas to receive shrubs or trees, excavate existing material and place topsoil to depth and dimensions shown on Drawings.
- D. Remove spilled topsoil from curbs, gutters, and, paved areas and dispose of excess topsoil in accordance with requirements of Division 1.
- E. Place topsoil to promote good drainage and compact with light roller. Water topsoil after placement until saturated for minimum depth 6 inches, fill in and recompact areas of settlement.

3.4 PROTECTION

- A. Protect topsoil from wind and water erosion until planting is completed.

END OF SECTION

SECTION 32 92 13

HYDRO - MULCHING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Seeding, fertilizing, mulching, and maintenance in areas other than designated athletic fields.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for Hydro-mulch is on a per acre basis.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract; payment for work in this Section is included in total Stipulated Price.

1.3 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit certification from supplier that each type of seed conforms to these specifications and requirements of Texas Seed Law. Certification shall accompany seed delivery.
- C. Submit certificate stating that fertilizer complies with these specifications and requirements of Texas Fertilizer Law.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Topsoil: Conform to material requirements of Division 32.
- B. Seed: Conform to U.S. Department of Agriculture rules and regulations of Federal Seed Act and Texas Seed Law. Seed shall be certified 90 percent pure and furnish 80 percent germination and meet following requirements:
 - 1. Rye: Fresh, clean, Italian rye grass seed (loium multi-florum), mixed in labeled proportions. As tested, minimum percentages of impurities and germination must be labeled. Deliver in original unopened containers.
 - 2. Bermuda: Extra-fancy, treated, lawn type common bermuda (Cynodon dactylon). Deliver in original, unopened container showing weight, analysis, name of vendor, and germination test results.
 - 3. Wet, moldy, or otherwise damaged seed will not be accepted.
 - 4. Seed requirements, application rates, and planting dates are:

TYPE	APPLICATION RATE POUNDS/A	PLANTING DATE
Hulled Common Bermuda Grass 98/88	40	Jan 1 to Mar 31
Unhulled Common Bermuda Grass 98/88	40	
Hulled Common Bermuda Grass 98/88	40	Apr 1 to Sep 30
Hulled Common Bermuda Grass 98/88	40	Oct 1 to Dec 31
Unhulled Common Bermuda Grass 98/88	40	
Annual Rye Grass (Gulf)	30	

- C. Fertilizer: Dry and free flowing, inorganic, water soluble commercial fertilizer, which is uniform in composition. Deliver in unopened containers which bear manufacturers guaranteed analysis. Caked, damaged, or otherwise unsuitable fertilizer will not be accepted. Fertilizer shall contain minimum percentages of following elements:
 - 1. Nitrogen: 10 Percent
 - 2. Phosphoric Acid: 20 Percent
 - 3. Potash: 10 Percent
- D. Mulch:
 - 1. Virgin wood cellulose fibers from whole wood chips having minimum of 20 percent fibers 0.42 inches in length and 0.01 inches in diameter.
 - 2. Cellulose fibers manufactured from recycled newspaper and meeting same fiber content and size as for cellulose fibers from wood chips.
 - 3. Dye mulch green for coverage verification purposes.
- E. Soil Stabilizer: "Terra Tack 1" or approved equal.
- F. Weed control agent: Pre-emergent herbicide for grass areas, such as "Benefin," or approved equal.

PART 3 EXECUTION

3.1 PREPARATION

- A. Place and compact topsoil in accordance with requirements of Division 32.
- B. Dispose of Objectionable and Waste Materials in accordance with Division 1.

3.2 APPLICATION

- A. Seed: Apply uniformly at rates given in Paragraph 2.01 B for type of seed and planting date.
- B. Fertilizer: Apply uniformly at rate of 500 pounds per acre.
- C. Mulch: Apply uniformly at rate of 50 pounds per 1000 square feet.
- D. Soil Stabilizer: Apply uniformly at rate of 40 pounds per acre.
- E. Weed Control Agent: Apply at manufacturer's recommended rate prior to hydro mulching.
- F. Sod: Lay single row of sod along perimeter where top soil and pavement intersect. Apply in conformance to Division 32.
- G. Suspend operations under conditions of drought, excessive moisture, high winds, or extreme or prolonged cold. Obtain Owner's Representative approval before resuming operations.

3.3 MAINTENANCE

- A. Maintain grassed areas minimum of 90 days, or as required to establish an acceptable lawn. For areas seeded in fall, continue maintenance following spring until acceptable lawn is established.
- B. Maintain grassed areas by watering, fertilizing, weeding, and trimming.

- C. Repair areas damaged by erosion by regrading, rolling and replanting.
- D. Reseed small, sparse grass areas. When sparse areas exceed 20 percent of planted area, reseed by hydro mulch.
- E. Mow grass when height reaches 3 1/2 inches or greater on average before final acceptance. Mow to height of 2 1/2 inches.

END OF SECTION

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SECTION 32 92 23

SODDING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Restoration of existing lawn areas disturbed by construction shall be by installation of new sod.
- B. Planting of sod within areas designated on Drawings for purpose of surface stabilization, channel stabilization or vegetation buffer strips.
- C. Sod is defined as blocks, squares, strips of turfgrass, and adhering soil used for vegetative planting. To be placed edge to edge for complete coverage.
- D. Lawn is defined as ground covered with fine textured grass kept neatly mowed.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices
 - 1. Payment for sodding is on square yard basis.
 - 2. Refer to Division 1 for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 SUBMITTALS

- A. Conform to requirements of Division 1.

1.4 QUALITY ASSURANCE

- A. Sod only when weather and soil conditions are deemed by Owner's Representative to be suitable for proper placement.
- B. Water and fertilize new sod.
- C. Guarantee sod to be growing 30 days after substantial completion.
- D. Maintenance Period:
 - 1. Begin maintenance immediately after each section of grass sod is installed and continue for 30 day period from date of substantial completion.
 - 2. Resod unacceptable areas.
 - 3. Water, fertilize, control disease and insect pests, mow, edge, replace unacceptable materials, and perform other procedures consistent with good horticultural practice to ensure normal, vigorous and healthy growth. Install disease control within guidelines set forth by Structural Pest Control Board of the State of Texas.
- E. Notify Owner's Representative 10 days before end of maintenance period for inspection.

PART 2 PRODUCTS

2.1 SOD

- A. Species: Bermuda (Cynodon Dactylon), Buffalo (Buchloe Dactyloides), or St. Augustine (Stenotaphrum Secundatum) Gulf Coast variety to match existing sod.
- B. Contents: 95 percent permanent grass suitable to climate in which it is to be placed; not more than 5 percent weeds and undesirable grasses; good texture, free from obnoxious grasses, roots, stones and foreign materials.
- C. Size: 12 inch wide strips, uniformly 2 inches thick with clean-cut edges.
- D. Sod is to be supplied and maintained in healthy condition as evidenced by grass being normal green color.

2.2 FERTILIZER

- A. Available nutrient percentage by weight: 12 percent nitrogen, 4 percent phosphoric acid, and 8 percent potash; or 15 percent nitrogen, 5 percent phosphoric acid, and 10 percent potash.

2.3 WEED AND INSECT TREATMENT

- A. Provide acceptable treatment to protect sod from weed and insect infestation. Submit treatment method to Owner's Representative for approval. Install insect and disease control within guidelines set forth by Structural Pest Control Board of the State of Texas.

2.4 WATER

- A. Potable, available on-site through Contractor's water trucks. Contractor may use public water when water use is measured through Contractor's meter. Do not use private resident's water.

2.5 BANK SAND

- A. Free of clay lumps, roots, grass, salt or other foreign material.

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify that soil placement and compaction have been satisfactorily completed. Verify that soil is within allowable range of moisture content.
- B. Top soil shall be free of weeds and foreign material immediately before sodding.
- C. Do not start work until conditions are satisfactory. Do not start work during inclement or impending inclement weather.
- D. Rake areas to be sodded smooth, free from unsightly variations, bumps, ridges or depressions.
- E. Spread 2 inch layer of bank sand over areas to be sodded prior to planting of sod.
- F. Apply fertilizer at rate of 25 pounds per 1000 square feet. Apply after raking soil surface and not more than 48 hours prior to laying sod. Mix thoroughly into upper 2 inches of soil. Lightly water to aid in dissipation of fertilizer.

3.2 APPLICATION

- A. Full Sodding: Lay sod with closely fitted joints leaving no voids and with ends of sod strips staggered. Lay sod within 24 hours of harvesting.
- B. On slopes 2:1 and steeper, lay sod perpendicular to slope and secure every row with wooden pegs at maximum 2 feet on center. Drive pegs flush with soil portion of sod.
- C. Prior to placing sod, on slopes 3:1 or where indicated, place Hold/Gro or Roll Lite or equal over topsoil. Securely anchor in place with posts sunk firmly into ground at maximum 16 feet on center along pitch of slope and equal to width of wire mesh horizontally across slopes.
- D. After sod is laid, irrigate thoroughly to secure 6-inch minimum penetration into soil below sod.
- E. Tamp and roll sod with approved equipment to eliminate minor irregularities and to form close contact with soil bed immediately after planting and watering. Submit type of tamping and rolling equipment to be used to Owner's Representative for approval, prior to construction.

3.3 MAINTENANCE

- A. Watering:
 - 1. Water lawn areas once a day with minimum 1/2 inch water for first 3 weeks after area is sodded.
 - 2. After 3 week period, water twice a week with 3/4 inch of water each time unless comparable amount has been provided by rain.
 - 3. Make weekly inspections to determine moisture content of soil unless soil is in frozen condition.
 - 4. Water in afternoon or at night to enable soil to absorb maximum amount of water with minimum evaporation.
- B. Mowing:
 - 1. Mow sod at intervals which will keep grass height from exceeding 3 1/2 inches.
 - 2. Set mower blades at 2 1/2 inches.
 - 3. Do not remove more than one-half of grass leaf surface.
 - 4. Mow sodded areas requiring mowing within 1 month after installation with light-weight rotary type mower. Mow sod only when dry and not in saturated or soft condition.
 - 5. Remove grass clippings during or immediately after mowing.
- C. Fertilizer and Pest Control:
 - 1. Evenly spread fertilizer composite at rate of 40 pounds per 5000 square feet or as recommended by manufacturer. Do not place fertilizer until 2 weeks after placement of sod.
 - 2. Restore bare or thin areas by topdressing with mix of 50 percent sharp sand and 50 percent sphagnum peat moss.
 - 3. Apply mixture 1/4 to 1/2 inch thick.
 - 4. Treat areas of heavy weed and insect infestation as recommended by treatment manufacturer.
- D. Restrict all traffic from sodded areas until sod is established or for minimum 10 days during growing season. Use wood lath and plastic tape to cordon sodded areas. Maintain tape and lath throughout for minimum 30 days during growing season.

3.4 CLEANUP

- A. During course of planting, remove excess and waste materials; keep lawn areas clean and take precautions to avoid damage to existing structures, plants, grass, and streets.

- B. Remove barriers, signs, and other Contractor material and equipment from project site at termination of establishment period.
- C. Dispose of unused materials and rubbish in accordance with Division 1.

END OF SECTION

SECTION 33 05 13

MANHOLES AND STRUCTURES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Precast concrete manholes for sanitary sewers, storm sewers, and water lines.
- B. Precast concrete sanitary sewer manholes with PVC liner where corrosion resistant manholes.
- C. Pile-supported concrete foundation used for unstable subgrade treatment for manhole base.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment is on a unit price basis for each manhole and structure installed.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ASME B 16.1 -Cast Iron Pipe Flanges and Flanged Fittings
- B. ASTM A 307 -Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile
- C. ASTM A 615 -Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- D. ASTM C 270-Standard Specification for Mortar for Unit Masonry
- E. ASTM C 443 -Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
- F. ASTM C 478 -Standard Specification for Precast Reinforced Concrete Manhole Sections
- G. ASTM C 923 -Standard Specifications for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes
- H. ASTM C 1107 -Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
- I. ASTM D 698 -Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/fr')
- J. ASTM D 2665 -Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste and Vent Pipe and Fittings
- K. ASTM D 2996 -Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

- L. ASTM D 2997 -Standard Specification for Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe
- M. AWWA C 213 -Standard for Fusion Bonded Epoxy Coating for Interior and Exterior of Steel Water Pipelines
- N. American Association of State Highway and Transportation Officials (AASHTO)

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit manufacturer's data and details of following items for approval:
 - 1. Shop drawings of manhole sections, base units and construction details, including reinforcement, jointing methods, materials and dimensions.
 - 2. Summary of criteria used in manhole design including, as minimum, material properties, loadings, load combinations, and dimensions assumed. Include certification from manufacturer that precast manhole design is in full accordance with ASTM C 478 and design criteria as established in Paragraph 2.01E of this Specification.
 - 3. Frames, grates, rings, and covers
 - 4. Materials to be used in fabricating drop connections
 - 5. Materials to be used for pipe connections at manhole walls
 - 6. Materials to be used for stubs and stub plugs, if required
 - 7. Materials and procedures for corrosion-resistant liner and coatings, if required.
 - 8. Plugs to be used for sanitary sewer hydrostatic testing
 - 9. Manufacturer's data for pre-mix (bag) concrete, if used for channel inverts and benches
- C. Seal submittal drawings by Professional Engineer registered in State of Texas.

PART 2 PRODUCTS

2.1 PRECAST CONCRETE MANHOLES

- A. Provide manhole sections, base sections, and related components conforming to ASTM C 478. Provide base riser section with integral floors, unless shown otherwise. Provide adjustment rings which are standard components of manufacturer of manhole sections. Mark date of manufacture and name or trademark of manufacturer on inside of barrel.
- B. Construct barrels for precast manholes from standard reinforced concrete manhole sections of diameter indicated on Drawings. Use various lengths of manhole sections in combination to provide correct height with fewest joints. Design wall sections for depth and loading conditions in Paragraph 2.01 E, with minimum thickness of 5 inches. Base section shall have minimum thickness of 12 inches under invert.
- C. Provide tops to support HS-20 vehicle loading, and receive cast iron frame covers, as indicated on Drawings.

- D. Where manholes larger than 48-inch diameter are indicated on Drawings, provide precast base sections with flat slab top precast sections used to transition to 48-inch diameter manhole access riser sections. Transition can be concentric or eccentric unless otherwise shown on Drawings. Locate transition to provide minimum of 7-foot head clearance from base to underside of transition unless otherwise approved by Owner's Representative.
- E. Design Loading Criteria: Manhole walls, transition slabs, cone tops, and manhole base slab shall be designed, by manufacturer, to requirements of ASTM C 478 for depth as shown on Drawings and to resist following loads.
 - 1. AASHTO HS-20 vehicle loading applied to manhole cover and transmitted down to transition and base slabs
 - 2. Unit soil weight of 120 pcf located above portions of manhole, including base slab projections
 - 3. Lateral soil pressure based on saturated soil conditions producing an at-rest equivalent fluid pressure of 100 pcf
 - 4. Internal liquid pressure based on unit weight of 63 pcf
 - 5. Dead load of manhole sections fully supported by transition and base slabs
- F. Design: Manhole walls, transition slabs, cone tops, and manhole base slab shall be designed according to requirements of ASTM C 478 and following:
 - 1. Design additional reinforcing steel to transfer stresses at openings. Area of steel to be no less than shown on Drawings.
 - 2. Wall loading conditions:
 - a. Saturated soil pressure acting on empty manhole
 - b. Manhole filled with liquid to a halfway depth as measured from invert to cover, with no balancing external soil pressure
 - 3. Minimum clear distance between two wall penetrations shall be 12 inches or half diameter of smaller penetration, whichever is greater
- G. Provide joints between sections with o-ring gaskets conforming to ASTM C 443.
- H. When base is cast monolithic with portion of vertical section, extend reinforcing in vertical section into base.
- I. Precast Concrete Base: Suitable cutouts or holes to receive pipe and connections. Lowest edge of holes or cutouts: For water line manhole, no less than 6 inches above inside surface of floor of base.

2.2 CONCRETE

- A. Conform to requirements of Division 32.
- B. Channel Inverts: Use 5 sack premix (bag) concrete or Class A concrete for inverts not integrally formed with manhole base, with minimum compressive strength of 4000 psi.
- C. Cement Stabilized Sand Foundation: Provide cement stabilized sand foundation under base section in lieu of foundation slab, as shown on Drawings, conforming to requirements of Division 31.
- D. Concrete Foundation: Provide Class A concrete with minimum compressive strength of 4000 psi for concrete foundation slab under manhole base section where indicated on Drawings.

2.3 REINFORCING STEEL

- A. Conform to requirements of Division 32.

2.4 MORTAR

- A. Conform to requirements of City of Houston Standard Specifications Section 04061 – Mortar.

2.5 MISCELLANEOUS METALS

- A. Provide cast-iron frames, rings, and covers conforming to requirements of Division 33.

2.6 DROP CONNECTIONS AND STUBS

- A. Provide drop connections and stubs conforming to same pipe material requirements used in main pipe, unless otherwise indicated on Drawings.

2.7 PIPE CONNECTIONS TO MANHOLE

- A. Sanitary Sewers.
 - 1. Provide resilient connectors conforming to requirements of ASTM C 923. Use the following materials for metallic mechanical devices as defined in ASTM C 923:
 - a. External clamps: Type 304 stainless steel
 - b. Internal, expandable clamps on standard manholes: Type 304 stainless steel, 11 gauge minimum.
 - c. Internal, expandable clamps on corrosion-resistant manholes:
 - 1) Type 316 stainless steel, 11 gauge minimum
 - 2) Type 304 stainless steel, 11 gauge minimum, coated with minimum 16 mil fusion-bonded epoxy conforming to AWWA C 213
 - 2. Where rigid joints between pipe and cast-in-place manhole base are specified or shown on Drawings, provide polyethylene-isoprene water-stop meeting physical property requirements of ASTM C 923, such as Press-Seal WS Series, or approved equal.
- B. Storm Sewer Connections:
 - 1. Provide watertight connections in accordance with ASTM C 923.
- C. Water Lines
 - 1. Where smooth exterior pipes, i.e., steel, ductile iron, or PVC pipes are connected to manhole base or barrel, seal space between pipe and manhole wall with assembly consisting of rubber gasket or links mechanically compressed to form a watertight barrier. Assemblies: Press-Wedge, Res-Seal, Thunderline Link-Seal, or approved equal. See Drawings for placement of assembly in manhole sections.
 - 2. When connecting concrete or cement mortar coated steel pipes, or as option for connecting smooth exterior pipes to manhole base or barrel, space between pipe and manhole wall may be sealed with an assembly consisting of a stainless steel power sleeve, stainless steel take-up clamp and a rubber gasket. Take-up clamp: Minimum

of 9/16 inch wide. Provide PSX positive seal gasket system by Press-Seal Gasket Corporation or approved equal.

2.8 SEALANT MATERIALS

- A. Provide sealing materials between precast concrete adjustment ring and manhole cover frame, Adeka Ultraseal P201, or approved equal.
- B. Provide approved external sealing material from Canusa Wrapid Seal manhole encapsulation system, or approved equal.
- C. Provide Butyl Sealant: Provide Press-Seal EZ Stick, or equal, for HDPE rings.

2.9 CORROSION RESISTANT MANHOLE MATERIALS

- A. Where corrosion-resistant manholes or PVC-lined manholes are indicated on Drawings, provide one of following:
 - 1. PVC liner for precast cylindrical manhole section, base sections, and cone sections in accordance with Division 33.
 - 2. Precast base sections, as specified above, lined with PVC or equal and fiberglass manholes in accordance with Division 33.

2.10 BACKFILL MATERIALS

- A. Conform to requirements of Division 31.

2.11 NON-SHRINK GROUT

- A. Provide prepackaged, inorganic, flowable, non-gas-liberating, non-metallic, cement-based grout requiring only addition of water.
- B. Meet requirements of ASTM C 1107 and have minimum 28-day compressive strength of 7000 psi.

2.12 VENT PIPES

- A. Provide external vent pipes for manholes where indicated on Drawings.
- B. Buried Vent Pipes: Provide 3 inch or 4 inch PVC DWV pipe conforming to ASTM D 2665. Alternatively, provide FRP pipe as specified for vent outlet assembly.
- C. Vent Outlet Assembly: Provide vent outlet assembly as shown on Drawings, constructed of following specified materials:
 - 1. FRP Pipe: Provide filament wound FRP conforming to ASTM D 2996 or centrifugally cast FRP conforming to ASTM D 2997. Seal cut ends in accordance with manufacturer's recommendations.
 - 2. Joints and Fittings: Provide epoxy bodied fittings and join pipe to fittings with epoxy adhesive
 - 3. Flanges: Provide socket-flange fittings for epoxy adhesive bonding to pipe ends where shown on Drawings. Meet bolt pattern and dimensions for ASME B 16.1, 125-pound flanges. Flange bolts shall be Type 304 stainless steel or hot-dip zinc coated, conforming to ASTM A 307, Class A or B.

4. Coating: Provide approved 2-component, aliphatic polyurethane coating using primer or tie coat recommended by manufacturer. Provide two or more coats to yield dry film thickness of at least 3 mils. Color shall be selected by The Engineer from manufacturer's standard colors.

2.13 PROHIBITED MATERIALS

- A. Do not use brick masonry for construction of manholes, including adjustment of manholes to grade unless approved by the Engineer. Use only specified materials listed above.

2.14 MANHOLE LADDER FOR WATERLINE MANHOLES

- A. Manhole Ladder: Fiberglass with 300-lb rating at appropriate length; conform to requirements of Occupational Safety and Health Standards (OSHA), U.S. Department of Labor except where shown on Drawings.
 1. Use components, including rungs, made of fiberglass, fabricated with nylon or aluminum rivets and/or epoxy. Apply non-skid coating to ladder rungs. Mount ladder using manufacturer's recommended hardware.
 2. Provide ladder as manufactured by Saf-Rail or approved equal. Locate ladder as shown on Drawings.
 3. Fiberglass: Premium type polyester resin, reinforced with fiberglass; constructed to provide complete wetting of glass by resin; resistant to rot, fungi, bacterial growth and adverse effects of acids, alkalis and residential and industrial waste; yellow in color.
 4. Provide approved petroleum-based tape encapsulating bolts in access manhole.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that lines and grades are correct.
- B. Determine if subgrade, when scarified and recompacted, can be compacted to 95 percent of maximum Standard Proctor Density according to ASTM D 698 prior to placement of foundation material and base section. When proper density is not reached, moisture condition subgrades until that density is reached or treat as unstable subgrade.
- C. Do not build manholes in ditches, swales, or drainage paths unless approved by the Engineer.

3.2 PLACEMENT

- A. Install precast manholes to conform to locations and dimensions shown on Drawings.
- B. Place sanitary and storm manholes at points of change in alignment, grade, size, pipe intersections, and end of sewer unless otherwise shown on Drawings.

3.3 MANHOLE BASE SECTIONS AND FOUNDATIONS

- A. Place precast base on 12 inch thick (minimum) foundation of crushed stone wrapped in filter fabric, cement stabilized sand, or concrete foundation slab. Compact cement-sand in accordance with requirements of Division 2.
- B. Unstable Subgrade Treatment: When unstable subgrade is encountered, notify the Engineer for examination of subgrade to determine if subgrade has heaved upwards after being excavated.

When heaving has not occurred, over-excavate subgrade to allow for 24 inch-thick layer of crushed stone wrapped in filter fabric as foundation material under manhole base. When there is evidence of heaving, provide pile-supported concrete foundation, as detailed on Drawings, under manhole base.

3.4 PRECAST MANHOLE SECTIONS

- A. Install sections, joints, and gaskets in accordance with manufacturer's printed recommendations.
- B. Install precast adjustment rings above tops of cones or flat-top sections as required to adjust finished elevation and to support manhole frame.
- C. Seal any lifting holes with non-shrink grout.
- D. Where PVC liners are required, seal joints between sections in accordance with manufacturer's recommendations.
- E. Place at least two precast concrete grade rings with thickness of 12 inches or less, under casting.

3.5 PIPE CONNECTIONS AT MANHOLES

- A. Install approved resilient connectors at each pipe entering and exiting manholes in accordance with manufacturer's instructions.
 - 1. Where smooth exterior pipes, i.e. steel, ductile iron or PVC pipes are connected to manhole base or barrel, space between pipe and manhole wall shall be sealed with an assembly consisting of rubber gaskets or links mechanically compressed to form watertight barrier. Assemblies: "Press-Wedge," "Res-Seal," "Thunderline Link-Seals," or approved equal. See Drawings for placement of assembly in manhole sections.
 - 2. When connecting concrete or cement mortar coated steel pipes, or as an option for connecting smooth exterior pipes to manhole base or barrel, space between pipe and manhole wall may be sealed with an assembly consisting of stainless steel power sleeve, stainless steel take-up clamp and rubber gasket. Take-up clamp: Minimum of 9/16 inch wide. Provide PSX positive seal gasket system by Press-Seal Gasket Corporation or approved equal.
- B. Grout storm sewer connections to manhole unless otherwise shown on Drawings. Grout pipe penetration in place on both inside and outside of manhole.
- C. Ensure no concrete, cement stabilized sand, fill, or other rigid material is allowed to enter space between pipe and edge of wall opening at and around resilient connector on either interior or exterior of manhole. If necessary, fill space with compressible material to ensure full flexibility provided by resilient connector.
- D. Where new manhole is constructed on existing sewer, rigid joint pipe may be used. Install waterstop gasket around existing pipe at center of cast-in-place wall. Join ends of split waterstop material at pipe springline using an adhesive recommended and supplied by waterstop manufacturer.
- E. Test connection for watertight seal before backfilling.

3.6 INVERTS FOR SANITARY SEWERS

- A. Construct invert channels to provide smooth flow transition waterway with no disruption of flow at pipe-manhole connections. Conform to following criteria:
 - 1. Slope of invert bench: 1 inch per foot minimum; 1-1/2 inches per foot maximum
 - 2. Depth of bench to invert:
 - a. Pipes smaller than 15 inches: one-half of largest pipe diameter
 - b. Pipes 15 to 24 inches: three-fourths of largest pipe diameter
 - c. Pipes larger than 24 inches: equal to largest pipe diameter
 - 3. Invert slope through manhole: 0.10 foot drop across manhole with smooth transition of invert through manhole, unless otherwise indicated on Drawings.
- B. Form invert channels with concrete if not integral with manhole base section. For direction changes of mains, construct channels tangent to mains with maximum possible radius of curvature. Provide curves for side inlets and smooth invert fillets for flow transition between pipe inverts.

3.7 DROP CONNECTIONS FOR SANITARY SEWERS

- A. Backfill drop assembly with crushed stone wrapped in filter fabric, cement stabilized sand, or Class A concrete to form solid mass. Extend cement stabilized sand or concrete encasement minimum of four (4) inches outside bells.
- B. Install drop connection when sewer line enters manhole higher than 30 inches above invert of manhole.

3.8 STUBS FOR FUTURE CONNECTIONS

- A. In manholes, where future connections are indicated on Drawings, install resilient connectors and pipe stubs with approved watertight plugs.

3.9 MANHOLE FRAME AND ADJUSTMENT RINGS

- A. Combine precast concrete adjustment rings so elevation of installed casting cover matches pavement surface. Seal between concrete adjustment ring and precast top section with non-shrink grout; do not use mortar between adjustment rings. Apply latex-based bonding agent to precast concrete surfaces joined with non-shrink grout. Set cast iron frame on adjustment ring in bed of approved sealant material. Install sealant bed consisting of two beads of sealant, each bead having minimum dimensions of 1/2-inch and 1/2-inch wide.
- B. Wrap manhole frame and adjustment rings with external sealing material, minimum 3 inches beyond joint between ring and frame and adjustment rings and precast section.
- C. For manholes in unpaved areas, set top of frame minimum of 6 inches above existing ground line unless otherwise indicated on Drawings. In unpaved areas, encase manhole frame in mortar or non-shrink grout placed flush with face of manhole ring and top edge of frame. Provide rounded corner around perimeter.

3.10 BACKFILL

- A. Place and compact backfill materials in area of excavation surrounding manholes in accordance with requirements of Division 31. Provide embedment zone backfill material, as specified for adjacent utilities, from manhole foundation up to an elevation 12 inches over each

pipe connected to manhole. Provide trench zone backfill, as specified for adjacent utilities, above embedment zone backfill.

- B. Where rigid joints are used for connecting existing sewers to manhole, backfill under existing sewer up to springline of pipe with Class B concrete or flowable fill.
- C. In unpaved areas, provide positive drainage away from manhole frame to natural grade. Provide minimum of 4 inches of topsoil conforming to requirements of Division 32. When shown on Drawings, sod disturbed areas in accordance with Division 32.

3.11 FIELD QUALITY CONTROL

- A. Conduct leakage testing of sanitary sewer manholes in accordance with requirements of Division 33.

3.12 PROTECTION

- A. Protect manholes from damage until work has been accepted. Repair damage to manholes at no additional cost to the Owner.

END OF SECTION

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SECTION 33 05 13.13

MANHOLE GRADE ADJUSTMENT

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Adjusting elevation of manholes, inlets, and valve boxes to new grades.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for the adjustment of a proposed manhole is incidental to the installation of the manhole.
 - 2. Payment for the adjustment of an existing manhole is on a unit price basis for each existing manhole adjusted.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

- A. Provide concrete, conforming to requirements of Division 33.
- B. Provide precast concrete manhole sections and adjustment rings conforming to requirements of Division 33.
- C. Provide mortar conforming to requirements of City of Houston Standard Specifications Section 04016 - Mortar.

2.2 CAST-IRON MATERIALS

- A. Provide cast-iron materials conforming to requirements of Division 33.

2.3 PIPING MATERIALS

- A. For riser pipes and fittings, refer to Division 33.

2.4 MASONRY MATERIALS FOR STORM SEWER MANHOLES AND INLETS

- A. Provide brick masonry units conforming to the requirements of Division 32.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine existing structure, valve box, frame and cover or inlet box, frame and cover or inlet, piping and connections for damage or defects affecting adjustment to grade. Report damage or defects to Project Manager.

3.2 ESTABLISHING GRADE

- A. Coordinate grade related items with existing grade and finished grade or paving, and relate to established bench mark or reference line.

3.3 ADJUSTING MANHOLES AND INLETS

- A. Rebuild adjustment portion of manhole or inlet by adding or removing Adjustments. Follow procedures for the type of structure being adjusted detailed in Division 33.
- B. Salvage and reuse cast-iron frame and cover or grate.
- C. Protect or block off manhole or inlet bottom using wood forms shaped to fit so that no debris or soil falls to bottom during adjustment.
- D. Verify that manholes and inlets are free of visible leaks as result of reconstruction. Repair leaks in manner subject to Project Manger's approval.

3.4 ADJUSTING VALVE BOXES

- A. Salvage and reuse valve box and surrounding concrete block as approved by Project Manger. No separate pay.
- B. Remove and replace 6 inch ductile iron riser pipe with suitable length for depth of cover required to establish adjusted elevation to accommodate actual finish grade.
- C. Reinstall valve box and riser piping plumbed in vertical position. Provide minimum 6 inches telescoping freeboard space between riser pipe top butt end and interior contact flange of valve box for vertical movement damping.
- D. After valve box has been set, aligned, and adjusted so that top lid is level with final grade.

3.5 BACKFILL AND GRADING

- A. Backfill area of excavation surrounding each adjusted manhole, inlet, and valve box and compact according to requirements of Division 31.
- B. Grade ground surface to drain away from each manhole and valve box. Place earth fill around manholes to level of upper rim of manhole frame. Place earth fill around valve box concrete slab.
- C. In unpaved areas, grade surface at uniform slope of 1 to 5 from manhole frame to natural grade. Provide minimum of 4 inches of topsoil conforming to requirements of Division 32.

END OF SECTION

SECTION 33 05 16.13

PRECAST CONCRETE UTILITY STRUCTURES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Precast concrete inlets for storm or sanitary sewers, including cast iron frame and plate or grate.
- B. Precast concrete headwalls and wingwalls for storm sewers.
- C. Precast junction box with lid or grate top.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for precast concrete utility structure is on a unit price basis for each structure installed.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ASTM C 76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit shop drawings for approval of design and construction details for precast concrete inlets, junction box headwalls, and wingwalls. Precast units differing from standard designs shown on Drawings will be rejected unless shop drawing submittals are approved. Clearly show proposed substitution is equal or superior in every aspect to standard designs.
- C. Submit manufacturers' data and details for frames, grates, rings, and covers.

1.5 STORAGE AND SHIPMENT

- A. Store precast units on level blocking. Do not place loads until design strength is reached. Shipment of acceptable units may be made when 28-day strength requirements have been met.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Concrete: Provide concrete for precast machine-made units meeting requirements of ASTM C 76 regarding reinforced concrete, cement, aggregate, mixture, and concrete test. Minimum 28-day compressive strength shall be 4,000 psi.

- B. Reinforcing Steel: Place reinforcing steel to conform to details shown on Drawings and as follows:
 - 1. Provide positive means for holding steel cages in place throughout production of concrete units. Maximum variation in reinforcement position is plus or minus 10 percent of wall thickness or plus or minus 1/2 inch, whichever is less. Regardless of variation, maintain minimum cover of concrete over reinforcement as shown on Drawings.
 - 2. Welding of reinforcing steel is not permitted unless noted on Drawings.
- C. Mortar and Hydraulic Cement: Conform to requirements of Division 32.
- D. Miscellaneous Metal: Cast-iron frames and plates conforming to requirements of Division 33.

2.2 SOURCE QUALITY CONTROL

- A. Tolerances: Allowable casting tolerances for concrete units are plus or minus 1/4 inch from dimensions shown on Drawings. Concrete thickness in excess of that required will not constitute cause for rejection provided that excess thickness does not interfere with proper jointing operations.
- B. Precast Unit Identification: Mark date of manufacture and name or trademark of manufacturer clearly on inside of inlet, headwall, or wingwall.
- C. Rejection: Precast units rejected for non-conformity with these specifications and for following reasons:
 - 1. Fractures or cracks passing through shell, except for single end crack that does not exceed depth of joint.
 - 2. Surface defects indicating honeycombed or open texture.
 - 3. Damaged or misshaped ends, where damage would prevent making satisfactory joint.
- D. Replacement: Immediately remove rejected units from Work site and replace with acceptable units.
- E. Repairs: Occasional imperfections resulting from manufacture or accidental damage may be repaired if, in opinion of Owner's Representative, repaired units conform to requirements of these specifications.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify lines and grades are correct.
- B. Verify compacted subgrade will support loads imposed by inlets.

3.2 INSTALLATION

- A. Install units complete in place to dimensions, lines, and grades as shown on Drawings.
- B. Excavate in accordance with requirements of Division 31.

- C. Bed precast concrete units on foundations of firm, stable material shaped to conform to shape of unit bases.
- D. Provide adequate means to lift and place concrete units.

3.3 FINISHES

- A. Use hydraulic cement to seal joints, fill lifting holes and as otherwise required.
- B. When box section of inlet has been completed, shape floor of inlet with mortar to conform to Drawing details.
- C. Adjust cast iron inlet plate frames to line, grade, and slope shown on Drawings. Grout frame in place with mortar.

3.4 INLET WATERTIGHTNESS

- A. Verify that inlets are free of leaks. Repair leaks in approved manner.

3.5 CONNECTIONS

- A. Connect storm sewer leads to inlets as shown on Drawings. Seal connections inside and outside with hydraulic cement. Make connections watertight.

3.6 BACKFILL

- A. Backfill area of excavation surrounding each completed inlet, headwall, or wingwall according to requirements of Division 31.

END OF SECTION

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SECTION 33 05 16.16

CONCRETE FOR UTILITY CONSTRUCTION

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cast-in-place concrete work for utility construction or rehabilitation, such as slabs on grade, small vaults, site-cast bases for precast units, and in-place liners for manhole rehabilitation.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No payment will be made for concrete for utility construction under this Section unless specifically noted in bid documents. Include cost in, unit price for appropriate Work item.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ACI 117 - Standard Tolerances for Concrete Construction and Materials.
- B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
- C. ACI 302.1R - Guide for Concrete Floor and Slab Construction.
- D. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
- E. ACI 308 - Standard Practice for Curing Concrete.
- F. ACI 309R - Guide for Consolidation of Concrete.
- G. ACI 311 - Guide for Concrete Plant Inspection and Field Testing of Ready-Mix Concrete.
- H. ACI 315 - Details and Detailing of Concrete Reinforcement.
- I. ACI 318 - Building Code Requirements for Reinforced Concrete and Commentary.
- J. ACI 544 - Guide for Specifying, Mixing, Placing, and Finishing Steel Fiber Reinforced Concrete.
- K. ASTM A 82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
- L. ASTM A 185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
- M. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

- N. ASTM A 767 - Standard Specifications for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
- O. ASTM A 775 - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
- P. ASTM A 820 - Standard Specification for Steel Fibers for Fiber-Reinforced Concrete.
- Q. ASTM A 884 - Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement.
- R. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- S. ASTM C 33 - Standard Specification for Concrete Aggregates.
- T. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- U. ASTM C 42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- V. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.
- W. ASTM C 138 - Standard Test Method for Unit Weight Yield and Air Content (Gravimetric) of Concrete.
- X. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
- Y. ASTM C 150 - Standard Specification for Portland Cement.
- Z. ASTM C 172 - Standard Practice for Sampling Freshly Mixed Concrete.
- AA. ASTM C 173 - Standard Test Method for Air Content of Freshly Mixed Concrete by Volumetric Method.
- BB. ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- CC. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.
- DD. ASTM C 309 - Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete.
- EE. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete.
- FF. ASTM C 595 - Standard Specification for Blended Hydraulic Cements.
- GG. ASTM C 685 - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.
- HH. ASTM C 1064 - Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete.
- II. ASTM C 1077 - Standard Practice for Laboratory Testing of Concrete and Concrete Aggregate for Use in Construction and Criteria for Laboratory Evaluation.
- JJ. CRSI MSP-1 - Manual of Standard Practice.

- KK. CRSI - Placing Reinforcing Bars.
- LL. Federal Specification SS-S-210A - Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints

- MM. NRMCA - Concrete Plant Standards.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit proposed mix design and test data for each type and strength of concrete in Work.
- C. Submit laboratory reports prepared by independent testing laboratory stating that materials used comply with requirements of this Section.
- D. Submit manufacturer's mill certificates for reinforcing steel. Provide specimens for testing when required by Owner's Representative.
- E. Submit certification from concrete supplier that materials and equipment used to produce and deliver concrete comply with this Specification.
- F. When required on Drawings, submit shop drawings showing reinforcement type, quantity, size, length, location, spacing, bending, splicing, support, fabrication details, and other pertinent information.
- G. For waterstops, submit product information sufficient to indicate compliance with this Section, including manufacturer's descriptive literature and specifications.

1.5 HANDLING AND STORAGE

- A. Cement: Store cement off of ground in well-ventilated, weatherproof building.
- B. Aggregate: Prevent mixture of foreign materials with aggregate and preserve gradation of aggregate.
- C. Reinforcing Steel: Store reinforcing steel to protect it from mechanical injury and formation of rust. Protect epoxy-coated steel from damage to coating.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

- A. Cementitious Material:
 - 1. Portland Cement: ASTM C 150, Type II, unless use of Type III is authorized by Owner's Representative; or ASTM C 595, Type IP. For concrete in contact with sewage use Type II cement.
 - 2. When aggregates are potentially reactive with alkalis in cement, use cement not exceeding 0.6 percent alkali content in form of $\text{Na}_2\text{O} + 0.658\text{K}_2\text{O}$.
- B. Water: Clean, free from harmful amounts of oils, acids, alkalis, or other deleterious substances, and meeting requirements of ASTM C 94.
- C. Fiber:

1. Fibrillated Polypropylene Fiber:
 - a. Addition Rate: 1.5 pounds of fiber per cubic yard of concrete.
 - b. Physical Properties:
 - 1) Material: Polypropylene
 - 2) Length: 1/2 inch or graded
 - 3) Specific Gravity: 0.91
 - c. Acceptable Manufacturer: W. R. Grace Company, Fibermesh, or approved equal.
 2. Steel Fiber: Comply with applicable provisions of ACI 544 and ASTM A 820.
 - a. Ratio: 50 to 200 pounds of fiber per cubic yard of concrete.
 - b. Physical Properties:
 - 1) Material: Steel
 - 2) Aspect Ratio (for fiber lengths of 0.5 to 2.5 inch, length divided by diameter or equivalent diameter): 30:1 to 100:1
 - 3) Specific Gravity: 7.8
 - 4) Tensile Strength: 40-400 ksi.
 - 5) Young's Modulus: 29,000 ksi
 - 6) Minimum Average Tensile Strength: 50,000 psi
 - 7) Bending Requirements: Withstand bending around 0.125-inch diameter mandrel to angle of 90 degrees, at temperatures not less than 60 degrees F, without breaking
- D. Curing Compounds: Type 2 white-pigmented liquid membrane-forming compounds conforming to ASTM C 309.

2.2 FORM WORK MATERIALS

- A. Lumber and Plywood: Seasoned and of good quality, free from loose or unsound knots, knot holes, twists, shakes, decay and other imperfections which would affect strength or impair finished surface of concrete. Use S4S lumber for facing or sheathing. Forms for bottoms of caps: At least 2 inch (nominal) lumber or 3/4 inch form plywood backed adequately to prevent misalignment. For general use, provide lumber of 1-inch nominal thickness or form plywood of approved thickness.
- B. Form work for Exposed Concrete Indicated to Receive Rubbed Finish: Form or form-lining surfaces free of irregularities; plywood of 1/4 inch minimum thickness, preferably oiled at mill.
- C. Chamfer Strips and Similar Moldings: Redwood, cypress, or pine that will not split when nailed and which can be maintained to true line. Use mill-cut molding dressed on all faces.
- D. Form Ties: Metal or fiberglass of approved type with tie holes not larger than 7/8 inch in diameter. Do not use wire ties or snap ties.
- E. Metal Forms: Clean and in good condition, free from dents and rust, grease, or other foreign materials that tend to disfigure or discolor concrete in gauge and condition capable of supporting concrete and construction loads without significant distortion. Countersink bolt and rivet heads on facing sides. Use only metal forms which present smooth surface and which line up properly.

2.3 PRODUCTION METHODS

- A. Use either ready-mixed concrete conforming to requirements of ASTM C 94, or concrete produced by volumetric batching and continuous mixing in accordance with ASTM C 685.

2.4 MEASUREMENT OF MATERIALS

- A. Measure dry materials by weight, except volumetric proportioning may be used when concrete is batched and mixed in accordance with ASTM C 685.
- B. Measure water and liquid admixtures by volume.

2.5 DESIGN MIX

- A. Use design mixes prepared by certified testing laboratory in accordance with ASTM C 1077 and conforming to requirements of this section.
- B. Proportion concrete materials based on ACI 211.1 to comply with durability and strength requirements of ACI 318, Chapters 4 and 5, and this specification. Prepare mix design of Class A concrete so minimum cementitious content is 564 pounds per cubic yard. Submit concrete mix designs to Owner’s Representative for review.
- C. Proportioning on basis of field experience or trial mixtures in accordance with requirements at Section 5.3 of ACI 318 may be used, when approved by Owner’s Representative.
- D. Classification:

Class	Type	Minimum Compressive Strength (LBS/Sq.In.)		Miximum W/C Ratio	Air Content (Percent)	Consistency Range in Slump (Inches)
		7-Day	28-Day			
A	Structural	3200	4000	0.45	4 ± 1	2 to 4*
B	Pipe Block Fill, Thrust Block	---	1500	---	4 ± 1	5 to 7

*When ASTM C 494, Types F or Type G admixture is used to increase workability, this range may be 6 to 9.

- E. Add steel or polypropylene fibers only when called for on Drawings or in another section of these Specifications.
- F. Determine air content in accordance with ASTM C 138, ASTM C 173 or ASTM C 231.
- G. Use of Concrete Classes: Use classes of concrete as indicated on Drawings and other Specifications. Use Class B for unreinforced concrete used for plugging pipes, seal slabs, thrust blocks, trench dams, tunnel inverts and concrete fill unless indicated otherwise. Use Class A for all other applications.

2.6 PVC WATERSTOPS

- A. Extrude from virgin polyvinyl chloride elastomer. Use no reclaimed or scrap material. Submit waterstop manufacturer's current test reports and manufacturer's written certification that material furnished meets or exceeds Corps of Engineers Specification CRD-C572 and other specified requirements.
- B. Flat Strip and Center-Bulb Waterstops:
 - 1. Thickness: not less than 3/8 inch
 - 2. Acceptable Manufacturers:
 - a. Kirkhill Rubber Co., Brea, California

- b. Water Seals, Inc., Chicago, Illinois
- c. Progress Unlimited, Inc., New York, New York
- d. Greenstreak Plastic Products Co., St. Louis, Missouri
- e. Approved equal.

2.7 RESILIENT WATERSTOP

- A. Resilient Waterstop: Where shown on Drawings; either bentonite- or adhesive-type material.
- B. Bentonite Waterstop:
 - 1. Material: 75 percent bentonite, mixed with butyl rubber-hydrocarbon containing less than 1.0 percent volatile matter, and free of asbestos fibers or asphaltics.
 - 2. Manufacturer's rated temperature ranges: For application, 5 to 125 degrees F; in service, -40 to 212 degrees F.
 - 3. Cross-sectional dimensions, unexpanded waterstop: 1 inch by 3/4 inch
 - 4. Provide with adhesive backing capable of producing excellent adhesion to concrete surfaces.
- C. Adhesive Waterstop:
 - 1. Preformed plastic adhesive waterstop at least 2 inches in diameter.
 - 2. Meets or exceeds requirements of Federal Specification SS-S-210A.
 - 3. Supplied wrapped completely by 2 part protective paper.
 - 4. Submit independent laboratory tests verifying that material seals joints in concrete against leakage when subjected to minimum of 30 psi water pressure for at least 72 hours.
 - 5. Provide primer, to be used on hardened concrete surfaces, from same manufacturer who supplies waterstop material.
 - 6. Acceptable Manufacturer: Synko-Flex Preformed Plastic Adhesive Waterstop, Synko-Flex Products, Inc.; or approved equal.

PART 3 EXECUTION

3.1 FORMS AND SHORING

- A. Provide mortar-tight forms sufficient in strength to prevent bulging between supports. Set and maintain forms to lines designated such that finished dimensions of structures are within tolerances specified in ACI 117. Construct forms to permit removal without damage to concrete. Forms may be given slight draft to permit ease of removal. Provide adequate clean out openings. Before placing concrete, remove extraneous matter from within forms.
- B. Install rigid shoring having no excessive settlement or deformation. Use sound timber in shoring centering. Shim to adjust and tighten shoring with hardwood timber wedges.
- C. Design Loads for Horizontal Surfaces of Forms and Shoring: Minimum fluid pressure, 175 pounds per cubic foot; live load, 50 pounds per square foot. Maximum unit stresses: 125 percent of allowable stresses used for form materials and for design of support structures.
- D. Back form work with sufficient number of studs and wales to prevent deflection.
- E. Re-oil or lacquer liner on job before using. Facing may be constructed of 3/4 inch plywood made with waterproof adhesive backed by adequate studs and wales. In such cases, form lining will not be required.
- F. Unless otherwise indicated, form outside corners and edges with triangular 3/4 inch chamfer strips (measured on sides).
- G. Remove metal form ties to depth of at least 3/4 inch from surface of concrete. Do not burn off ties. Do not use pipe spreaders. Remove spreaders which are separate from forms as concrete is being placed.
- H. Treat facing of forms with approved form coating before concrete is placed. When directed by Owner's Representative, treat both sides of face forms with coating. Apply coating before reinforcement is placed. Immediately before concrete is placed, wet surface of forms which will come in contact with concrete.

3.2 EMBEDDED ITEMS

- A. Install conduit and piping as shown on Drawings. Accurately locate and securely fasten conduit, piping, and other embedded items in forms.
- B. Install waterstops as specified in other sections and according to manufacturer's instructions. Securely position waterstops at joints as indicated on Drawings. Protect waterstops from damage or displacement during concrete placing operations.

3.3 BATCHING, MIXING AND DELIVERY OF CONCRETE

- A. Measure, batch, mix, and deliver ready-mixed concrete in accordance with ASTM C 94, Sections 8 through 11. Produce ready-mixed concrete using automatic batching system as described in NRMCA Concrete Plant Standards, Part 2 - Plant Control Systems.
- B. Measure, mix and deliver concrete produced by volumetric batching and continuous mixing in accordance with ASTM C 685, Sections 6 through 8.
- C. Maintain concrete workability without segregation of material and excessive bleeding. Obtain approval of Owner's Representative before adjustment and change of mix proportions.

- D. Ready-mixed concrete delivered to site shall be accompanied by batch tickets providing information required by ASTM C 94, Section 16. Concrete produced by continuous mixing shall be accompanied by batch tickets providing information required by ASTM C 685, Section 14.
- E. When adverse weather conditions affect quality of concrete, postpone concrete placement. Do not mix concrete when air temperature is at or below 40 degrees F and falling. Concrete may be mixed with shade, away from artificial heat. Protect concrete from temperatures below 32 degrees F until concrete has cured for minimum of 3 days at 70 degrees F or 5 days at 50 degrees F.
- F. Clean, maintain and operate equipment so that it thoroughly mixes material as required.
- G. Hand-mix only when approved by Owner's Representative.

3.4 PLACING CONCRETE

- A. Give sufficient advance notice to Owner's Representative (at least 24 hours prior to commencement of operations) to permit inspection of forms, reinforcing steel, embedded items and other preparations for placing concrete. Place no concrete prior to Owner's Representative's approval.
- B. Schedule concrete placing to permit completion of finishing operations in daylight hours. However, when necessary to continue after daylight hours, light site as required. When rainfall occurs after placing operations are started, provide covering to protect work.
- C. Use troughs, pipes and chutes lined with approved metal or synthetic material in placing concrete so that concrete ingredients are not separated. Keep chutes, troughs and pipes clean and free from coatings of hardened concrete. Allow no aluminum material to be in contact with concrete.
- D. Limit free fall of concrete to 4 feet. Do not deposit large quantities of concrete at one location so that running or working concrete along forms is required. Do not jar forms after concrete has taken initial set; do not place strain on projecting reinforcement or anchor bolts.
- E. Use tremies for placing concrete in walls and similar narrow or restricted locations. Use tremies made in sections, or provide in several lengths, so that outlet may be adjusted to proper height during placing operations.
- F. Place concrete in continuous horizontal layers approximately 12 inches thick. Place each layer while layer below is still plastic.
- G. Compact each layer of concrete with concrete spading implements and mechanical vibrators of approved type and adequate number for size of placement. When immersion vibrators cannot be used, use form vibrators. Apply vibrators to concrete immediately after depositing. Move vibrator vertically through layer of concrete just placed and several inches into plastic layer below. Do not penetrate or disturb layers previously placed which have partially set. Do not use vibrators to aid lateral flow concrete. Closely supervise consolidation to ensure uniform insertion and duration of immersion.
- H. Handling and Placing Concrete: Conform to ACI 302.1R, ACI 304R and ACI 309R.

3.5 WATERSTOPS

- A. Embed waterstops in concrete across joints as shown. Waterstops shall be continuous for extent of joint; make splices necessary to provide continuity in accordance with manufacturer's

instructions. Support and protect waterstops during construction operations; repair or replace waterstops damaged during construction.

- B. Install waterstops in concrete on one side of joints, leaving other side exposed until next pour. When waterstop will remain exposed for 2 days or more, shade and protect exposed end. When temperature is 35 degrees waterstop from direct rays of sun during entire exposure and until exposed portion of waterstop is embedded in concrete.

3.6 F and rising. Take temperature readings in

A. Splicing PVC Waterstops:

1. Splice waterstops by heat-sealing adjacent waterstop sections in accordance with manufacturer's printed instructions.
2. Butt end-to-end joints of two identical waterstop sections may be made in forms during placement of waterstop material.
3. Prior to placement in form work, prefabricate waterstop joints involving more than two ends to be joined together, angle cut, alignment change, or joining of two dissimilar waterstop sections, allowing not less than 24 inch long strips of waterstop material beyond joint. Upon inspection and approval by Owner's Representative, install prefabricated waterstop joint assemblies in form work, and butt-weld ends of 24 inch strips to straight-run portions of waterstop in forms.

B. Setting PVC Waterstops:

1. Correctly position waterstops during installation. Support and anchor waterstops during progress of work to ensure proper embedment in concrete and to prevent folding over of waterstop by concrete placement. Locate symmetrical halves of waterstops equally between concrete pours at joints, with center axis coincident with joint openings. Thoroughly work concrete in joint vicinity for maximum density and imperviousness.
2. Where waterstop in a vertical wall joint does not connect with any other waterstop, and is not intended to be connected to waterstop in future concrete placement, terminate waterstop 6 inches below top of wall.

- C. Replacement of Defective Field Joints: Replace waterstop field joints showing evidence of misalignment, offset, porosity, cracks, bubbles, inadequate bond or other defects with products and joints complying with Specifications.

D. Resilient Waterstop:

1. Install resilient waterstop in accordance with manufacturer's instructions and recommendations.
2. When requested by Owner's Representative, provide technical assistance by manufacturer's representative in field at no additional cost to City.
3. Use resilient waterstop only where complete confinement by concrete is provided; do not use in expansion or contraction joints.
4. Where resilient waterstop is used in combination with PVC waterstop, lap resilient waterstop over PVC waterstop minimum of 6 inches and place in contact with PVC waterstop. Where crossing PVC at right angles, melt PVC ribs to form smooth joining surface.
5. At free top of walls without connecting slabs, stop resilient waterstop and grooves (where used) 6 inches from top in vertical wall joints.

6. Bentonite Waterstop:
 - a. Locate bentonite waterstop as near as possible to center of joint and extend continuous around entire joint. Minimum distance from edge of waterstop to face of member: 5 inches.
 - b. Where thickness of concrete member to be placed on bentonite waterstop is less than 12 inches, place waterstop in grooves at least 3/4 inch deep and 1 1/4 inches wide formed or ground into concrete. Minimum distance from edge of waterstop placed in groove to face of member: 2.5 inches.
 - c. Do not place bentonite waterstop when waterstop material temperature is below 40 degrees F. Waterstop material may be warmed so that it remains above 40 degrees F during placement but means used to warm it shall in no way harm material or its properties. Do not install waterstop where air temperature falls outside manufacturer's recommended range.
 - d. Place bentonite waterstop only on smooth and uniform surfaces; grind concrete smooth when necessary to produce satisfactory substrate, or bond waterstop to irregular surfaces using epoxy grout which completely fills voids and irregularities beneath waterstop material. Prior to installation, wire brush concrete surface to remove laitance and other substances that may interfere with bonding of epoxy.
 - e. In addition to adhesive backing provided with waterstop, secure bentonite waterstop in place with concrete nails and washers at 12 inch maximum spacing.
7. Adhesive Waterstop:
 - a. With wire brush thoroughly clean concrete surface on which waterstop is to be placed and then coat with primer.
 - b. If surface is too rough to allow waterstop to form complete contact, grind to form adequately smooth surface.
 - c. Install waterstop with top protective paper left in place. Overlap joints between strips minimum of 1 inch and cover back over with protective paper.
 - d. Do not remove protective paper until just before final form work completion. Place concrete immediately. Time that waterstop material is uncovered prior to concrete placement shall be minimized and shall not exceed 24 hours.

3.7 CONSTRUCTION JOINTS

A. Definitions:

1. Construction joint: Contact surface between plastic (fresh) concrete and concrete that has attained initial set.
2. Monolithic: Manner of concrete placement to reduce or eliminate construction joints; joints other than those indicated on Drawings will not be permitted without written approval of Owner's Representative. Where so approved, make additional construction joints with details equivalent to those indicated for joints in similar locations.
3. Preparation for Construction Joints: Roughen surface of concrete previously placed, leaving some aggregate particles exposed. Remove laitance and loose materials by sandblasting or high-pressure water blasting. Keep surface wet for several hours prior to placing of plastic concrete.

3.8 CURING

- A. Comply with ACI 308. Cure by preventing loss of moisture, rapid temperature change and mechanical injury for period of 7 curing days when Type II or IP cement has been used and for 3 curing days when Type III cement has been used. Start curing as soon as free water has disappeared from concrete surface after placing and finishing. A curing day is any calendar day in which temperature is above 50 degrees F for at least 19 hours. Colder days may be counted when air temperature adjacent to concrete is maintained above 50 degrees F. In continued cold weather, when artificial heat is not provided, removal of forms and shoring may be permitted at end of calendar days equal to twice required number of curing days. However, leave soffit forms and shores in place until concrete has reached specified 28 day strength, unless directed otherwise by Owner's Representative.
- B. Cure formed surfaces not requiring rubbed-finished surface by leaving forms in place for full curing period. Keep wood forms wet during curing period. Add water as needed for other types of forms. Or, at Contractor's option, forms may be removed after 2 days and curing compound applied.
- C. Rubbed Finish:
 - 1. At formed surfaces requiring rubbed finish, remove forms as soon as practicable without damaging surface.
 - 2. After rubbed-finish operations are complete, continue curing formed surfaces by using either approved curing/sealing compounds or moist cotton mats until normal curing period is complete.
- D. Unformed Surfaces: Cure by membrane curing compound method.
 - 1. After concrete has received final finish and surplus water sheen has disappeared, immediately seal surface with uniform coating of approved curing compound, applied at rate of coverage recommended by manufacturer or as directed by Owner's Representative. Do not apply less than 1 gallon per 180 square feet of area. Provide satisfactory means to properly control and check rate of application of compound.
 - 2. Thoroughly agitate compound during use and apply by means of approved mechanical power pressure sprayers equipped with atomizing nozzles. For application on small miscellaneous items, hand-powered spray equipment may be used. Prevent loss of compound between nozzle and concrete surface during spraying operations.
 - 3. Do not apply compound to dry surface. When concrete surface has become dry, thoroughly moisten surface immediately prior to application. At locations where coating shows discontinuities, pinholes or other defects, or when rain falls on newly coated surface before film has dried sufficiently to resist damage, apply additional coat of compound at specified rate of coverage.

3.9 REMOVAL OF FORMS AND SHORING

- A. Remove forms from surfaces requiring rubbing only as rapidly as rubbing operation progresses. Remove forms from vertical surfaces not requiring rubbed-finish when concrete has aged for required number of curing days. When curing compound is used, do not remove forms before 2 days after concrete placement.
- B. Leave soffit forms and shores in place until concrete has reached specified 28-day strength, unless directed otherwise by Owner's Representative.

3.10 DEFECTIVE WORK

- A. Immediately repair defective work discovered after forms have been removed. When concrete surface is bulged, uneven, or shows excess honeycombing or form marks which cannot be repaired satisfactorily through patching, remove and replace entire section.

3.11 FINISHING

- A. Patch honeycomb, minor defects and form tie holes in concrete surfaces with cement mortar mixed one part cement to two parts fine aggregate. Repair defects by cutting out unsatisfactory material and replacing with new concrete, securely keyed and bonded to existing concrete. Finish to make junctures between patches and existing concrete as inconspicuous as possible. Use stiff mixture and thoroughly tamp into place. After each patch has stiffened sufficiently to allow for greatest portion of shrinkage, strike off mortar flush with surface.
- B. Apply rubbed finish to exposed surfaces of formed concrete structures as noted on Drawings. After pointing has set sufficiently, wet surface with brush and perform first surface rubbing with No. 16 carborundum stone, or approved equal. Rub sufficiently to bring surface to paste, to remove form marks and projections, and to produce smooth, dense surface. Add cement to form surface paste as necessary. Spread or brush material, which has been ground to paste, uniformly over surface and allow to reset. In preparation for final acceptance, clean surfaces and perform final finish rubbing with No. 30 carborundum stone or approved equal. After rubbing, allow paste on surface to reset; then wash surface with clean water. Leave structure with clean, neat and uniform-appearing finish.
- C. Apply wood float finish to concrete slabs.

3.12 FIELD QUALITY CONTROL

- A. Testing shall be performed under provisions of Division 1.
- B. Unless otherwise directed by Owner's Representative, following minimum testing of concrete is required. Testing shall be performed by qualified individuals employed by approved independent testing agency, and conform to requirements of ASTM C 1077.
 - 1. Take concrete samples in accordance with ASTM C 172.
 - 2. Make one set of four compression test specimens for each mix design at least once per day and for each 150 cubic yards or fraction thereof. Make, cure and test specimens in accordance with ASTM C 31 and ASTM C 39.
 - 3. When taking compression test specimens, test each sample for slump according to ASTM C 143, for temperature according to ASTM C 1064, for air content according to ASTM C 231, and for unit weight according to ASTM C 138.
 - 4. Inspect, sample and test concrete in accordance with ASTM C 94, Section 13, 14, and 15, and ACI 311-5R.
- C. Test Cores: Conform to ASTM C 42.
- D. Testing High Early Strength Concrete: When Type III cement is used in concrete, specified 7 day and 28 day compressive strengths shall be applicable at 3 and 7 days, respectively.
- E. If 7-day or 3-day test strengths (as applicable for type of cement being used) fail to meet established strength requirements, extended curing or resumed curing on those portions of structure represented by test specimens may be required. When additional curing fails to produce required strength, strengthening or replacement of portions of structure which fail to develop required strength may be required by Owner's Representative, at no additional cost to City.

3.13 PROTECTION

- A. Protect concrete against damage until final acceptance by City and/or County.
- B. Protect fresh concrete from damage due to rain, hail, sleet, or snow. Provide protection while concrete is still plastic, and whenever precipitation is imminent or occurring.
- C. Do not backfill around concrete structures or subject them to design loadings until components of structure needed to resist loading are complete and have reached specified 28 day compressive strength, except as authorized otherwise by Owner's Representative.

END OF SECTION

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SECTION 33 06 10.14

POLYVINYL CHLORIDE (PVC) PIPE

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Polyvinyl chloride pressure pipe for water distribution, in nominal diameters 4 inches through 20 inches.
- B. Polyvinyl chloride sewer pipe for gravity sewers in nominal diameters 4 inches through 48 inches.
- C. Polyvinyl chloride pressure pipe for gravity sewers and force mains in nominal diameters 4 inches through 20 inches.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No separate payment will be made for PVC pipe under this section. Include cost in unit price for work included as specified in the following sections:
 - a. Section 33 11 00 – Water Utility Distribution Piping
 - b. Section 33 31 00 – Sanitary Utility Sewerage Piping
 - c. Section 33 31 00.11 – Sanitary Sewage Force Mains
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ANSI A 21.16 (AWWA C 116) - Protective Fusion Bonded Epoxy Coating for the Interior and Exterior Surfaces of Ductile Iron and Grey Iron Fittings for Water Supply Service.
- B. ASTM D 1248 - Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.
- C. ASTM D 1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
- D. ASTM D 2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
- E. ASTM D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
- F. ASTM D 2444 - Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight).
- G. ASTM D 2680 - Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.
- H. ASTM D 3034 - Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

- I. ASTM D 3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
- J. ASTM D 3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
- K. ASTM F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- L. ASTM F 679 - Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
- M. ASTM F 794 - Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
- N. ASTM F 949 - Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with Smooth Interior and Fittings.
- O. AWWA C 110 - American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 Inches Through 48 Inches for Water.
- P. AWWA C 111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- Q. AWWA C 900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches Through 12 Inches for Water Distribution.
- R. AWWA C 905 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In., for Water Transmission and Distribution.
- S. AWWA C 909 - Standard for Molecularly-Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 Inches through 12 Inches (100mm through 300 mm), for Water Distribution.
- T. PPI TR3 - Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials.
- U. UNI-B-13 - Recommended Standard Performance Specification for Joint Restraint Devices for Use with Polyvinyl Chloride Pipe.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit shop drawings showing design of new pipe and fittings indicating alignment and grade, laying dimensions, fabrication, fittings, flanges, and special details.

1.5 QUALITY CONTROL

- A. Submit manufacturer's certifications that PVC pipe and fittings meet requirements of this Section and AWWA C 900, AWWA C 909 and AWWA C 905 for pressure pipe applications, or appropriate ASTM standard specified for gravity sewer pipe.
- B. Submit manufacturer's certification that PVC pressure pipe for water lines and force mains has been hydrostatically tested at factory in accordance with AWWA C 900, AWWA C 909 and AWWA C 905, and this Section.

- C. When foreign manufactured material is proposed for use, have material tested for conformance to applicable ASTM requirements by certified independent testing laboratory located in United States. Certification from other source is not acceptable. Furnish copies of test reports to Owner's Representative for review. Cost of testing paid by Contractor.

PART 2 PRODUCTS

2.1 MATERIAL

- A. Use PVC compounds in manufacture of pipe that contain no ingredient in amount that has been demonstrated to migrate into water in quantities considered to be toxic.
- B. Furnish PVC pressure pipe manufactured from Class 12454-A or Class 12454-B virgin PVC compounds as defined in ASTM D 1784. Use compounds qualifying for rating of 4000 psi for water at 73.4 F per requirements of PPI TR3. Provide pipe which is homogeneous throughout, free of voids, cracks, inclusions, and other defects, uniform as commercially practical in color, density, and other physical properties. Deliver pipe with surfaces free from nicks and scratches with joining surfaces of spigots and joints free from gouges and imperfections which could cause leakage.
- C. PVC Restrained Pipe: Must be listed on City's current Product Approval List.
 - 1. Pipe Material:
 - a. DR 18: For restrained joints where shown on Drawings.
 - b. DR 14: For alternate to offset pipe sections shown on Drawings. Do not use PVC for offset sections with depth of cover greater than 20 feet or less than 4 feet. Do not use PVC in potentially petroleum contaminated areas.
- D. Water Service.
 - 1. Provide self-extinguishing PVC pipe that bears Underwriters' Laboratories mark of approval and is acceptable without penalty to Texas State Fire Insurance Committee for use in fire protection lines.
 - 2. Bear National Sanitation Foundation Seal of Approval (NSF-PW).
- E. Gaskets:
 - 1. Gaskets shall meet requirements of ASTM F 477. Use elastomeric factory-installed gaskets to make joints flexible and watertight.
 - 2. Flat Face Mating Flange: Full faces 1/8-inch-thick ethylene propylene (EPR) rubber.
 - 3. Raised Face Mating Flange: Flat ring 1/8-inch ethylene propylene (EDR) rubber, with filler gasket between OD of raised face and flange OD to protect flange from bolting moment.
- F. Lubricant for rubber-gasketed joints: Water soluble, non-toxic, non-objectionable in taste and odor imparted to fluid, non-supporting of bacteria growth, having no deteriorating effect on PVC or rubber gaskets.
- G. Do not use PVC in potentially or known contaminated areas.
- H. Do not use PVC in areas exposed to direct sunlight.

2.2 WATER SERVICE PIPE

- A. Pipe 4 inch through 12 inch: AWWA C 900, AWWA C 909, Class 150, DR 18; AWWA C 900, Class 200, DR 14 as alternate to offset pipe sections; nominal 20-foot lengths; cast-iron equivalent outside diameters.
- B. Pipe 14 inch through 20 inch: AWWA C 905; Class 235; DR 18; nominal 20-foot lengths; cast-iron equivalent outside diameter.
- C. Provide Polyvinyl Chloride Pipe from approved manufacturers.
- D. Make curves and bends by deflecting joints. Do not exceed maximum deflection recommended by pipe manufacturer. Submit details of other methods of providing curves and bends for review by Owner’s Representative.
- E. Hydrostatic Test: AWWA C 900, AWWA C 905, AWWA C 909, ANSI A 21.10 (AWWA C 110); at point of manufacture; submit manufacturer's written certification.

2.3 GRAVITY SEWER PIPE

- A. PVC gravity sanitary sewer pipe and storm sewer pipe shall be in accordance with provisions in following table:

Wall Construction	Manufacturer	ASTM Designation	SDR (Max.)/ Stiffness (Min.)	Diameter Size Range
Solid	J-M Pipe	D3034	SDR 26 / PS 115	6” to 10”
	Certain Teed	D3034	SDR 35 / PS 46	12” & 15”
	Diamond	F679	SDR 35 / PS 46	18” to 27”
	Uponor ETI	AWWA C900	DR 18 / N/A	4” to 12”
	North American	AWWA C909	DR 18 / N/A	4” to 12”
		AWWAC905	DR 18 / N/A	14” to 16”
Truss (Gasketed)	Contech	D2680	N/A / 200 psi	8” to 15”
Profile	Contech A-2000	F949	N/A / 46 psi	12” to 36”
	Contech A-2026	F949	N/A / 115 psi	8” to 10”
	ETI, Ultra-Rib	F794	N/A / 46 psi	8” to 30”
	ETI, Ultra-Corr	F794	N/A / 46 psi	24” to 36”

- B. When solid wall PVC pipe 18 inches to 27 inches in diameter is required in SDR 26, provide pipe conforming to ASTM F 679, except provide wall thickness as required for SDR 26 and pipe strength of 115 psi.
- C. For sewers up to 12-inch diameter crossing over water lines, or crossing under water lines with less than 2-foot separation, provide minimum 150 psi pressure-rated pipe conforming to ASTM D 2241 with suitable PVC adapter couplings.
- D. Joints: Spigot and integral wall section bell with solid cross section elastomeric or rubber ring gasket conforming to requirements of ASTM D 3212 and ASTM F 477, or ASTM D 3139 and ASTM F 477. Gaskets shall be factory-assembled and securely bonded in place to prevent displacement. Manufacturer shall test sample from each batch conforming to requirements ASTM D 2444.
- E. Fittings: Provide PVC gravity sewer sanitary bends, tee, or wye fittings for new sanitary sewer construction. PVC pipe fittings shall be full-bodied, either injection molded or factory fabricated. Saddle-type tee or wye fittings are not acceptable.

- F. Conditioning. Conditioning of samples prior to and during tests is subject to approval by Owner's Representative. When referee tests are required, condition specimens in accordance with Procedure A in ASTM D 618 at 73.4 degrees F plus or minus 3.6 degrees F and 50 percent relative humidity plus or minus 5 percent relative humidity for not less than 40 hours prior to test. Conduct tests under same conditions of temperature and humidity unless otherwise specified.
- G. Pipe Stiffness. Determine pipe stiffness at 5 percent deflection in accordance with Test Method D 2412. Minimum pipe stiffness shall be 46 psi. For diameters 4 inches through 18 inches, test three specimens, each a minimum of 6 inches (152 mm) in length. For diameters 21 inch through 36 inch, test three specimens, each a minimum of 12 inch (305 mm) in length.
- H. Flattening. Flatten three specimens of pipe, prepared in accordance with Paragraph 2.04F, in suitable press until internal diameter has been reduced to 60 percent of original inside diameter of pipe. Rate of loading shall be uniform. Test specimens, when examined under normal light and with unaided eye, shall show no evidence of splitting, cracking, breaking, or separation of pipe walls or bracing profiles. Perform the flattening test in conjunction with pipe stiffness test.
- I. Joint Tightness. Test for joint tightness in accordance with ASTM D 3212, except that joint shall remain watertight at minimum deflection of 5 percent. Manufacturer will be required to provide independent third party certification for joint testing each diameter of storm sewer pipe.
- J. Purpose of Tests. Flattening and pipe stiffness tests are intended to be routine quality control tests. Joint tightness test is intended to qualify pipe to specified level of performance.

2.4 SANITARY SEWER FORCE MAIN PIPE

- A. Provide approved PVC pressure pipe conforming to requirements for water service pipe, and conforming to minimum working pressure rating specified in Division 33.
- B. Acceptable pipe joints are integral bell-and-spigot, containing a bonded-in elastomeric sealing ring meeting requirements of ASTM F 477. In designated areas requiring restrained joint pipe and fittings, use approved joint restraint device conforming to UNI-B-13, for PVC pipe 12-inch diameter and less.
- C. Fittings: Provide approved ductile iron fittings as per Division 33, except furnish fittings with one of following approved internal linings:
 - 1. Nominal 40 mils (35 mils minimum) virgin polyethylene complying with ASTM D 1248, heat fused to interior surface of fitting
 - 2. Nominal 40 mils (35 mils minimum) polyurethane
 - 3. Nominal 40 mils (35 mils minimum) ceramic epoxy
 - 4. Nominal 40 mils (35 mils minimum) fusion bonded epoxy
- D. Exterior Protection: Provide polyethylene wrapping of ductile-iron fittings as required by Division 33.
- E. Hydrostatic Tests: Hydrostatically test pressure rated pipe in accordance with Paragraph 2.02E.

2.5 BENDS AND FITTINGS FOR PVC PRESSURE PIPE

- A. Bends and Fittings: ANSI A 21.10 or ANSI A 21.53, ductile iron; ANSI A 21.11 single rubber gasket push-on type joint; minimum 150 psi pressure rating. Approved restrained joints, 250 200 psi, may be provided for up to 12 inches in diameter (water or sanitary).

- B. Provide approved restrained joint fittings: Integral restrained joint fittings and pipe do not require secondary restraint.

PART 3 EXECUTION

3.1 PROTECTION

- A. Store pipe under cover out of direct sunlight and protect from excessive heat or harmful chemicals in accordance with manufacturer's recommendations.

3.2 INSTALLATION

- A. Conform to requirements of Division 33, as applicable.
- B. Install PVC pipe in accordance with Division 33, ASTM D 2321 for Sewer Pipe, and manufacturer's recommendations.
- C. Install PVC water service pipe to clear utility lines and have minimum depth of cover below property line grade of street, unless otherwise required by Drawings:
 - 1. Water service pipe 12 inches in diameter and smaller 4 feet of cover.
 - 2. Water service pipe 16 inches in diameter and larger 5 feet of cover.
- D. Avoid imposing strains that will overstress or buckle pipe when lowering pipe into trench.
- E. Hand shovel pipe bedding under pipe haunches and along sides of pipe barrel and compact to eliminate voids and ensure side support.
- F. Store PVC pipe under cover out of direct sunlight. Protect pipe from excessive heat or harmful chemicals. Prevent damage by crushing or piercing.
- G. Allow PVC pipe to cool to ground temperature before backfilling when assembled out of trench to prevent pullout due to thermal contraction.

3.3 PVC RESTRAINED MECHANISM

- A. Do not apply lubricant to spline or pipe or coupling spline grooves.
- B. Do not use excessive force while inserting the spline through coupling.
- C. Insert spline until it is fully seated around circumference of pipe.
- D. Field Cutting of Pipe Ends:
 - 1. Perform by workers certified by manufacturer.
 - 2. Use a PVC pipe cutter and provide square ends.
 - 3. Use manufacturer approved power routing and grooving tool to field fabricate required pipe groove.

END OF SECTION

SECTION 33 11 00

WATER UTILITY DISTRIBUTION PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Installation of water lines.
- B. Specifications identify requirements for both small diameter water lines and large diameter water lines. When specifications for large diameter water lines differ from those for small diameter water lines, large diameter specifications will govern for large diameter pipe.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices.
 - 1. Payment for water lines installed by open-cut, augered with or without casing, aerial crossing, and pipe offset section or within limits of Potentially Petroleum Contaminated Area (PPCA) is on linear foot basis for each size of pipe installed. Separate pay items are used for each type of installation.
 - a. Mains: Measure along axis of pipe and include fittings and valves.
 - b. Branch Pipe: Measure from axis of water line to end of branch.
 - 2. Payment for interconnection is on lump sum basis for each interconnection identified on Drawings. Payment will include tapping sleeve and valves piping, connections and other related work necessary for construction as shown on Drawings or specified herein.
 - 3. Payment for removal of existing internal elliptical or dished head plug is on unit price basis for each internal elliptical or dished head plug removed. Payment will include deletion of plug, drainage or dewatering of water lines, repair of damaged linings, rechlorination and items incidental to operation.
 - 4. Payment for plug and clamp is on a unit price basis for each size of pipe.
 - 5. Payment for drainline connection with service manhole is on unit price basis for each drainline shown on drawings. Payment includes valve, access manhole and connection.
 - 6. Payment for cylindrical corrosion barriers is on a unit price basis for each pipe fitting installed with one or more barriers.
 - 7. When directed by Owner's Representative to install extra fittings as required to avoid unforeseen obstacles, payment will be based on the following:
 - a. Each extra fitting requested by Owner's Representative and delivered to jobsite will be paid according to unit price for "Extra Fittings in Place."
 - b. Payment will include and be full compensation for items necessary for installation and operation of water line.
 - 8. Refer to Division 1 for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ANSI A 21.11/AWWA C111 - Standard for Rubber-Gasket Joints for Ductile - Iron Pressure Pipe and Fittings
- B. ANSI/NSF Standard 61 - Drinking Water System -Health Components

- C. ASTM A 36 - Standard Specification for Carbon Structural Steel
- D. ASTM A 536 - Standard Specification for Ductile Iron Castings
- E. ASTM A 126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
- F. ASTM B 21 - Standard Specification for Naval Brass Rod, Bar, and Shapes
- G. ASTM B 98 - Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes
- H. ASTM B 301 - Standard Specification for Free-Cutting Copper Rod and Bar
- I. ASTM B 584 - Standard Specification for Copper Alloy Sand Casting for General Application.
- J. ASTM E 165 - Standard Test Method for Liquid Penetrant Examination
- K. ASTM E 709 - Standard Guide for Magnetic Particle Examination
- L. ASTM F 1674 - Standard Test Method for Joint Restraint Products for Use with PVC Pipe
- M. AWWA C 206 - Standard for Field Welding of Steel Water Pipe
- N. AWWA C 207 - Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 Inches through 144 Inches

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Conform to submittal requirements of applicable Section for type of pipe used.
- C. Photographs: Submit photographs conforming to requirements of Division 1 prior to commencement of construction.
- D. Submit videotapes conforming to requirements of Division 1, if applicable.
- E. Submit Lone Star notification transmittal number prior to beginning excavation.
- F. Submit, a minimum of 15 days before beginning pipe laying operations, layout drawing identifying proposed sections for disinfecting, hydrostatic testing and site restoration for entire project for review and approval. Layout drawing to identify sequence of sections for:
 - 1. Disinfection; not to exceed 4,000 linear feet per section.
 - 2. Hydrostatic testing and transfer of services; to immediately follow sequence of disinfected section.
 - 3. Site restoration; not to exceed limits specified; Sequence in order of disturbance.

PART 2 PRODUCTS

2.1 PIPE MATERIALS

- A. Install pipe materials which conform to Division 33.

- B. Conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61 and have certified by an organization accredited by ANSI.
- C. Type of pipe materials used is Contractor's option unless specifically identified on Drawings.
- D. Provide minimum of 3/8 inch inside joint recess between ends of pipe in straight pipe sections.

2.2 WELDED JOINT PROTECTION FITTING FOR SMALL DIAMETER STEEL PIPE

- A. Cylindrical Corrosion Barrier: Provide approved cylindrical corrosion barrier.
- B. O-rings: Conform to National Sanitary Foundation requirements.

2.3 RESTRAINED JOINTS

- A. Ductile-Iron Pipe: See Division 33.
- B. PVC Pipe: See Division 33. Perform hydrostatic testing in accordance with ASTM F 1674.
- C. Prestressed Concrete Cylinder Pipe, Bar-Wrapped Pipe and Steel Pipe: Welded joints (see Paragraph 3.06 D).
- D. Restrained Joints where required on DIP and PVC pipe:
 - 1. Restraint devices: Manufacture of high strength ductile iron, ASTM A 536 up to 24 inches, and ASTM A 36 for sizes greater than 30 inches. Working pressure rating twice that of design test pressure.
 - 2. Bolts and connecting hardware: High strength low alloy material in accordance with ANSI A21.11/AWWA C111.

2.4 COUPLINGS AND APPURTENANCES FOR LARGE DIAMETER WATERLINE

- A. Flexible (Dresser-type) Couplings.
 - 1. Install where shown on Drawings or where allowed by Owner's Representative for Contractor's convenience. Use galvanized flexible couplings when installed on galvanized pipe which is cement lined, or when underground. Provide gaskets manufactured from Neoprene or Buna-N.
 - 2. For steel pipe; provide approved sleeve-type flexible couplings. Thickness of middle ring equal to or greater than thickness of pipe wall.
 - 3. Provide approved flanged adapter couplings for steel pipe.
 - 4. Use Type 316 stainless steel bolts, nuts and washers where flexible couplings are installed underground. Coat entire coupling with 20-mil of approved coal tar coating.
- B. Flap Valves: Provide approved flap valves on discharge of manhole drainline as shown on Drawings.
 - 1. Body and Flap: ASTM A 126-B cast iron.
 - 2. Seats: ASTM B 21-CA482 or ASTM B 301-CA145 bronze.
 - 3. Resilient Seat
 - 4. Hinge Arms: ASTM B 584-CA865 high tensile bronze.
 - 5. Hinge pins: ASTM B 98-CA655 silicon bronze.

PART 3 EXECUTION

3.1 PREPARATION

- A. Conform to applicable installation specifications for types of pipe used.
- B. Employ workmen who are skilled and experienced in laying pipe of type and joint configuration being furnished. Provide watertight pipe and pipe joints.
- C. Lay pipe to lines and grades shown on Drawings.
- D. Confirm that nine feet minimum separation from gravity sanitary sewers and manholes or separation of four feet minimum from force mains as specified in this Section in all directions unless special design is provided on Drawings.
- E. Where above clearances cannot be attained, and special design has not been provided on Drawings, obtain direction from Owner's Representative before proceeding with construction.
- F. Inform Owner's Representative if unmetred sprinkler or fire line connections exist which are not shown on Drawings. Make transfer only after approval by Owner's Representative.
- G. For projects involving multiple subdivisions or locations, limit water line installation to maximum of two project site locations. Maximizing 2 pipe installation crews shall be permitted, unless otherwise approved by Owner's Representative.
- H. Only the appropriate governing agency will handle operations involving opening and closing valves for wet connections and for chlorination. Contractor is responsible for handling necessary installations and removal of chlorination and testing taps and risers.
- I. If asbestos-cement (A.C.) pipe is encountered, follow safety practices outlined in American Water Works Association's publication, "Work Practices for A/C Pipe". Strictly adhere to "recommended practices" contained in this publication and make them "mandatory practices" for this Project.
- J. For pipe diameters 36 inches and greater, clearly mark each section of pipe and fitting with unique designation on inside of pipe along with pressure class. Locate unique identifying mark minimum of five feet away from either end of each section of pipe. Provide one unique identifying mark in middle of each fitting. Place markings at consistent locations. Use permanent black paint and minimum letter height of 4 inches to mark designations.
- K. Contractor is responsible for assuring chosen manufacturer fulfills requirements for extra fittings and, therefore, is responsible for costs due to downtime if requirements are not met.
- L. Do not remove plugs or clamps during months of peak water demands; June, July and August, unless otherwise approved by Owner's Representative.

3.2 HANDLING, CLEANING AND INSPECTION

- A. Handling:
 - 1. Place pipe along project site where storm water or other water will not enter or pass through pipe.

2. Load, transport, unload, and otherwise handle pipe and fittings to prevent damage of any kind. Handle and transport pipe with equipment designed, constructed and arranged to prevent damage to pipe, lining and coating. Do not permit bare chains, hooks, metal bars, or narrow skids or cradles to come in contact with coatings. Where required, provide pipe fittings with sufficient interior strutting or cross bracing to prevent deflection under their own weight.
 3. Hoist pipe from trench side into trench by means of sling of smooth steel cable, canvas, leather, nylon or similar material.
 4. For large diameter water lines, handle pipe only by means of sling of canvas, leather, nylon, or similar material. Sling shall be minimum 36 inches in width. Do not tear or wrinkle tape layers.
 5. Use precautions to prevent injury to pipe, protective linings and coatings.
 - a. Package stacked pipe on timbers. Place protective pads under banding straps at time of packaging.
 - b. Pad fork trucks with carpet or other suitable material. Use nylon straps around pipe for lift when relocating pipe with crane or backhoe.
 - c. Do not lift pipe using hooks at each end of pipe.
 - d. Do not place debris, tools, clothing, or other materials on pipe.
 6. Repair damage to pipe or protective lining and coating before final acceptance.
 7. For cement mortar line and coated steel pipe and PCCP, permit no visible cracks longer than 6 inches, measured within 15 degrees of line parallel to pipe longitudinal axis of finished pipe, except:
 - a. In surface laitance of centrifugally cast concrete.
 - b. In sections of pipe with steel reinforcing collars or wrappers.
 - c. Within 12 inches of pipe ends.
 8. Reject pipe with visible cracks (not meeting exceptions) and remove from project site.
- B. Cleaning: Thoroughly clean and dry interior of pipe and fittings of foreign matter before installation, and keep interior clean until Work has been accepted. Keep joint contact surfaces clean until jointing is completed. Do not place debris, tools, clothing or other materials in pipe. After pipe laying and joining operations are completed, clean inside of pipe and remove debris.
- C. Inspection: Before installation, inspect each pipe and fitting for defects. Reject defective, damaged or unsound pipe and fittings and remove them from site.

3.3 EARTHWORK

- A. Conform to applicable provisions of Division 31.
- B. Bedding: Use bedding materials in conformance with Division 31.
- C. Backfill: Use bank run sand or earth or native soil as specified in Division 31. Backfill excavated areas in same day excavated. When not possible, cover excavated areas using steel plates on paved areas and other protective measures elsewhere.
- D. Place material in uniform layers of prescribed maximum loose thickness and wet or dry material to approximately optimum moisture content. Compact to prescribed density Water tamping is not allowed.
- E. Pipe Embedment: Including 6-inch pipe bedding and backfill to 12 inches above top of pipe.

3.4 PIPE CUTTING

- A. Cut pipe 12 inches and smaller with standard wheel pipe cutters. Cut pipe larger than 12 inches in manner approved by Owner's Representative. Make cuts smooth and at right angles to axis of pipe. Bevel plain end with heavy file or grinder to remove sharp edges.

3.5 PIPING INSTALLATION

- A. General Requirements:
1. Lay pipe in subgrade free of water.
 2. Make adjustments of pipe to line and grade by scraping away subgrade or filling in with granular material.
 3. Properly form bedding to fully support bell without wedging or blocking up bell.
 4. Open Cut Construction: Keep pipe trenches free of water which might impair pipe laying operations. Grade pipe to provide uniform support along bottom of pipe. Excavate for bell holes after bottom has been graded and in advance of placing pipe. Lay not more than nominal city block length of not more than 300 feet of pipe in trench ahead of backfilling operations. Cover or backfill laid pipe if pipe laying operations are interrupted and during non-working hours. Place backfill carefully and simultaneously on each side of pipe to avoid lateral displacement of pipe and damage to joints. If adjustment of pipe is required after it has been laid, remove and re-lay as new pipe.
- B. Install pipe continuously and uninterrupted along each street on which work is to be performed. Obtain approval of Owner's Representative prior to skipping any portion of Work.
- C. Protection of Pipeline: Securely place stoppers or bulkheads in openings and in end of line when construction is stopped temporarily and at end of each day's work.
- D. Perform Critical Location as shown on Drawings. Refer to Division 33 for additional requirements at critical locations.
- E. Laying Large Diameter Water Line
1. Lay not more than 50 feet of pipe in trench ahead of backfilling operations.
 2. Dig trench proper width as shown. When trench width below top of pipe becomes 4 feet wider than specified, install higher class of pipe or improved bedding, as determined by Owner's Representative. No additional payment will be made for higher class of pipe or improved bedding.
 3. Use adequate surveying methods and equipment; employ personnel competent in use of this equipment. Horizontal and vertical deviations from alignment as indicated on Drawings shall not exceed 0.10 feet. Measure and record "as-built" horizontal alignment and vertical grade at maximum of every 100 feet on record drawings.
 4. Prevent damage to coating when placing backfill. Use backfill material free of large rocks or stones, or other material which could damage coatings.
 5. Before assembling couplings, lightly coat pipe ends and outside of gaskets with cup grease or liquid vegetable soap to facilitate installation.
 6. Prior to proceeding with critical tie-ins submit sequence of work based on findings from "critical location" effort.
- F. Perform following additional procedures when working on plant sites.
1. Seventy-two hours prior to each plant shut down or connection, schedule coordination meeting with Owner's Representative and Water Production personnel. At this meeting, present proposed sequencing of Work and verification of readiness to

- complete Work as required and within time permitted. Do not proceed with Work until Owner's Representative agrees key personnel, equipment and materials are on hand to complete Work.
 2. Prior to fully excavating around existing piping, excavate as minimal as possible to confirm type and condition of existing joints. Verify size, type, and condition of pipe prior to ordering materials or fully mobilizing for Work.
 3. Do not proceed with connections to existing piping and identified critical stages of work unless approved by Owner's Representative and the governing agency is present to observe.
 4. Coordinate with the governing agency to obtain reduction in operating pressures prior to performing connections to existing piping.
 5. Make connections to existing piping only when two valves are closed off between connection and source of water pressure. Do not make connection relying solely on one valve, unless otherwise approved by Owner's Representative.
 6. Perform critical stages of Work identified on Drawings at night or during low water demand months as specified in Division 1.
 7. Excavation equipment used on plant sites to have smooth bucket; no teeth or side cutters.
 8. Submit to Owner's Representative Lone Star Notification transmittal number prior to beginning excavation.
 9. Before each "dig" with mechanical excavator, probe ground to determine potential obstructions. Repeat procedure until existing pipe is located or excavation reaches desired elevation. Perform excavations within one foot to existing piping by hand methods.
 10. Provide adequate notice to pipe manufacture's representative when connecting or modifying existing prestressed or pretension concrete cylinder pipe.
 11. Provide field surveyed (horizontal and vertical elevations) "as-builts" of new construction and existing underground utilities encountered. Submit in accordance with Division 1.
 12. Prior to performing plant work to be done on weekend, provide list of sites and contact person with phone numbers to Owner's Representative by noon on Thursday of week. Contact person must be accessible during weekend, have Houston Metro Area phone number, and be authorized to make emergency decisions.
 13. No night work or plant shut down will be scheduled to begin two working days before or after designated Holidays.
- G. For tie-ins to existing water lines, provide necessary material on hand to facilitate connection prior to shutting down existing water line. Provide governing agency a minimum of two weeks notice prior to shutting down existing water line.

3.6 JOINTS AND JOINTING

- A. Rubber Gasketed Bell-and-Spigot Joints for Concrete Cylinder Pipe, Bar Wrapped Pipe PVC, Steel, and DIP:
1. After rubber gasket is placed in spigot groove of pipe, equalize rubber gasket cross section by inserting tool or bar recommended by manufacturer under rubber gasket and moving it around periphery of pipe spigot.
 2. Lubricate gaskets with nontoxic water-soluble lubricant before pipe units are joined.
 3. Fit pipe units together in manner to avoid twisting or otherwise displacing or damaging rubber gasket.
 4. After pipe sections are joined, check gaskets to ensure that no displacement of gasket has occurred. If displacement has occurred, remove pipe section and remake joint as for new pipe. Remove old gasket, inspect for damage and replace if necessary before remaking joint.

5. Where preventing movement of 16-inch diameter or greater pipe is necessary due to thrust, use restrained joints as shown on Drawings.
 - a. Include buoyancy conditions for soil unit weight when computing thrust restraint calculations.
 - b. Do not include passive resistance of soil in thrust restraint calculations.
 6. Except for PVC pipe, provide means to prevent full engagement of spigot into bell as shown on Drawings. Means may consist of wedges or other types of stops as approved by Owner's Representative.
- B. Flanged Joints where required on Concrete Cylinder Pipe, Bar Wrapped Pipe, Ductile Iron Pipe, or Steel Pipe:
1. AWWA C 207. Prior to installation of bolts, accurately center and align flanged joints to prevent mechanical prestressing of flanges, pipe and equipment. Align bolt holes to straddle vertical, horizontal or north-south center line. Do not exceed 3/64 inch per foot inclination of gasket face from true alignment.
 2. Use full-face gaskets for flanged joints. Provide 1/8-inch-thick cloth inserted rubber gasket material. Cut gaskets at factory to proper dimensions.
 3. Use galvanized or black nuts and bolts to match flange material. Use cadmium-plated steel nuts and bolts underground. Tighten bolts progressively to prevent unbalanced stress. Maintain at all times approximately same distance between two flanges at points around flanges. Tighten bolts alternately (180° apart) until all are evenly tight. Draw bolts tight to ensure proper seating of gaskets. Provide Densco petroleum based tape or approved equal for all exposed portions of nuts, bolts and pipe.
 4. Full length bolt isolating sleeves and washers shall be used with flanged connections. Furnish kits in accordance with City of Houston's "Approved Products List."
 5. For in-line flange joints 30 inches in diameter and greater and at butterfly valve flanges, provide Pyrox G-10 with nitrite seal, conforming to ANSI A 21.11 mechanical joint gaskets. For in-line flange joints sized between 12 inches in diameter and greater and 24 inches in diameter and smaller, provide Phenolic PSI with nitrite seal gasket conforming to ANSI A 21.11 mechanical joint gaskets.
- C. Welded Joints (Concrete Cylinder Pipe, Bar Wrapped Pipe, Steel Pipe):
1. Prior to starting work, provide certification of qualification for welders employed on project for type of work procedures and positions involved.
 2. Joints: AWWA C 206. Full-fillet, single lap-welded slip-type either inside or outside, or double butt-welded type; use automatic or hand welders; completely penetrate deposited metal with base metal; use filler metal compatible with base metal; keep inside of fittings and joints free from globules of weld metal which would restrict flow or become loose. Do not use mitered joints. For interior welded joints, complete backfilling before welding. For exterior field-welded joints, provide adequate working room under and beside pipe. Use exterior welds for 30-inch and smaller.
 3. Furnish welded joints with trimmed spigots and interior welds for 36-inch and larger pipe.
 4. Bell-and-spigot, lap-welded slip joints: Deflection may be taken at joint by pulling joint up to 3/4 inch as long as 1 1/2 inch minimum lap is maintained. Spigot end may be miter cut to take deflections up to 5 degrees as long as joint tolerances are maintained. Miter end cuts of both ends of butt-welded joints may be used for joint deflections of up to 5 degrees.
 5. Align piping and equipment so that no part is offset more than 1/8 inch. Set fittings and joints square and true, and preserve alignment during welding operation. For butt welded joints, align abutting ends to minimize offset between surfaces. For pipe of same nominal wall thickness, do not exceed 1/16 inch offset. Use line-up clamps for this purpose; however, take care to avoid damage to linings and coatings.

6. Protect coal-tar-epoxy lining during welding by draping an 18-inch-wide strip of heat resistant material over top half of pipe on each side of lining holdback to avoid damage to lining by hot splatter. Protect tape coating similarly if external welding is required.
7. Welding rods: Compatible with metal to be welded to obtain strongest bond, E-70XX.
8. Deposit metal in successive layers to provide at least 2 passes or beads for automatic welding and 3 passes or beads for manual welding in completed weld.
9. Deposit no more than 1/4 inch of metal on each pass. Thoroughly clean each individual pass with wire brush or hammer to remove dirt, slag or flux.
10. Do not weld under weather condition that would impair strength of weld, such as wet surface, rain or snow, dust or high winds, unless work is properly protected.
11. Make tack weld of same material and by same procedure as completed weld. Otherwise, remove tack welds during welding operation.
12. Remove dirt, scale, and other foreign matter from inside piping before tying in sections, fittings, or valves.
13. Welded Joints for Large Diameter Water Lines:
 - a. Furnish pipe with trimmed spigots and interior welds for 36-inch and larger pipe.
 - b. Use exterior welds for 30 inch and smaller.
 - c. Only one end may be miter cut. Miter end cuts of both ends of butt-welded joints may be used for joint deflections of up to 2 ½ degrees.
 - d. For large diameter water lines, employ an independent certified testing laboratory, approved by Owner's Representative, to perform weld acceptance tests on welded joints. Include cost of such testing and associated work to accommodate testing in contract unit price bid for water line. Furnish copies of test reports to Owner's Representative for review. Owner's Representative has final decision as to suitability of welds tested.
 - 1) Weld acceptance criteria:
 - a) Conduct in accordance with ASTM E165- Standard Test Method for Liquid Penetrant Examination and ASTM E709 Standard Guide for Magnetic Particle Examination. Use X-ray methods for butt welds, for 100 percent of joint welds.
 - b) Examine welded surfaces for the following defects:
 - (1) Cracking
 - (2) Lack of fusion/penetration
 - (3) Slag which exceeds one-third (t) where (t) equals material thickness
 - (4) Porosity/Relevant rounded indications greater than 3/16 inch; rounded indication is one of circular or elliptical shape with length equal to or less than three times its width
 - (5) Relevant linear indications in which length of linear indication exceeds three times its width
 - (6) Four or more relevant 1/16-inch rounded indications in line separated by 1/16 inch or less edge to edge
14. After pipe is joined and prior to start of welding procedure, make spigot and bell essentially concentric by jacking, shimming or tacking to obtain clearance tolerance around periphery of joint except for deflected joints.
15. Furnish each welder employed steel stencil for marking welds, so work of each welder can be identified. Mark pipe with assigned stencil adjacent to weld. When welder leaves job, stencil must be voided and not duplicated. Welder making defective welds must discontinue work and leave project site. Welder may return to project site only after recertification.

16. Provide cylindrical corrosion barriers for epoxy lined steel pipe 24-inch diameter and smaller, unless minimum wall thickness is 0.5 inches or greater.
 - a. In addition to welding requirements contained here in Paragraph 3.06, conform to protection fitting manufacturer's installation recommendations.
 - b. Provide services of technical representative of manufacturer available on site at beginning of pipe laying operations. Representative to train welders and advise regarding installation and general construction methods. Welders must have 12 months prior experience installing protection fittings.
 - c. All steel pipe is to have cutback 3/4 inch to no greater than 1 inch of internal diameter coating from weld bevel.
 - d. Furnish steel fittings with cylindrical corrosion barriers with shop welded extensions to end of fittings. Extension length to measure no less than diameter of pipe. Shop apply lining in accordance with AWWA C 210 or AWWA C 213.
 - e. All steel pipe receiving field adjustments are to be cold cut using standard practices and equipment. No cutting using torch is to be allowed.

- D. Harnessed Joints (Concrete Cylinder Pipe, Bar Wrapped Pipe):
 1. Use of snap-ring type restrained joints on pipe is limited to 20-inch through 48-inch diameters.
 2. Position snap-ring joint bolt on top (12 o'clock portion). Provide minimum 1/2-inch joint recess. Use joint "diapers" minimum of 12 inches wide.
 3. For field adjustments with deflections beyond manufacturer's recommendations:
 - a. Field trim spigot.
 - b. Do not engage ring.
 4. Harnessed joints are not permitted in areas defined on Drawings as potentially petroleum contaminated material, in tunnels, or at bend greater than 5 degrees.
 5. Install harness type joints including snap rings at straight sections of pipe.

- E. Restrained Joints
 1. For existing water lines and water lines less than 16 inches in diameter, restrain pipe joints with concrete thrust blocks.
 2. Thrust restraint lengths shown on Drawings are minimum anticipated lengths. These lengths are based on deflections indicated and on use of prestressed concrete cylinder pipe for large diameter lines and ductile iron pipe for small diameter lines. Adjustments in deflections or use of other pipe material may result in reduction or increase of thrust lengths. Perform calculations by pipe manufacturer to verify proposed thrust restraint lengths. Submit calculations for all pipe materials sealed by a registered Professional Engineer in State of Texas for review by Owner's Representative. Make adjustments in thrust restraint lengths at no additional cost to Owner.
 3. Passive resistance of soil will not be permitted in calculation of thrust restraint.
 4. For 16-inch lines and larger use minimum 16-foot length of pipe in and out of joints made up of beveled pipe where restraint joint lengths are not identified on Drawings. Otherwise, provide restraint joints for a minimum length of 16 feet on each side of beveled joints.
 5. Installation.
 - a. Install restrained joints mechanism in accordance with manufacturer's recommendations.
 - b. Examine and clean mechanism; remove dirt, debris and other foreign material.
 - c. Apply gasket and joint NSF 61 FDA food grade approved lubricant.
 - d. Verify gasket is evenly seated.
 - e. Do not over stab pipe into mechanism.

6. Prevent any lateral movement of thrust restraints throughout pressure testing and operation.
 7. Place 2500 psi concrete conforming to Division 32, for blocking at each change in direction of existing water lines, to brace pipe against undisturbed trench walls. Finish placement of concrete blocking, made from Type I cement, 4 days prior to hydrostatic testing of pipeline. Test may be made 2 days after completion of blocking if Type II cement is used.
- F. Joint Grout (Concrete Cylinder Pipe, Bar Wrapped Pipe, Steel Pipe):
1. Mix cement grout mixture by machine except when less than 1/2 cubic yard is required. When less than 1/2 cubic yard is required, grout may be hand mixed. Mix grout only in quantities for immediate use. Place grout within 20 minutes after mixing. Discard grout that has set. Retempering of grout by any means is not permitted.
 2. Prepare grout in small batches to prevent stiffening before it is used. Do not use grout which has become so stiff that proper placement cannot be assured without retempering. Use grout for filling grooves of such consistency that it will adhere to ends of pipe.
 3. Surface Preparation: Remove defective concrete, laitance, dirt, oil, grease and other foreign material from concrete surfaces with wire brush or hammer to sound, clean surface. Remove rust and foreign materials from metal surfaces in contact with grout.
 4. Follow established procedures for hot and cold weather concrete placement.
 5. Complete joint grout operations and backfilling of pipe trenches as closely as practical to pipe laying operations. Allow grouted exterior joints to cure at least 1 hour before compacting backfill.
 6. Grouting exterior joint space: Hold wrapper in place on both sides of joint with minimum 5/8-inch-wide steel straps or bands. Place no additional bedding or backfill material on either side of pipe until after grout band is filled and grout has mechanically stiffened. Pull ends of wrapper together at top of pipe to form access hole. Pour grout down one side of pipe until it rises on other side. Rod or puddle grout to ensure complete filling of joint recess. Agitate for 15 minutes to allow excess water to seep through joint band. When necessary, add more grout to fill joint completely. Protect gap at top of joint band from backfill by allowing grout to stiffen or by covering with structurally protective material. Do not remove band from joint. Proceed with placement of additional bedding and backfill material.
 7. Interior Joints for Pipe 24 inches and Smaller: Circumferentially butter bell with grout prior to insertion of spigot, strike off flush surplus grout inside pipe by pulling filled burlap bag or inflated ball through pipe with rope. After joint is engaged, finish off joint grout smooth and clean. Use swab approved by Owner's Representative for 20-inch pipe and smaller.
 8. Protect exposed interior surfaces of steel joint bands by metallizing, by other approved coatings, or by pointing with grout. Joint pointing may be omitted on potable water pipelines if joint bands are protected by zinc metallizing or other approved protective coatings.
 9. Remove and replace improperly cured or otherwise defective grout.
 10. Strike off grout on interior joints and make smooth with inside diameter of pipe.
 11. When installed in tunnel or encasement pipe and clearance within casing does not permit outside grout to be placed in normal manner, apply approved flexible sealer, such as Flex Protex or equal, to outside joint prior to joint engagement. Clean and prime surfaces receiving sealer in accordance with manufacturer's recommendations. Apply sufficient quantities of sealer to assure complete protection of steel in joint area. Fill interior of joint with grout in normal manner after joint closure.
 12. Interior Joints for Water Lines 30 inches and Larger: Clean joint space, wet joint surfaces, fill with stiff grout and trowel smooth and flush with inside surfaces of pipe using steel trowel so that surface is smooth. Accomplish grouting at end of each work

- day. Obtain written acceptance from Owner's Representative of inside joints before proceeding with next day's pipe laying operation. During inspection, insure no delamination of joint mortar has occurred by striking joint mortar lining with rubber mallet. Remove and replace delaminated mortar lining.
13. Work which requires heavy equipment to be over water line must be completed before mortar is applied to interior joints.
- G. Large Diameter Water Main Joint Testing: In addition to testing individual joints with feeler gauge approximately 1/2 inch wide and 0.015-inch thick, use other joint testing procedure approved or recommended by pipe manufacturer which will help ensure watertight installation prior to backfilling. Perform tests at no additional cost to Owner.
- H. Make curves and bends by deflecting joints or other method as recommended by manufacturer and approved by Owner's Representative. Submit details of other methods of providing curves and bends which exceed manufacturer's recommended deflection prior to installation.
1. Deflection of pipe joints shall not exceed maximum deflection recommended by pipe manufacturer, unless otherwise indicated on Drawings.
 2. If deflection exceeds that specified but is less than 5 percent, repair entire deflected pipe section such that maximum deflection allowed is not exceeded.
 3. If deflection is equal to or exceeds 5 percent from that specified, remove entire portion of deflected pipe section and install new pipe.
 4. Replace, repair, or reapply coatings and linings as required.
 5. Assessment of deflection may be measured by Owner's Representative at location along pipe. Arithmetical averages of deflection or similar average measurement methods will not be deemed as meeting intent of standard.
 6. When rubber gasketed pipe is laid on curve, join pipe in straight alignment and then deflect to curved alignment.
- I. Closures Sections and Approved Field Modifications to Steel, Concrete Cylinder Pipe, Bar Wrapped Pipe and Fittings:
1. Apply welded-wire fabric reinforcement to interior and exterior of exposed interior and exterior surfaces greater than 6 inches in diameter. Welded-wire fabric: minimum W1; maximum spacing 2 inches by 4 inches; 3/8 inch from surface of steel plate or middle third of lining or coating thickness for mortar thickness less than 3/4 inch.
 2. Fill exposed interior and exterior surfaces with nonshrink grout.
 3. For pipe diameters 36 inches and greater, perform field welds on interior and exterior of pipe.
 4. For large diameter water lines, provide minimum overlap of 4 inches of butt strap over adjacent piece on butt-strap closures.

3.7 CATHODIC PROTECTION APPURTENANCES

- A. Where identified on Drawings, modify pipe for cathodic protection as detailed on Drawings and specified. Unless otherwise noted, provide insulation kits including test stations at connections to existing water system or at locations to isolate one type of cathodic system from another type, between water line, access manhole piping and other major openings in water line, or as shown on Drawings.
- B. Bond joints for pipe installed in tunnel or open cut, except where insulating flanges are provided. Weld strap or clip between bell and spigot of each joint or as shown on Drawings. No additional bonding required where joints are welded for thrust restraint. Repair coatings as specified by appropriate AWWA standard, as recommended by manufacturer, and as approved by Owner's Representative.

- C. Bonding Strap or Clip: Free of foreign material that may increase contact resistance between wire and strap or clip.

3.8 SECURING, SUPPORTING AND ANCHORING

- A. Support piping as shown on Drawings and as specified in this Section, to maintain line and grade and prevent transfer of stress to adjacent structures.
- B. Where shown on Drawings, anchor pipe fittings and bends installed on water line by welding consecutive joints of pipe together to distance each side of fitting. Restrained length, as shown on Drawings, assumes that installation of pipe and subsequent hydrostatic testing begins upstream and proceed downstream, with respect to normal flow of water in pipe. If installation and testing differs from this assumption, submit for approval revised method of restraining pipe joints upstream and downstream of device used to test against (block valve, blind flange or dished head plug).
- C. Use adequate temporary blocking of fittings when making connections to distribution system and during hydrostatic tests. Use sufficient anchorage and blocking to resist stresses and forces encountered while tapping existing water line.

3.9 POLYETHYLENE WRAP FOR DUCTILE IRON PIPE

- A. Double wrap pipe and appurtenances (except fire hydrants and fusion bond or polyurethane coated fittings) with 8-mil polyethylene film.
- B. Do not use polyethylene wrap if pipe is cathodically protected.
- C. Conform to requirements of Division 33.

3.10 CLEANUP AND RESTORATION

- A. Provide cleanup and restoration crews to work closely behind pipe laying crews, and where necessary, during disinfection and hydrostatic testing, service transfers, abandonment of old water lines, backfill and surface restoration.
- B. Unless otherwise approved by Owner's Representative, comply with the following:
 - 1. Once water line is installed to limits approved in layout submitted, immediately begin preparatory work for disinfection effort.
 - 2. No later than three days after completing disinfection preparatory work, execute disinfection work.
 - 3. Immediately after transfer of services, begin abandonment of old water lines and site restoration.
 - 4. Do not exceed a total of 50% of total project linear feet of disturbed right-of-way and easement until site is restored in accordance with Division 1.
 - 5. Exceeding any of the above footage limitations shall be considered a material breach of the Contract and subject to termination in accordance with the General Conditions.
- C. For large diameter water lines, do not install more than 2,000 linear feet of water line, without previous 2,000 linear feet being restored in accordance with Division 1. Schedule paving crews so repaving work will not lag behind pipe laying work by more than 1,000 linear feet. Failure to comply with this requirement shall be considered a material breach of the Contract and subject to termination in accordance with the General Conditions.

3.11 CLEANING PIPING SYSTEMS

- A. Remove construction debris or foreign material and thoroughly broom clean and flush piping systems. Provide temporary connections, equipment and labor for cleaning. Owner's Representative must inspect water line for cleanliness prior to filling.

3.12 DISINFECTION OF WATER LINES

- A. Conform to requirements of Division 33.

3.13 FIELD HYDROSTATIC TESTS

- A. Conform to requirements of Division 33.

END OF SECTION

SECTION 33 12 13.10

TAPPING SLEEVES AND VALVES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Tapping sleeves and valves for connections to existing water system.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices.
 - 1. Payment is on unit price basis for each tap installed.
 - 2. Refer to Division 1 for unit price procedures.
 - 3. For water lines 4-inches and greater, no payment will be made until coupon (cut out portion of pipe tapped) is delivered to the Owner.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ASTM A240 - Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
- B. ASTM A193 Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
- C. ASTM A194 Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service.
- D. AWWA C 110 - Standard for Ductile-Iron and Gray-Iron Fittings, 3 in. through 48 in., for Water and other Liquids.
- E. AWWA C 200 - Standard for Steel Water Pipe - 6 in. and Larger.
- F. AWWA C 207 - Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 in. through 144 in.
- G. AWWA C 500 - Standard for Metal Seated Gate Valves, for Water Supply Service.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit results of tapping sleeves NPT test opening.
- C. Submit manufacturer's affidavit as required in Division 1.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Ship steel sleeves in wooden crates that provide protection from damage to epoxy coating during transport and storage.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Tapping Sleeves:
 - 1. Tapping Sleeve Bodies: AWWA C 110 cast or ductile iron or AWWA C 200 carbon steel in two sections to be bolted together with high-strength, corrosion-resistant, low-alloy steel bolts with mechanical joint ends.
 - 2. Branch Outlet of Tapping Sleeve:
 - a. Flanged, machined recess, AWWA C 207, Class D, ANSI 150 pound drilling.
 - b. Gasket: Affixed around recess of tap opening to prevent rolling or binding during installation.
 - 3. Use cast iron split sleeve where fire service from 6-inch water line is approved.
- B. Welded-steel tapping-sleeve bodies may be used in lieu of cast or ductile iron bodies for following sizes and with following restrictions:
 - 1. Flange: AWWA C 207, Class D, ANSI 150 pound drilling.
 - 2. Gasket: Affixed around recess of tap opening to prevent rolling or binding during installation.
 - 3. Steel sleeves are restricted to use on pipe sizes 6 inches and larger.
 - 4. Body: Heavy, welded-steel construction; top half grooved to retain neoprene O-ring seal permanently against outside diameter of pipe.
 - 5. Bolts: AWWA C 500 Section 3.5; coated with 100 percent vinyl resin or corrosive resistant material.
 - 6. Steel Sleeves Finish: Fusion-bonded epoxy coated to minimum 12 mil thickness.
 - 7. Finished Epoxy Coat: Free of laminations and blisters; and remain pliant and resistant to impact with non-peel finish.
 - 8. Provide approved steel tapping sleeves.
 - 9. Tapping Sleeves: Provide with 3/4-inch NPT test opening for testing prior to tapping. Provide 3/4-inch bronze plug for opening.
 - 10. Do not use steel sleeves for taps greater than 75 percent of pipe diameter.
- C. Stainless Steel tapping-sleeve bodies and flange may be used in lieu of cast or ductile iron bodies for following sizes and with following restrictions:
 - 1. Flange: ASTM A240 Stainless Steel, Type 304, ANSI 150 pound drilling.
 - 2. Gasket: Full circumferential, affixed around recess of tap opening to prevent rolling or binding during installation, compounded for water and sewer service.
 - 3. Stainless Steel sleeves are restricted to use on pipe sizes 4 inches and larger.
 - 4. Body: ASTM A240 Stainless Steel, Type 304.
 - 5. Bolts: ASTM A193 Stainless Steel, Type 304.
 - 6. Nuts: ASTM A194 Stainless Steel, Type 304.
 - 7. Branch Outlet: Heavy Stainless Steel Pipe.
 - 8. Provide approved stainless steel tapping sleeves.
 - 9. Do not use stainless steel sleeves for taps greater than 75 percent of pipe diameter.

- D. Tapping Valves: Meet requirements of Division 33 with following exceptions:
 - 1. Inlet Flanges:
 - a. AWWA C 110; Class 125.
 - b. AWWA C 110; Class 150 and higher: Minimum 8-hole flange.
 - 2. Outlet: Standard mechanical or push-on joint to fit any standard tapping machine.
 - 3. Valve Seat Opening: Accommodate full-size shell cutter for nominal size tap without contact with valve body; double disc.
- E. Valve Boxes: Standard Type "A" valve boxes conforming to requirements of Division 33.

PART 3 EXECUTION

3.1 APPLICATION

- A. Install tapping sleeves and valves at locations and of sizes shown on Drawings. Install sleeve so valve is in horizontally level position unless otherwise indicated on Drawings.
- B. Clean tapping sleeve, tapping valve, and pipe prior to installation and in accordance with manufacturer's instructions.
- C. Hydrostatically test installed tapping sleeve to 150 psig for minimum of 15 minutes. Inspect sleeve for leaks, and remedy leaks prior to tapping operation.
- D. When tapping concrete pressure pipe, size on size, use shell cutter one standard size smaller than water line being tapped.
- E. Do not use Large End Bell (LEB) increasers with next size tap unless existing pipe is asbestos-cement.

3.2 INSTALLATION

- A. Verify outside diameter of pipe to be tapped prior to ordering sleeve.
- B. Tighten bolts in proper sequence so that undue stress is not placed on pipe.
- C. Align tapping valve properly and attach to tapping sleeve. Insert insulation sleeves into flange holes of tapping valve and pipe. Make insertions of sleeves on pipe side of tapping valve. Do not damage insulation sleeves during bolt tightening process.
- D. Make tap with sharp, shell cutter:
 - 1. For 12-inch and smaller tap, use minimum cutter diameter one-half inch less than nominal tap size.
 - 2. For 16-inch and larger tap, use manufacturer's recommended cutter diameter.
- E. Withdraw coupon and flush cuttings from newly-made tap.
- F. Wrap:
 - 1. For 12-inch and smaller tap, wrap completed tapping sleeve and valve in accordance with Division 2.
 - 2. For 16-inch and larger tap, apply coal tar epoxy around completed tapping sleeve and valve. The coal tar epoxy shall be applied with minimum of two (2) coats. Each coat of coal tar epoxy shall have minimum dry film thickness of 16 mils.

- G. Place concrete thrust block behind tapping sleeve (not over tapping sleeve and valve).
- H. Request inspection of installation prior to backfilling.
- I. Backfill in accordance with Division 31.

END OF SECTION

SECTION 33 12 13.12

WET CONNECTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wet connections for new water mains and service lines to existing water mains.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices.
 - 1. Payment for wet connections shown on Drawings is on the basis of each wet connection. Separate payment will be made for each size of water main.
 - 2. No compensation will be given for extra work or for damages occurring as a result of an incomplete shutoff.
- B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.3 REFERENCES

- A. AWWA C 800 - Underground Service Line Valves and Fittings.

1.4 DEFINITIONS

- A. Wet connections consist of isolating sections of pipe to be connected with installed valves, draining the isolated sections, and completing the connections.
- B. Connection of 2-inch or smaller lines, which may be referred to on Drawings as "2-inch standard connections" or "gooseneck connections" will be measured as 2-inch wet connections. This item is not to be used as part of a 2-inch service line.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Pipe shall conform to requirements of applicable portions of Division 33 related to piping materials and to water distribution.
- B. Corporation cocks and saddles shall conform to requirements in Division 33.
- C. Valves shall conform to requirements of Section 33 12 16 – Water Utility Distribution Valves.
- D. Brass fittings shall conform to requirements of AWWA C 800.

PART 3 EXECUTION

3.1 CONNECTION OPERATIONS

- A. Plan wet connections in such manner and at such hours as to least inconvenience public. Notify Engineer at least 48 hours in advance of making connections.

- B. Do not operate valves on mains in use by Owner. Owner Representative will handle, at no cost to Contractor, operations involving opening and closing valves for wet connections.
- C. Conduct connection operations when Owner Representative is at job site. Connection work shall progress without interruption until complete once existing mains have been cut or plugs has been removed for making connections.

3.2 2-INCH WET CONNECTIONS

- A. Tap water main. Use corporation cocks, saddles, copper tubing as required for line and grade adjustment, and brass fittings necessary to adapt to existing main. Use 2-inch valves when indicated on Drawings for 2-inch copper gooseneck connections.

END OF SECTION

SECTION 33 12 16

WATER UTILITY DISTRIBUTION VALVES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Gate valves.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices.
 - 1. No separate payment will be made for gate valves 20 inches in diameter and smaller under this Section. Include payment in unit price for water lines.
 - 2. Payment for gate valves 24 inches to 36 inches in diameter is on a unit price basis. Unit price includes cost of required box for gate valves.
 - 3. Payment for 2-inch blow-off valve with box is on a unit price basis for each installation.
 - 4. Refer to Division 1 for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ASTM A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
- B. ASTM B 62 - Standard Specification for Composition Bronze or Ounce Metal Casting.
- C. ASTM D 429 - Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates.
- D. ASTM B 763 - Standard Specification for Copper Alloy Sand Casting for Valve Application.
- E. AWWA C 500 - Standard for Metal-Seated Gate Valves for Water Supply Service.
- F. AWWA C 509 - Standard for Resilient-Seated Gate Valves for Water Supply Service.
- G. AWWA C 515- Standard for Reduced Wall, Resilient- Seated Gate Valves for Water Supply Service.
- H. AWWA C 550 - Standard for Protective Epoxy Interior Coatings for Valves and Hydrants.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit manufacturer's product data for proposed valves for approval.
- C. Provide detailed drawings of gearing mechanism for 20-inch and larger gate valves.

1.5 QUALITY CONTROL

- A. Submit manufacturer's affidavit that gate valves are manufactured in the United States and conform to stated requirements of AWWA C 500, AWWA C 509, AWWA C 515, and this Section, and that they have been satisfactorily tested in the United States in accordance with AWWA C 500, AWWA C 509, and AWWA C 515.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Gate Valves: AWWA C 500, AWWA C 509, AWWA C 515 and additional requirements of this Section. All valves to open counterclockwise.
- B. If type of valve is not indicated on Drawings, use gate valves as line valves for sizes 20-inches and smaller. When type of valve is indicated, no substitute is allowed.
- C. Gate Valves 1-1/2 inches in Diameter and Smaller: 125 psig; bronze; rising-stem; single-wedge; disc type; screwed ends.
- D. Coatings for Gate Valves 2 inches and larger: AWWA C 550 non-toxic, imparts no taste to water, functions as physical, chemical, and electrical barrier between base metal and surroundings, minimum 8-mil-thick, fusion-bonded epoxy. Prior to assembly of valve, apply protective coating to interior and exterior surfaces of body.
- E. Gate Valves 2 inches in diameter: Iron body, double disc or resilient-seated, non-rising stem, 150-pound test, 2-inch square nut operating; counterclockwise to open.
- F. Gate Valves 3 inches to 12 inches in diameter: Non-directional, standard-wall resilient seated (AWWA C 509), parallel seat double disc (AWWA C 500), or reduced-wall resilient seated gate valves (AWWA C 515), 200 psig pressure rating, bronze mounting, push-on bell ends with rubber joint rings, and nut-operated unless otherwise specified. Provide approved standard-wall resilient seated valves. Provide approved reduced-wall resilient seated valves. Provide approved double disc valves. Comply with following requirements unless otherwise specified in Drawings:
 - 1. Design: Fully encapsulated rubber wedge or rubber seat ring mechanically attached with minimum 304 stainless-steel fasteners or screws; threaded connection isolated from water by compressed rubber around opening.
 - 2. Body: Cast or ductile iron, flange bonnet and stuffing box together with ASTM A 307 Grade B bolts. Manufacturer's initials, pressure rating, and year manufactured shall be cast in body.
 - 3. Bronze: Valve components in waterway to contain not more than 15 percent zinc and not more than 2 percent aluminum.
 - 4. Stems: ASTM B 763 bronze, alloy number-995 minimum yield strength of 40,000 psi; minimum elongation in 2-inches of 12 percent, non-rising.
 - 5. O-rings: For AWWA C 500, Section 3.12.2. For AWWA C 509, Sections 2.2.6 and 4.8.2. For AWWA C 515, Section 4.2.2.5.
 - 6. Stem Seals Consist of three O-rings, two above and one below thrust collar with anti-friction washer located above thrust collar for operating torque.
- G. Stem Nut: Independent or integrally cast of ASTM B 62 bronze.
- H. Resilient Wedge: Molded, synthetic rubber, vulcanized and bonded to cast or ductile iron wedge or attached with 304 stainless steel screws tested to meet or exceed ASTM D 429 Method B; seat against epoxy-coated surface in valve body.
- I. Bolts: AWWA C 500 Section 3.4, AWWA C 509 Section 4.4 or AWWA C 515 Section 4.4.4; stainless steel; cadmium plated, or zinc coated.
- J. Gate valves 14 inch and larger in Diameter: AWWA C 500; parallel seat double disc gate valves; push-on bell ends with rubber rings and nut-operated unless otherwise specified. Provide approved double disc valves with 150 psig pressure rating. Comply with following requirements unless otherwise specified on Drawings:

1. Body: Cast iron or ductile iron; flange together bonnet and stuffing box with ASTM A 307 Grade B bolts. Cast following into valve body manufacturer's initials, pressure rating, and year manufactured. When horizontally mounted, equip valves greater in diameter than 12 inches with rollers, tracks, and scrapers.
 2. O rings: For AWWA C 500, Section 3.12.2. For AWWA C 515, Section 4.2.2.5.
 3. Stems: ASTM B 763 bronze, alloy number-995 minimum yield strength of 40,000 psi; minimum elongation in 2-inches of 12 percent, non-rising.
 4. Stem Nut: Machined from ASTM B 62 bronze rod with integral forged thrust collar machined to size; non-rising.
 5. Stem Seals: Consist of three O-rings, two above and one below thrust collar with anti-friction washer located above thrust collar for operating torque.
 6. Bolts: AWWA C 500 Section 3.4 or AWWA C 515 Section 4.4.4; stainless steel; cadmium plated, or zinc coated.
 7. Discs: Cast iron with bronze disc rings securely pinned into machined dovetailed grooves.
 8. Wedging Device: Solid bronze or cast-iron, bronze-mounted wedges. Thin plates or shapes integrally cast into cast-iron surfaces are acceptable. Other moving surfaces integral to wedging action shall be bronze monel or nickel alloy-to-iron.
 9. Provide bypass for valves 24 inches and larger.
 10. Bronze Mounting: Built as integral unit mounted over, or supported on, cast-iron base and of sufficient dimensions to be structurally sound and adequate for imposed forces.
 11. Gear Cases: Cast iron; furnished on 18-inch and larger valves and of extended type with steel side plates, lubricated, gear case enclosed with oil seal or O-rings at shaft openings.
 12. Stuffing Boxes: Located on top of bonnet and outside gear case.
- K. Gate valves 14 inches to 24 inches: Provide AWWA C 515; reduced-wall, resilient seated gate valves with 250 psig pressure rating. Furnish with spur or bevel gearing.
1. Mount valves horizontally if proper ground clearance cannot be achieved by normal vertical installation. For horizontally mounted gate valves, provide bevel operation gear mounted vertically for above ground operation.
 2. Use valve body, bonnet, wedge, and operator nut constructed of ductile iron. Fully encapsulate exterior of ductile iron wedge with rubber.
 3. Ensure wedge is symmetrical and seals equally well with flow in either direction.
 4. Provide ductile iron operator nut with four flats at stem connection to apply even input torque to the stem.
 5. Bolts: AWWA C515, Section 4.4.4, Stainless Steel; cadmium plated or zinc coated.
 6. Provide high strength bronze stem and nut.
 7. O-rings: AWWA C515, Section 4.2.2.5, pressure O-rings as gaskets.
 8. Provide stem sealed by three O-rings. Top two O-rings are to be replaceable with valve fully open at full rated working pressure.
 9. Provide thrust washers to the thrust collar for easy valve operation.
- L. Gate Valves Extension Stem: When shown on Drawings, provide non-rising, extension stem having coupling sufficient to attach securely to operating nut of valve. Upper end of extension stem shall terminate in square wrench nut no deeper than 4 feet from finished grade or as shown on Drawings. Support extension stem with an arm attached to wall of manhole or structure that loosely holds extension stem and allows rotation in the axial direction only.
- M. Gate Valves in Factory Mutual (Fire Service) Type Meter Installations: Conform to provisions of this specification; outside screw and yoke valves; carry label of Underwriters' Laboratories, Inc.; flanged, Class 125; clockwise to close.
- N. Gate Valves for Tapping Steel Pipe: Provide double disc gate valve. Resilient wedge gate valve shall only be installed in a vertical position.
- O. Provide flanged joints when valve is connected to steel or PCCP.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Earthwork. Conform to applicable provisions of Division 31.
- B. Operation. Do not use valves for throttling without prior approval of manufacturer.

3.2 SETTING VALVES AND VALVE BOXES

- A. Remove foreign matter from within valves prior to installation. Inspect valves in open and closed positions to verify that parts are in satisfactory working condition.
- B. Install valves and valve boxes where shown on Drawings. Set valves plumb and as detailed. Center valve boxes on valves. Carefully tamp earth around each valve box for minimum radius of 4 feet, or to undisturbed trench face when less than 4 feet. Install valves completely closed when placed in water line.
- C. For pipe section of each riser, use only 6 inch, ductile iron Class 51, or DR18 PVC pipe cut to proper length. Riser must be installed to allow complete access for operation of valve.
- D. Assemble and brace box in vertical position as indicated on Drawings.

3.3 DISINFECTION AND TESTING

- A. Assist Owner's Representative with disinfection of valves and appurtenances as required by Division 33 and test as required by Division 33.
- B. Double-Disc Gate Valves: Apply hydrostatic test pressure equal to twice rated working pressure of valve between discs. Valve shall show no leakage through metal, flanged joints, or stem seals. Test at rated working pressure, applied between discs. Valve shall show no leakage through metal, flanged joints, or stem seals. Do not exceed leakage rate of 1 oz/hr/inch of nominal valve size.
- C. Solid-Wedge Gate Valves: Apply hydrostatic pressure equal to twice rated working pressure of valve with both ends bulkheaded and gate open. Valve shall show no leakage through metal, flanged joints, or stem seals. Test at rated working pressure, applied through bulkheads alternately to each side of closed gate with opposite side open for inspection. Valve shall show no leakage through metal, flanged joints, or stem-seals. Do not exceed leakage rate of 1 oz/hr/inch of nominal valve size.
- D. Repair or replace valves which exceed leakage rate.

3.4 PAINTING OF VALVES

- A. Paint valves in vaults, stations, and above ground with approved paint.

END OF SECTION

SECTION 33 12 40

VALVE BOXES, METER BOXES, AND METER VAULTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Valve boxes for water service.
- B. Meter boxes for water service.
- C. Meter vaults for water service.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices.
 - 1. No separate payment will be made for valve boxes under this Section. Include payment in unit price for Division 1.
 - 2. No separate payment will be made for meter boxes under this Section. Include payment in unit price for Division 1.
 - 3. Payment for each size of meter vaults is on unit price basis per vault. Payment will be made for each vault installed, regardless of depth.
 - 4. Refer to Division 1.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ASTM A 48 - Standard Specification for Gray Iron Castings.
- B. ASTM D 256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
- C. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics.
- D. ASTM D 648 - Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
- E. ASTM D 790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- F. ASTM D 2240 - Standard Test Method for Rubber Property-Durometer Hardness.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit manufacturers' product data for following items for approval:
 - 1. Each type of valve box and lid.
 - 2. Each type of meter box and cover.
 - 3. Each type of meter vault frame and cover.

- C. Submit design calculations and shop drawings for precast vault elements, sealed by an Engineer registered in State of Texas.
- D. Submit shop drawings for cast-in-place meter vaults for approval if proposed construction varies from Drawings.
- E. Submit manufacturer's certification that plastic meter boxes meet requirements of Paragraph 2.05, Plastic Meter Boxes.

PART 2 PRODUCTS

2.1 VALVE BOXES

- A. Provide approved Type A, cast-iron/ductile-iron, slide-type, valve boxes. Design of valve box shall minimize stresses on valve imposed by loads on box lid.
- B. Cast letter "W" into lid, 1/2 inch in height and raised 3/32 inch, for valves serving potable water lines.
- C. Unless otherwise specified, uncoated cast iron.
- D. Riser Pipe.
 - 1. Provide 6-inch PVC, Class 150, DR 18, riser pipes in accordance with Division 33 or
 - 2. 6-inch ductile-iron, thickness Class 51 riser pipes in accordance with Division 33.
 - 3. Provide single section of pipe.
- E. Concrete for valve box placement:
 - 1. For locations in new concrete pavement, provide strength and mix design of new pavement.
 - 2. For other locations, provide concrete for sidewalks conforming to requirements of Division 32.

2.2 METER BOXES

- A. Provide meter boxes as required by the governing authority and as shown on the drawings.

2.3 CAST-IRON METER BOXES

- A. Cast-Iron Boxes: Clean and free from sand blow-holes or other defects conforming to requirements of ASTM A 48, Class 30B. Bearing surfaces shall be machined so that covers seat evenly in frames.
- B. Boxes and lids shall have dipped, coal-tar-pitch, varnish finish.
- C. Provide lock-type meter boxes when required by Drawings. Lock mechanisms shall work with ease.

2.4 CONCRETE METER BOXES

- A. Concrete Meter Boxes: Made of Class A concrete, with minimum 4000 psi compressive strength, conforming to requirements of Division 32. Construct to dimensions shown on Drawings.

- B. Castings: Free from fractures, large or deep cracks, blisters or surface roughness or any other defects that may affect serviceability.

2.5 PLASTIC METER BOXES

- A. Plastic Meter Boxes: Made of high density polyethylene conforming to the following ASTM standards:

ASTM	REQUIREMENT
D 256	Impact Strength = 1/9 ft.-lb./inch (Izod, Notched)
D 256	Impact Strength – 6.4 ft.-lb./inch (Izod, Un-Notched)
D 638	Tensile Strength (2.0 min.) = 3400 psi
D 648	Deflection Temperature = 170 degrees F
D 2240	Shore D, Hardness, 55-65 Impact Strength, Falling Dart Method, 160 inch-lb.
D 790	Flexural Modulus = 90,000 psi

- B. Meter boxes shall meet the following test requirements:
 - 1. Static Load: Not less than 2500 pounds using 6-inch disc with direct compression exerted at center of top of meter box with solid plastic lid.
 - 2. Deflection: Not less than 1000 pounds load required to deflect top edge of meter box 1/8- inch.
 - 3. Meter box body, without lid, shall weigh approximately 7 pounds.

2.6 METER VAULTS

- A. Meter vaults may be constructed of precast concrete, cast-in-place concrete, or common brick masonry unless a specific type of construction is required by Drawings.
- B. Concrete for Meter Vaults: Class A concrete, conforming to requirements of Division 32 with minimum compressive strength of 4000 psi at 28 days.
- C. Reinforcing steel for meter vaults: Conform to requirements of Division 32.
- D. Grates and Covers: Conform to requirements of Division 33.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Obtain approval from Owner’s Representative for location of meter vault.
- B. Verify lines and grade are correct.
- C. Verify compacted subgrade will support loads imposed by vaults.

3.2 VALVE BOXES

- A. Install riser pipe with suitable length for depth of cover indicated on Drawings or to accommodate actual finish grade.
 - 1. Install with bell on top of valve.
 - 2. Place riser pipe in plumb, vertical position.
- B. Install valve box and riser piping plumbed in a vertical position. Provide 6-inches telescoping freeboard space between riser pipe top butt end, and interior contact flange of valve box, for vertical movement damping. End of pipe resting on valve shall be notched out sufficiently to provide a snug fit around the valve bonnet and to center valve inside of pipe.
- C. Set, align, and adjust valve box so that lid is 6" above final grade in grass areas.
- D. Paint covers of new valve boxes in fluorescent orange when installed. After completion and acceptance by Owner, repaint covers black.

3.3 METER BOXES

- A. Install cast iron or plastic boxes in accordance with manufacturer's instructions.
- B. Construct concrete meter boxes to dimensions shown on Drawings.
- C. Adjust top of meter boxes to conform to cover elevations specified in Paragraph 3.05, Frame and Cover for Meter Vaults.
- D. Do not locate under paved areas unless approved by Owner's Representative. Use approved traffic-type box with cast iron lid when meter must be located in paved areas.

3.4 METER VAULTS

- A. Construct concrete meter vaults to dimensions shown on Drawings. Do not cast in presence of water. Make bottom uniform. Verify lines and grades are correct and compacted subgrade will support loads imposed by vaults.
- B. Precast Meter Vaults:
 - 1. Install precast vaults in accordance with manufacturer's recommendations. Set level on a minimum 3-inch-thick bed of sand conforming to requirements of Division 31.
 - 2. Seal lifting holes with cement-sand mortar or non-shrink grout.
- C. Meter Vault Floor Slab:
 - 1. Construct floor slabs of 6-inch-thick reinforced concrete. Slope floor 1/4 inch per foot toward sump. Make sump 12 inches in diameter, or 12 inches square, and 4 inches deep, unless other dimensions are required by Drawings. Install dowels at maximum of 18 inches, center-to-center for keying walls to floor slab.
 - 2. Precast floor slab elements may be used for precast vault construction.
- D. Cast-in-Place Meter Vault Walls:
 - 1. Key walls to floor slab and form to dimensions shown on Drawings. Minimum wall thickness shall be 4 inches.
 - 2. Cast walls monolithically. One cold joint will be allowed when vault depth exceeds 12 feet.
 - 3. Set frame for cover in concrete.

3.5 FRAME AND COVER FOR METER VAULTS

- A. Set cast iron frame in a mortar bed and adjust elevation of cover as follows:
 - 1. In unpaved areas, set top of meter box or meter vault cover 2 to 3 inches above natural grade.
 - 2. In paved areas, set top of meter box or meter vault cover flush with adjacent concrete but no higher than 1/2-inch.

3.6 BACKFILL

- A. Provide bank run sand in accordance with Division 31 and backfill and compact in accordance with Division 31.
- B. In unpaved areas, slope backfill around meter boxes and vaults to provide a uniform slope 1-to-5 slope from top to natural grade.
- C. In paved areas, slope concrete down from meter box or vault to meet adjacent paved area.

END OF SECTION

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SECTION 33 13 00

DISINFECTING OF WATER UTILITY DISTRIBUTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Disinfection of potable water lines.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices.

1. No separate payment will be made for disinfection of water lines under this Section. Include cost in unit price of water lines being disinfected.
2. Refer to Division 1 for unit price procedures.

- B. Adjusting Payment for Retesting.

1. Subsequent disinfection operations which may be necessary due to nonconforming or incomplete construction will be charged to Contractor. Charges will be deducted from retainage amounts when construction estimates are processed for final payment.
2. Total charge will consist of base charge of \$135.00 plus footage charge based on number of feet of specified diameter pipe in construction project. Footage charge is as follows:

<u>Size of Pipe</u>	<u>Charge per Linear Foot</u>
2 inch to 4 inch	\$0.03
6 inch	\$0.04
8 inch	\$0.05
10 inch to 12 inch	\$0.07
16 inch to 20 inch	\$0.09
24 inch to 30 inch	\$0.13
32 inch to 48 inch	\$0.16
54 inch	\$0.20
60 inch	\$0.22
66 inch	\$0.31
72 inch to 84 inch	\$0.40
90 inch to 96 inch	\$0.58
108 inch	\$0.75
120 inch or larger	\$1.00

- C. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. AWWA C 651 - Standard for Disinfecting Water Mains.

PART 2 PRODUCTS -Not Used

PART 3 EXECUTION

3.1 CONDUCTING DISINFECTION

- A. Promptly disinfect water lines constructed before tests are conducted on water lines and before water lines are connected to Public water distribution system.
- B. Contractor shall provide water for disinfection at no additional charge to the Owner.
- C. Unless otherwise provided in Contract Documents, Contractor will conduct disinfection operations.
- D. Coordinate chlorination operations through Owner's Representative.

3.2 PREPARATION

- A. Provide temporary blind flanges, cast-iron sleeves, plugs, necessary service taps, copper service leads, risers and jumpers of sizes, location and materials, and other items needed to facilitate disinfection of new water lines prior to connection to Public water distribution system. Normally, each valved section of water line requires two each 3/4-inch taps. A 2-inch minimum blow-off is required for water lines up to and including 6-inch diameter.
- B. Use fire hydrants as blow-offs to flush newly constructed water lines 8 inch diameters and above. Where fire hydrants are not available on water lines, install temporary blow-off valves and remove promptly upon successful completion of disinfection and testing.
- C. Slowly fill each section of pipe with water in manner approved by Owner's Representative. Average water velocity when filling pipeline should be less than one foot per second and shall not, under any circumstance, exceed 2 feet per second. Before beginning disinfection operations, expel air from pipeline.
- D. Backfill excavations immediately after installation of risers or blow-offs.
- E. Install blow-off valves at end of water line to facilitate flushing of dead-end water lines. Install permanent blow-off valves according to drawings.

3.3 DISINFECTION BY CONTRACTOR

- A. The following procedure will be used when disinfection by Contractor is required by Contract Documents:
 - 1. Use not less than 100 parts of chlorine per million parts of water.
 - 2. Introduce chlorinating material to water lines in accordance with AWWA C 651.
 - 3. After contact period of not less than 24 hours, flush system with clean water until residual chlorine is no greater than 1.0 parts per million parts of water.
 - 4. Open and close valves in lines being sterilized several times during contact period.
 - 5. If chemical compound is used for sterilizing agent, place in pipes as directed by Owner's Representative.

3.4 BACTERIOLOGICAL TESTING

- A. After disinfection and flushing of water lines, bacteriological tests will be performed by the governing agency or testing laboratory in accordance with Division 1. When test results indicate need for additional disinfection of water lines based upon Texas Department of Health requirements, assist Contractor shall provide additional disinfection operations at no additional cost to the Owner.

3.5 COMPLETION

- A. Upon completion of disinfection and testing, remove risers except those approved for use in subsequent hydrostatic testing, and backfill excavation promptly.

END OF SECTION

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33 13 00 - 4

DISINFECTING OF WATER UTILITY
DISTRIBUTION

SECTION 33 13 00.10

HYDROSTATIC TESTING OF PIPELINES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Field hydrostatic testing of newly installed water pipelines.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices.
 - 1. No payment will be made for hydrostatic testing of pipelines under this Section. Include cost in unit price of pipelines being tested.
 - 2. Refer to Division 1 for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION

3.1 PREPARATION

- A. Disinfect water system pipelines prior to hydrostatic testing.
- B. Hydrostatically test newly installed water pipelines after disinfection, when required, and before connecting to Public water distribution system.
- C. Water for testing will be charged to Contractor in accordance with applicable Ordinances. Prior to hydrostatic testing, obtain a transient meter from the appropriate governing authority. Contractor shall pay all fees associated with transient meter.
- D. Test pipelines in lengths between valves, or plugs, of not more than 4,000 feet.
- E. Conduct hydrostatic tests in presence of Owner's Representative.

3.2 TEST PROCEDURES

- A. Furnish, install, and operate connections, pump, meter and gages necessary for hydrostatic testing.
- B. Allow pipeline to sit minimum of 24 hours from time it is initially disinfected until testing begins, to allow pipe wall or lining material to absorb water. Periods of up to 7 days may be required for mortar lining to become saturated.
- C. For small diameter pipelines, expel air and apply minimum test pressure of 125 psi. For large diameter water lines, expel air and apply minimum test pressure of 150 psi.
- D. Begin test by 9:00 a.m. unless otherwise approved by Owner's Representative. Maintain test pressure for 8 hours. When large quantity of water is required to maintain pressure during test, discontinue testing until cause of water loss is identified and corrected.

- E. Keep valves inside pressure reducing stations closed during hydrostatic pressure test.

3.3 ALLOWABLE LEAKAGE FOR WATERLINES

- A. During hydrostatic tests, no leakage will be allowed for sections of water lines consisting of welded joints.
- B. Maximum allowable leakage for water lines with rubber gasketed joints: 3.19 gallons per inch nominal diameter per mile of pipe per 24 hours while testing.
- C. For meter run installation, when work cannot be isolated and line fails pressure test, visual inspection of work by Owner's Representative for leakage during pressure test may be used to fulfill requirements of this section.

3.4 CORRECTION FOR FAILED TESTS

- A. Repair joints showing visible leaks on surface regardless of total leakage shown on test. Check valves and fittings to ensure that no leakage occurs that could affect or invalidate test. Remove cracked or defective pipes, fittings, and valves discovered during pressure test and replace with new items.
- B. Owner's Representative may require failed lines to be disinfected after repair and prior to retesting. Conduct and pay for subsequent disinfection operations in accordance with requirements of Division 33. Pay for water required for additional disinfection and retesting.
- C. Repeat test until satisfactory results are obtained.

3.5 COMPLETION

- A. Upon satisfactory completion of testing, remove risers remaining from disinfection and hydrostatic testing, and backfill excavation promptly.

END OF SECTION

SECTION 33 31 00

SANITARY UTILITY SEWERAGE PIPING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Gravity sanitary sewers and appurtenances, including stacks and service connections.

1.2 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit proposed methods, equipment, materials and sequence of operations for sewer construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.
- C. Test Reports: Submit test reports and inspection videos as specified in Part 3 of this Section. Video tapes become property of Owner.

1.3 QUALITY ASSURANCE

- A. Qualifications. Install sanitary sewer that is watertight both in pipe-to-pipe joints and in pipe-to-manhole connections. Perform testing in accordance with Division 33.
- B. Regulatory Requirements.
 - 1. Install sewer lines to meet minimum separation distance from potable water line, as scheduled below. Separation distance is defined as distance between outside of water pipe and outside of sewer pipe. When possible, install new sanitary sewers no closer to water lines than 9 feet in all directions. Where this separation distance cannot be achieved, new sanitary sewers shall be installed as specified in this section.
 - 2. Make notification to Owner's Representative when water lines are uncovered during sanitary sewer installation where minimum separation distance cannot be maintained.
 - 3. Lay gravity sewer lines in straight alignment and grade.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Inspect pipe and fittings upon arrival of materials at job site.
- B. Handle and store pipe materials and fittings to protect them from damage due to impact, shock, shear or free fall. Do not drag pipe and fittings along ground. Do not roll pipe unrestrained from delivery trucks.
- C. Use mechanical means to move or handle pipe. Employ acceptable clamps, rope or slings around outside barrel of pipe and fittings. Do not use hooks, bars, or other devices in contact with interior surface of pipe to lift or move lined pipe.

PART 2 PRODUCTS

2.1 PIPE

- A. Provide piping materials for gravity sanitary sewers of sizes and types indicated on Drawings or as specified.
- B. Reinforced concrete pipe is not acceptable.

2.2 PIPE MATERIAL SCHEDULE

- A. Unless otherwise shown on Drawings, use pipe materials that conform to requirements specified in Division 33.
- B. Where shown on Drawings, provide pipe meeting minimum class, dimension ratio, or other criteria indicated.
- C. Pipe materials other than those listed above shall not be used for gravity sanitary sewers.

2.3 APPURTENANCES

- A. Stacks. Conform to requirements of Division 33.
- B. Service Connections. Conform to requirements of Division 33.
- C. Roof, street or other type of surface water drains shall not be connected or reconnected into sanitary sewer lines.

2.4 BEDDING, BACKFILL, AND TOPSOIL MATERIAL

- A. Bedding and Backfill: Conform to requirements of Division 31.
- B. Topsoil: Conform to requirements of Division 32.

PART 3 EXECUTION

3.1 PREPARATION

- A. Prepare traffic control plans and set up street detours and barricades in preparation for excavation when construction will affect traffic. Conform to requirements of Division 1.
- B. Provide barricades, flashing warning lights, and warning signs for excavations. Conform to requirements of Division 1. Maintain barricades and warning lights where work is in progress or where traffic is affected by work.
- C. Perform work in accordance with OSHA standards. Employ trench safety system as specified in Division 31 for excavations over 5 feet deep.
- D. Immediately notify agency or company owning utility line which is damaged, broken or disturbed. Obtain approval from Owner's Representative and agency or utility company for repairs or relocations, either temporary or permanent.
- E. Remove old pavements and structures including sidewalks and driveways in accordance with requirements of Division 2.
- F. Install and operate dewatering and surface water control measures in accordance with Division 1.

- G. Do not allow sand, debris or runoff to enter sewer system.

3.2 DIVERSION PUMPING

- A. Install and operate required bulkheads, plugs, piping, and diversion pumping equipment to maintain sewage flow and to prevent backup or overflow. Obtain approval for diversion pumping equipment and procedures from Owner's Representative.
- B. Design piping, joints and accessories to withstand twice maximum system pressure or 50 psi, whichever is greater.
- C. No sewage shall be diverted into area outside of sanitary sewer.
- D. In event of accidental spill or overflow, immediately stop overflow and take action to clean up and disinfect spillage. Promptly notify Owner's Representative so that required reporting can be made to Texas Natural Resources Conservation Commission and Environmental Protection Agency by Owner's Representative.

3.3 EXCAVATION

- A. Earthwork. Conform to requirements of Division 31. Use bedding as indicated on Drawings.
- B. Line and Grade. Establish required uniform line and grade in trench from benchmarks identified by Owner's Representative. Maintain this control for minimum of 100 feet behind and ahead of pipe-laying operation. Use laser beam equipment to establish and maintain proper line and grade of work. Use of appropriately sized grade boards which are substantially supported is also acceptable. Protect boards and location stakes from damage or dislocation.
- C. Trench Excavation. Excavate pipe trenches to depths shown on Drawings and as specified in Division 31.

3.4 PIPE INSTALLATION BY OPEN CUT

- A. Install pipe in accordance with pipe manufacturer's recommendations and as specified in following paragraphs.
- B. Install pipe only after excavation is completed, bottom of trench fine graded, bedding material is installed, and trench has been approved by Owner's Representative.
- C. Install pipe to line and grade indicated. Place pipe so that it has continuous bearing of barrel on bedding material and is laid in trench so interior surfaces of pipe follow grades and alignment indicated. Provide bell holes where necessary.
- D. Install pipe with spigot ends toward downstream end of flow such that water flows into bell and out the spigot.
- E. Form concentric joint with each section of adjoining pipe so as to prevent offsets.
- F. Keep interior of pipe clean as installation progresses. Remove foreign material and debris from pipe.
- G. Provide lubricant, place and drive home newly laid sections with come-a-long winches so as to eliminate damage to sections. Install pipe to "home" mark where provided. Use of back hoes or

similar powered equipment will not be allowed unless protective measures are provided and approved in advance by Owner's Representative.

- H. Keep excavations free of water during construction and until final inspection.
- I. When work is not in progress, cover exposed ends of pipes with approved plug to prevent foreign material from entering pipe.
- J. Where gravity sanitary sewer is to be installed under existing water line with separation distance of at least 2 feet and less than 9 feet, install new sewer pipe so that one full 18 foot long pipe is centered on water line crossing. Embed sewer pipe in cement stabilized sand for minimum distance of 9 feet on each side of crossing.
- K. Where gravity sanitary sewer is to be installed under existing water line with separation distance of less than 2 feet, install new sewer using pressure-rated pipe as shown on Drawings. Maintain minimum 6-inch separation distance.
- L. Where the length of the stub is not indicated, install the stub to the right-of-way line and seal the free end with an approved plug.

3.5 PIPE INSTALLATION OTHER THAN OPEN CUT

- A. For installation of pipe by augering, jacking, or tunneling, conform to requirements of specification sections on tunneling augering, jacking and microtunneling work as appropriate.

3.6 INSTALLATION OF APPURTENANCES

- A. Service Connections. Install service connections to conform to requirements of Division 33.
- B. Stacks. Construct stacks to conform to requirements of Division 33.
- C. Construct manholes to conform to requirements of Division 33 as applicable. Install frames, rings, and covers to conform to requirements of Division 33.

3.7 INSPECTION AND TESTING

- A. Visual Inspection: Check pipe alignment in accordance with Division 33.
- B. Mandrel Testing. Use Mandrel Test to test flexible pipe for deflection. Refer to Division 33.
- C. Pipe Leakage Test. After backfilling line segment and prior to tie-in of service connections, visually inspect gravity sanitary sewers where feasible, and test for leakage in accordance with Division 33. Maintain piezometer installed to conform with Division 1 until acceptance testing is completed.

3.8 BACKFILL AND SITE CLEANUP

- A. Backfill and compact soil in accordance with Division 31.
- B. Backfill trench in specified lifts only after pipe installation is approved by Owner's Representative.
- C. Repair and replace removed or damaged pavement, curbs, gutters, and sidewalks as specified in Division 32.
- D. Provide hydromulch seeding in areas of commercial, industrial or undeveloped land use over surface of ground disturbed during construction and not paved or not designated to be paved. Grade surface

at uniform slope to natural grade as indicated on Drawings. Provide minimum of 4 inches of topsoil and apply hydromulch according to requirements of Division 32.

- E. Provide sodding in areas of residential land use over surface of ground disturbed during construction and not paved or not designated to be paved. Grade surface at uniform slope to natural grade as indicated on Drawings. Provide minimum of 4 inches of topsoil and sod disturbed areas in accordance with Division 32.

3.9 POST-INSTALLATION TELEVISION INSPECTION

- A. Prior to final acceptance of newly constructed gravity sanitary sewers, perform cleaning and closed circuit television inspection. Cleaning shall include utilizing variable pressure water nozzles (3000 psi) and collection, removal, transportation and disposal of sand, debris, and liquid wastes to legal disposal sites.
- B. Select and use closed-circuit television equipment that will produce color video tape. Produce video tape using pan-and-tilt, radial viewing, pipe inspection camera that pans plus and minus 275 degrees and rotates 360 degrees. Use camera with accurate footage counter which displays on monitor exact distance of camera from starting manhole. Use camera with camera height adjustment so that camera lens is always centered at one-half inside diameter, or higher, in pipe being televised. Provide lighting system that allows features and condition of pipe to be clearly seen. Reflector in front of camera may be necessary to enhance lighting in dark or large diameter pipe.
- C. Perform television inspection of gravity sanitary sewers as follows:
 - 1. Videos shall pan beginning and ending manholes to demonstrate that debris has been removed. Camera operator shall slowly pan each service connection and where sewer transitions from one pipe material to another.
 - 2. Video tapes shall be continuous for pipe segments between manholes. Do not leave gaps in video taping of segment between manholes and do not show single segment on more than one video tape.
 - 3. No flow is allowed in gravity sanitary sewer while performing post-installation television inspection.
- D. Provide video tapes on CD in a format compatible with Windows Media Player. Two labels are required. Place one label on the case and the other on face of each CD. Permanently label each video tape with following information.

Face of CD

Wastewater File No.: _____	Contractor's Name: _____
Inspection Type: <input type="checkbox"/> Survey <input type="checkbox"/> Pre-Installation <input type="checkbox"/> Post-Installation	
Tape No.: _____	Date Televised: _____
Basin No.: _____	Date Submitted: _____

CD Case

Manhole No. From	Manhole No. To	Pipe Diameter	Pipe Length	Street
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

- E. For each video tape provide completed TV Inspection Report, as attached at end of this section. TV Inspection Report is written/narrated log of pipe conditions and service connections, indexed to footage counter.
- F. Upon completion of video tape reviews by Owner’s Representative, Contractor will be notified regarding final acceptance of sewer segment.

TELEVISION INSPECTION CODES

<u>HEADER INFORMATION</u>		JOINTS		
LOCATION		CODES DESCRIPTION		USE IN
A	STREET ROW, HEAVY TRAFFIC	A (3)	RP JT > 90% CLEAR	MJ
B	STREET ROW, LIGHT TRAFFIC	B (6)	DRP JT 80 – 90% CLEAR	MJ
C	EASEMENT, POOR ACCESS	C (9)	DRP JT < 80% CLEAR	MJ
D	EASEMENT, GOOD ACCESS	D (3)	SHF JT > 90% CLEAR	MJ
E	PARKING LOT, POOR ACCESS	E (6)	SHF JT 80 – 90% CLEAR	MJ
F	PARKIGN LOT, GOOD ACCESS	F (9)	SHF JT < 80% CLEAR	MJ
G	ALLEY, POOR ACCESS	G (1)	WD JT 2” – 3”	MJ
H	ALLEY, GOOD ACCESS	H (2)	WD JT 3” – 4”	MJ
I	OPEN AREA, POOR ACCESS	I (3)	WD JT > 4”	MJ
J	OPEN AREA, GOOD ACCESS	J (2)	BRK JT – LIGHT	BJ
		K (4)	BRK JT – MEDIUM	BJ
		L (6)	BRK JT – HEAVY	BJ
		N (0)	VISIBLE GASKET	MJ
		O (0)	LEAKING AT JOINT	MJ
SURFACE COVER		LATERALS (L)		
		CODES	DESCRIPTION	
A	ASPHALT STREET	A (1)	PRT SER 0” – 1”	
B	CONCRETE STREET	B (2)	PRT SER 1” – 2”	
C	SHELL STREET	C (3)	PRY SER 2” – 3”	
D	SIDEWALK	D (4)	PRT SER 3” +	
E	TREES/SHRUBS	E (5)	EFFECTI E – SERVICE CONN.	
F	CLOSE TO FENCE	F (6)	DEAD/UNUSED SERVICE	
G	OPEN AREA	G (7)	FACTORY SERVICE	
H	MOVABLE BUILDING	H (0)	PLUMBER SERVICE	
I	UNMOVABLE BUILDING			
J	OVERHEAD UTILITIES			
K	WATERWAY OR RAILWAY			
L	HIGHWAY OR RUNWAY			
M	PIPE ABOVE GROUND			
		ROOTS (R)		
		CODES	DESCRIPTION	
		A (1)	ROOTS - LIGHT	
		B (2)	ROOTS - MEDIUM	
		C (3)	ROOTS – HEAVY	
		DEBRIS (D)		
		CODES	DESCRIPTION	
		A	DEBRIS - LIGHT	
		B	DEBRIS - MEDIUM	
		C	DEBRIS - HEAVY	
		D	GREASE - LIGHT	
		E	GREASE - MEDIUM	
		F	GREASE – HEAVY	
		INFLOW/INFILTRATION (I)		
		CODES	DESCRIPTION	
		A (3)	I/I – LIGHT (0-1 GPM)	
		B (6)	I/I – MEDIUM (1-5 GPM)	
		C (9)	I/I – HEAVY (> 5 GPM)	
		D (2)	I/I – SOME EVIDENCE	
		E (4)	I/I – CONSIDERABLE EVIDENCE	
		F (6)	I/I – GREAT EVIDENCE	
		G (0)	I/I – NO EVIDENCE	

WEATHER
 DRY - WET

CODE DESCRIPTIONS

CRACKS

RC-RADIAL LC-LONGITUDINAL

CODES	DESCRIPTION	USE IN
A (1)	< ½" W, 1' L	CRK
B (2)	< ½" W, 1' - 2' L	CRK
C (3)	< ½" W, >2' L	CRK
D (4)	> ½" W, < 1' L	CRK
E (5)	> ½" W, 1' - 2' L	CRK
F (6)	> ½" W, > 2' L	CRK
G (7)	HOLE IN PIPE - SMALL	
H (8)	PIPE MISSING - < 60°	
I (9)	PIPE MISSING - > 60°	

ALIGNMENT (A)

CODES	DESCRIPTION
A	BEGIN ¼ PIPE WATER
B	BEGIN ½ PIPE WATER
C	CAMERA UNDERWATER
D	END CAMERA UNDERWATER
E	END ½ PIPE WATER
F	END ¼ PIPE WATER

STRUCTURAL

DS-DETERIORATED; OS-OVALITY; CS COLLAPSED		
CODES	DESCRIPTION	USE IN
A (3)	LINE DET - LIGHT	DS
B (6)	LINE DET - MEDIUM	DS
C (9)	LINE DET - HEAVY	DS
D (3)	OVAL < 5%	OS
E (6)	OVAL > 5% & < 10%	OS
F (9)	OVAL > 10%	OS
G (9)	COLLAPSED	CS
H (0)	PIPE DET - HEAVY	DS
L (0)	PIPE DET - LIGHT	DS
M (0)	PIPE - MEDIUM	DS
N (0)	PIPE DET - NONE	DS
O	LINE DET - NONE	DS
Z (0)	AT MANHOLE NUMBER	CS

END OF SECTION

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SECTION 33 31 00.10

ACCEPTANCE TESTING FOR SANITARY SEWERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Acceptance testing of sanitary sewers including:
 - 1. Visual inspection of sewer pipes.
 - 2. Mandrel testing for flexible sewer pipes.
 - 3. Leakage testing of sewer pipes.
 - 4. Leakage testing of manholes.
 - 5. Smoke testing of point repairs.
 - 6. 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 Division 1 for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 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.

1.4 PERFORMANCE REQUIREMENTS

- A. Gravity flow sanitary sewers are required to have straight alignment and uniform grade between manholes.
- B. Flexible pipe, including "semi-rigid" pipe, is required to show no more than 5 percent deflection. Test pipe no sooner than 30 days after backfilling of line segment but prior to final acceptance using standard mandrel to verify that installed pipe is within specified deflection tolerances.

- C. Maximum allowable leakage for Infiltration or Exfiltration.
 - 1. The total exfiltration, as determined by hydrostatic head test, shall not exceed 50 gallons per inch diameter per mile of pipe per 24 hours at minimum test head of 2 feet above crown of pipe at upstream manhole or 2 feet above groundwater elevation, whichever is greater.
 - 2. When pipes are installed more than 2 feet below groundwater level, use infiltration test in lieu of exfiltration test. Total infiltration shall not exceed 50 gallons per inch diameter per mile of pipe per 24 hours. Groundwater elevation must be at least 2 feet above crown of pipe at upstream manhole.
 - 3. Refer to Table 33 31 00.10-1, Water Test Allowable Leakage, at end of Section, for measuring leakage in sewers. Perform leakage testing to verify that leakage criteria are met.
- D. Perform air testing in accordance with requirements of this Section and Texas Natural Resources Conservation Commission requirements. Refer to Table 33 31 00.10-2, Time Allowed for Pressure Loss from 3.5 psig to 2.5 psig, Table 33 31 00.10-3, Minimum Testing Times for Low Pressure Air Test, and Table 33 31 00.10-4, Vacuum Test Time Table, at end of this Section.

1.5 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Test Plan: Before testing begins and in adequate time to obtain approval through submittal process, prepare and submit test plan for approval by Owner's Representative. Include testing procedures, methods, equipment, and tentative schedule. Obtain advance written approval for deviations from Drawings and Specifications.
- C. Test Reports: Submit test reports for each test on each segment of sanitary sewer.

1.6 GRAVITY SANITARY SEWER QUALITY ASSURANCE

- A. Repair, correct, and retest manholes or sections of pipe which fail to meet specified requirements when tested.
- B. Provide testing reports and video tape of television inspection as directed by Owner's Representative.
- C. Upon completion of tape reviews by Owner's Representative, Contractor will be notified regarding final acceptance of sewer segment.

1.7 SEQUENCING 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 Owner's Representative. Perform testing under observation of Owner's Representative.

PART 2 PRODUCTS

2.1 DEFLECTION MANDREL

- A. Mandrel Sizing. Rigid mandrel shall have outside diameter (O.D.) equal to 95 percent of inside diameter (I.D.) of pipe. Inside diameter of pipe, for purpose of determining outside diameter of mandrel, shall be average outside diameter minus two minimum wall thicknesses for O.D. controlled pipe and average inside diameter for I.D. controlled pipe, dimensions shall be per appropriate standard. Statistical or other "tolerance packages" shall not be considered in mandrel sizing.

- B. Mandrel Design. Rigid mandrel shall be constructed of metal or rigid plastic material that can withstand 200 psi without being deformed. Mandrel shall have nine or more "runners" or "legs" as long as total number of legs is odd number. Barrel section of mandrel shall have length of at least 75 percent of inside diameter of pipe. Rigid mandrel shall not have adjustable or collapsible legs which would allow reduction in mandrel diameter during testing. Provide and use proving ring for modifying each size mandrel.
- C. Proving Ring. Furnish "proving ring" with each mandrel. Fabricate ring of 1/2-inch-thick, 3-inch-wide bar steel to diameter 0.02 inches larger than approved mandrel diameter.
- D. Mandrel Dimensions (5 percent allowance). Average inside diameter and minimum mandrel diameter are specified in Table 30 31 00.10-5, Pipe vs. Mandrel Diameter, at end of this Section. Mandrels for higher strength, thicker wall pipe or other pipe not listed in table may be used when approved by Owner's Representative.

2.2 EXFILTRATION TEST

- A. Water Meter: Obtain transient water meter from appropriate governmental agency for use when water for testing will be taken from public system. Conform to governmental agency requirements for water meter use.
- B. Test Equipment:
 - 1. Pipe plugs.
 - 2. Pipe risers where manhole cone is less than 2 feet above highest point in pipe or service lead.

2.3 INFILTRATION TEST

- A. Test Equipment:
 - 1. Calibrated 90 degree V-notch weir.
 - 2. Pipe plugs.

2.4 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.

2.5 GROUND WATER DETERMINATION

- A. Equipment: Pipe probe or small diameter casing for ground water elevation determination.

2.6 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. Determine selection of test methods and pressures for gravity sanitary sewers based on ground water elevation. Determine ground water elevation using equipment and procedures conforming to Division 1.

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 re-lay or replace pipe segment.

3.3 MANDREL TESTING FOR GRAVITY SANITARY SEWERS

- A. Perform deflection testing on flexible and semi-rigid pipe to confirm pipe has no more than 5 percent deflection. Mandrel testing shall conform to ASTM D 3034. Perform testing no sooner than 30 days after backfilling of line segment, but prior to final acceptance testing of line segment.
- B. Pull approved mandrel by hand through sewer sections. Replace any section of sewer not passing mandrel. Mandrel testing is not required for stubs.
- C. Retest repaired or replaced sewer sections.

3.4 LEAKAGE TESTING FOR GRAVITY SANITARY SEWERS

- A. Test Options:
 - 1. Test gravity sanitary sewer pipes for leakage by either exfiltration or infiltration methods, as appropriate, or with low pressure air testing.
 - 2. Test new or rehabilitated sanitary sewer manholes with water or low pressure air. Manholes tested with low pressure air shall undergo physical inspection prior to testing.
 - 3. Perform leakage testing after backfilling of line segment, and prior to tie-in of service connections.
 - 4. If no installed piezometer is within 500 feet of sewer segment, provide temporary piezometer for this purpose.
- 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. Exfiltration test:
1. Determine ground water elevation.
 2. Plug sewer in downstream manhole.
 3. Plug incoming pipes in upstream manhole.
 4. Install riser pipe in outgoing pipe of upstream manhole when highest point in service lead (house service) is less than 2 feet below bottom of manhole cone.
 5. Fill sewer pipe and manhole or pipe riser, when used, with water to point 2-1/2 feet above highest point in sewer pipe, house lead, or ground water table, whichever is highest.
 6. Allow water to stabilize for one to two hours. Take water level reading to determine drop of water surface, in inches, over one-hour period, and calculate water loss (1 inch of water in 4 feet diameter manhole equals 8.22 gallons) or measure quantity of water required to keep water at same level. Loss shall not exceed that calculated from allowable leakage according to Table 33 31 00.10-1 at end of this Section.
- D. Infiltration test: Ground water elevation must be not less than 2.0 feet above highest point of sewer pipe or service lead (house service).
1. Determine ground water elevation.
 2. Plug incoming pipes in upstream manhole.
 3. Insert calibrated 90 degree V-notch weir in pipe on downstream manhole.
 4. Allow water to rise and flow over weir until it stabilizes.
 5. Take five readings of accumulated volume over period of 2 hours and use average for infiltration. Average must not exceed that calculated for 2 hours from allowable leakage according to Table 33 31 00.10-1 at end of this Section.
- E. Low Air Pressure Test: When using this test conform to ASTM C 828, ASTM C 924, or ASTM F 1417, as applicable, with holding time not less than that listed in Table 33 01 30-2.
1. Air testing for sections of pipe shall be limited to lines less than 36-inch average inside diameter.
 2. Lines 36-inch average inside diameter and larger shall be tested at each joint. Minimum time allowable for pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch during joint test shall be 10 seconds, regardless of pipe size.
 3. For pipe sections less than 36-inch average inside diameter:
 - a. Determine ground water level.
 - b. Plug both ends of pipe. For concrete pipe, flood pipe and allow 2 hours to saturate concrete. Then drain and plug concrete pipe.
 - c. After manhole-to-manhole section of sanitary sewer main has been sliplined and prior to any service lines being connected to new liner, plug liner at each manhole with pneumatic plugs.
 - d. Pressurize pipe to 4.0 psig. Increase pressure 1.0 psi for each 2.3 feet of ground water over highest point in system. Allow pressure to stabilize for 2 to 4 minutes. Adjust pressure to start at 3.5 psig (plus adjustment for ground water table). See Table 33 31 00.10-2 at end of this Section.
 - e. To determine air loss, measure time interval for pressure to drop to 2.5 psig. Time must exceed that listed in Table 33 31 00.10-2 at end of this Section for pipe diameter and length. For sliplining, use diameter of carrier pipe.
- F. Retest: Repair and retest any section of pipe which fails to meet requirements.

3.5 TEST CRITERIA TABLES

A. Exfiltration and Infiltration Water Tests: Refer to Table 33 31 00.10-1, Water Test Allowable Leakage, at end of this Section.

B. Low Pressure Air Test:

1. Times in Table 33 31 00.10-2, Time Allowed For Pressure Loss From 3.5 psig to 2.5 psig, at end of this Section, are based on equation from Texas Natural Resources and Conservation Commission (TNRCC) Design Criteria 317.2(a)(4)(B).

		$T = 0.0850(D)(K)/(Q)$
Where:	T =	Time for pressure to drop 1.0 pounds per square inch gauge in seconds
	K =	0.000419 DL, but not less than 1.0
	D =	Average inside diameter in inches
	L =	Length of line of same pipe size in feet
	Q =	Rate of loss, 0.0015 ft ³ /min./sq. ft. internal surface

2. Since K value of less than 1.0 shall not be used, there are minimum testing times for each pipe diameter as given in Table 33 31 00.10-3, Minimum Testing Times for Low Pressure Air Test.

Notes:

1. When two sizes of pipe are involved, compute time by ratio of lengths involved.
2. Lines with 27-inch average inside diameter and larger may be air tested at each joint.
3. Lines with average inside diameter greater than 36 inches must be air tested for leakage at each joint.
4. If joint test is used, perform visual inspection of joint immediately after testing.
5. For joint test, pipe is to be pressurized to 3.5 psi greater than pressure exerted by groundwater above pipe. Once pressure has stabilized, minimum times allowable for pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge shall be 10 seconds.

3.6 LEAKAGE TESTING FOR MANHOLES

A. After completion of manhole construction, wall sealing, or rehabilitation, but prior to backfilling, test manholes for water tightness using hydrostatic or vacuum testing procedures.

B. Plug influent and effluent lines, including service lines, with suitably-sized pneumatic or mechanical plugs. Ensure plugs are properly rated for pressures required for test; follow manufacturer's safety and installation recommendations. Place plugs minimum of 6 inches outside of manhole walls. Brace inverts to prevent lines from being dislodged when lines entering manhole have not been backfilled.

C. Vacuum testing:

1. Install vacuum tester head assembly at top access point of manhole and adjust for proper seal on straight top section of manhole structure. Following manufacturer's instructions and safety precautions, inflate sealing element to recommended maximum inflation pressure; do not over-inflate.
2. Evacuate manhole with vacuum pump to 10 inches mercury (Hg), disconnect pump, and monitor vacuum for time period specified in Table 33 31 00.10-4, Vacuum Test Time Table.
3. If drop in vacuum exceeds 1 inch Hg over specified time period tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test procedure until satisfactory results are obtained.

- D. Perform hydrostatic exfiltration testing as follows:
1. Seal wastewater lines coming into manhole with internal pipe plug. Then fill manhole with water and maintain it full for at least one hour.
 2. The maximum leakage for hydrostatic testing shall be 0.025 gallons per foot diameter per foot of manhole depth per hour.
 3. If water loss exceeds amount tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test procedure until satisfactory results are obtained.

3.7 SMOKE TEST PROCEDURE FOR POINT REPAIRS

- A. Application: Perform smoke test to:
1. Locate points of line failure for point repair.
 2. Determine when point repairs are properly made.
 3. Determine when service connections have been reconnected to rehabilitated sewer.
 4. Check integrity of connections to newly replaced service taps to liners and to existing private service connections.
- B. Limitations: Do not backfill service taps until completion of this test. Test only those taps in single manhole section at one time. Keep number of open excavations to minimum.
- C. Preparation: Prior to smoke testing, give written notices to area residents no fewer than 2 days, nor more than 7 days, prior to proposed testing. Also give notice to Police and Fire Departments 24 hours prior to actual smoke testing.
- D. Isolate Section: Isolate manhole section to be tested from adjacent manhole sections to keep smoke localized. Temporarily seal annular space at manhole for sliplined sections.
- E. Smoke Introduction:
1. Operate equipment according to manufacturer's recommendation and as approved by Owner's Representative.
 2. Conduct test by forcing smoke from smoke generators through sanitary sewer main and service connections. Operate smoke generators for minimum of 5 minutes.
 3. Introduce smoke into upstream and downstream manhole as appropriate. Monitor tap/connection for smoke leaks. Note sources of leaks.
- F. Repair and Retest: Repair and replace taps or connections noted as leaking and then retest. Taps and connections may be left exposed in only one manhole section at time. When repair or replacement, testing or retesting, and backfilling of excavation is not completed within one work day, properly barricade and cover each excavation as approved by Owner's Representative.
- G. Service Connections: On houses where smoke does not issue from plumbing vent stacks to confirm reconnection of sewer service to newly installed liner pipe, perform dye test to confirm reconnection. Introduce dye into service line through plumbing fixture inside structure or sewer cleanout immediately outside structure and flush with water. Observe flow at service reconnection or downstream manhole. Detection of dye confirms reconnection.

Table 33 31 00.10-1

WATER TEST ALLOWABLE LEAKAGE

DIAMETER OF RISER OR STACK IN INCHES	VOLUME PER INCH OF DEPTH		ALLOWANCE LEAKAGE*	
	INCH	GALLONS	PIPE SIZE IN INCHES	GALLONS/MINUTE PER 100 FEET
1	0.7854	.0034	6	0.0039
2	3.1416	.0136	8	0.0053
2.5	4.9087	.0212	13	0.0066
3	7.0686	.0306	12	0.0079
4	12.5664	.0306	15	0.0099
5	19.6350	.0544	18	0.0118
6	28.2743	.1224	21	0.0138
8	50.2655	.2176	24	0.0158
			27	0.0177
			30	0.0197
			36	0.0237
			42	0.0276
For other diameters, multiply square of diameters by value for 1"			Equivalent to 50 gallons per inch of inside diameter per mile per 24 hours.	

* Allowable leakage rate shall be reduced to 10 gallons per inch of inside diameter per mile per 24 hours, when sewer is identified as located within 25-year flood plain.

Table 33 31 00.10-2
ACCEPTANCE TESTING FOR SANITARY SEWERS

TIME ALLOWED FOR PRESSURE LOSS FROM 3.5 PSIG TO 2.5 PSIG														
Pipe Diam. (in.)	Min. Time	Length For Min. Time (ft)	Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)										
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	500 ft	550 ft	600 ft
6	5:40	398	0.8548	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:25	7:07	7:50	8:33
8	7:33	298	1.5196	7:33	7:33	7:33	7:33	7:36	8:52	10:08	11:24	12:40	13:56	15:12
10	9:27	239	2.3743	9:27	9:27	9:27	9:54	11:52	13:51	15:50	17:48	19:47	21:46	23:45
12	11:20	199	3.4190	11:20	11:20	11:20	14:15	17:06	19:57	22:48	25:39	28:30	31:20	34:11
15	14:10	159	5.3423	14:10	14:10	17:48	22:16	26:43	31:10	35:37	40:04	44:31	48:58	53:25
18	17:00	133	7.6928	17:00	19:14	25:39	32:03	38:28	44:52	51:17	57:42	64:06	70:31	76:56
21	19:50	114	10.4708	19:50	26:11	35:54	43:38	52:21	61:05	69:48	78:32	87:15	95:59	104:42
24	22:40	99	13.6762	22:48	34:11	45:35	56:59	68:23	79:47	91:10	102:34	113:58	125:22	136:46
27	25:30	88	17.3089	28:51	43:16	57:42	72:07	86:33	100:58	115:24	129:49	144:14	158:40	173:05
30	28:20	80	21.3690	35:37	53:25	71:14	89:02	106:51	124:39	142:28	160:16	178:05	195:53	213:41
33	31:10	72	25.8565	43:06	64:38	86:11	107:44	129:17	150:50	172:23	193:55	215:28	237:01	258:34

Table 33 31 00.10-3
MINIMUM TESTING TIMES FOR LOW PRESSURE AIR TEST

Pipe Diameter (inches)	Minimum Time (seconds)	Length for Minimum Time (feet)	Time for Longer Length (seconds)
6	340	398	0.855 (L)
8	454	298	1.520 (L)
10	567	239	2.374 (L)
12	680	199	3.419 (L)
15	850	159	5.342 (L)
18	1020	133	7.693 (L)
21	1190	114	10.471 (L)
24	1360	100	13.676 (L)
27	1530	88	17.309 (L)
30	1700	80	21.369 (L)
33	1870	72	25.856 (L)

Table 33 31 00.10-4
VACUUM TEST TIME TABLE

DEPTH IN FEET	TIME IN SECONDS BY PIPE DIAMETER		
	48"	60"	72"
4	10	13	16
8	20	26	32
12	30	39	48
16	40	52	64
20	50	65	80
24	60	78	96
*	5.0	6.5	8.0

*Add T times for each additional 2-foot depth.
(The values listed above have been extrapolated from ASTM C 924-85)

Table 33 31 00.10-5
PIPE VS. MANDREL DIAMETER

Material and Wall Construction	Nominal Size (Inches)	Average I.D. (Inches)	Minimum Mandrel Diameter (Inches)
PVC-Solid (SDR 26)	6	5.764	5.476
	8	7.715	7.329
	10	9.646	9.162
PVC-Solid (SDR 35)	12	11.737	11.150
	15	14.374	13.655
	18	17.629	16.748
	21	20.783	19.744
	24	23.381	22.120
	27	26.351	25.033
PVC-Truss	8	7.750	7.363
	10	9.750	9.263

	12	11.790	11.201
	15	14.770	14.032
PVC-Profile (ASTM F 794)	12	11.740	11.153
	15	14.370	13.652
	18	17.650	16.768
	21	20.750	19.713
	24	23.500	22.325
	27	26.500	25.175
	30	29.500	28.025
	36	35.500	33.725
	42	41.500	39.425
	48	47.500	45.125
HDPE-Profile	18	18.000	17.100
	21	21.000	19.950
	24	24.000	22.800
	27	27.000	25.650
	30	30.000	28.500
	36	36.000	34.200
	42	42.000	39.900
	48	48.000	45.600
	54	54.000	51.300
	60	60.000	57.000
Fiberglass (Class SN 46)	12	12.85	11.822
	18	18.66	17.727
	20	20.68	19.646
	24	24.72	23.484
	30	30.68	29.146
	36	36.74	34.903
	42	42.70	40.565
	48	48.76	46.322
	54	54.82	52.079
	60	60.38	57.361

END OF SECTION